VTS NEWS
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IEEE

FEATURES

http://www.vtsociety.org
Vehicular Technology Society News
Vol. 49, No. 4 issn 1068 5731
November 2002

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PHOTO SIEMENS AG

The ultimate in comparison shopping using MMS on a Siemens' S55. Gwenaël Le Bodic discusses the operation of MMS in his article.

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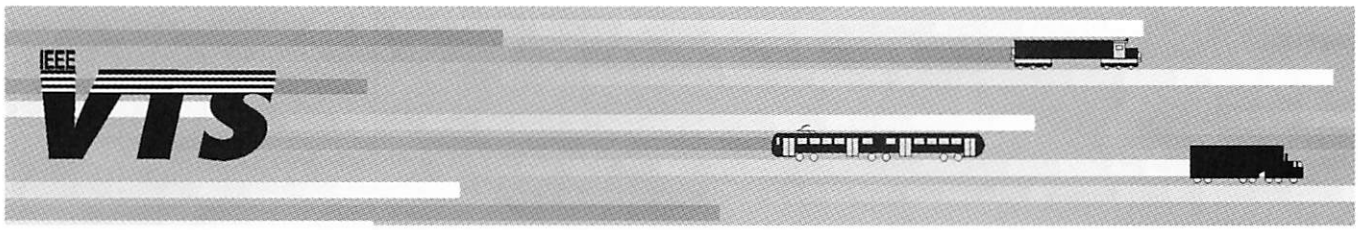

Foreward

James Irvine, Editor

No prizes for what the mobile industry wants for Christmas – increased ARPU (Average Revenue Per User). Indeed they would probably be happy if ARPU held steady next year. ARPU is a key indicator for profitable mobile companies, and as voice services become increasingly commoditised, ARPU is declining. Most European operators are maintaining it only through increasing messaging traffic.

This issue contains two articles on subjects likely to cause mobile operators good cheer. The first is on mobile location. Location based services - tell me where I am or what is near me - are widely foreseen to be important to users. The other is multimedia messaging (MMS), which aims to build on the success of text messaging services like SMS by sending pictures and short sound clips. In the UK, marketing for MMS has matured from the truly special (the birth of a baby) to the everyday (sending an audio message to your partner saying 'I love you'). Cleverly, the advertising recognises that the message could be sent other ways, but 'why wait?' This probably comes from the fact that for the same cost (about 60¢), most users can send half a dozen text messages or have three or four minutes talking interactively with their loved one to deliver the same message.

In trials, MMS has proved very popular, particularly with teenagers. However, that depends not only on having suitably deep pockets, but also on having plenty of friends to send messages to. This requires a large user base of MMS compatible phones. When SMS started, it was plagued by problems of compatibility between phones and networks, and that was simply with GSM. This time we have numerous 2G, 2.5G and 3G standards and standards bodies. However, the industry is moving in the right direction. June saw the formation of the Open Mobile Alliance (OMA, www.openmobilealliance.org) out of a group of five industry fora, with two more joining later. The OMA aims to 'grow the market for the entire mobile industry by removing the barriers to global user adoption and by ensuring seamless application interoperability while allowing businesses to compete through innovation and differentiation.' While this is a significant challenge in such a diverse industry, it is essential if the full potential of the market is going to be fulfilled.

Interestingly, neither mobile location nor MMS requires 3G, although the latter adds capabilities to both. This may be just as well, given that 3G is not immune to falling ARPU. APRU for the NTT DoCoMo's 3G FOMA service has fallen by 14%, causing it to fall behind that of the company's 2G PDC users.

In Europe, a number of operators are promoting MMS heavily for the Christmas market with free messaging until January, no doubt hoping that habits will continue after the bills start to roll in. If they don't, the whole mobile industry will be suffering New Year hangovers.

Copy for 2003 issues of *VTS News* should reach Dr. James Irvine by:

Issue	*Due Date*
February 2003	December 5, 2002
May 2003	March 6, 2003
August 2003	June 5, 2003
November 2003	September 4, 2003

at Mobile Communications Group, EEE, Strathclyde University, George Street, Glasgow G1 1XW Scotland, E mail: j.m.irvine@ieee.org.

IEEE Vehicular Technology Society News (ISSN 1068-5731) is published February, May, August and November by the Vehicular Technology Society of the Institute of Electrical & Electronics Engineers, Inc. Headquarters of IEEE is at 3 Park Avenue, 17th Floor New York, NY 10016 5997. Printed in USA. Periodicals postage paid at New York, NY and at additional mailing offices. Postmaster: Send address changes to IEEE Vehicular Technology Society News, IEEE, 445 Hoes Lane, Piscataway, NJ 08855.

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Transactions on Vehicular Technology subscription price is $22 per year for IEEE members. For non members, the price is $445 per year.

Vehicular Technology Society News subscription price of $15 is included in membership in VTS. For non members, the annual price for the four issues of February, May, August and November is $30.

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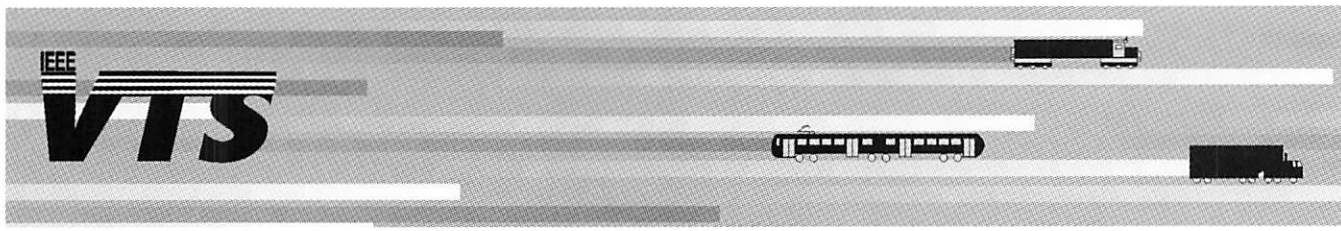

E911 Phase II Location Technologies

Mark A. Birchler, Motorola, Inc

This article will focus on the high level technical issues associated with cellular E911 location solutions. The starting point is a brief discussion of the regulatory background. Next, a short tutorial on location finding fundamentals is provided. The primary solution classes are then identified and discussed. Finally, the primary sources of location error are identified and discussed.

Introduction

The FCC (Federal Communications Commission) E911 Phase II cellular handset location mandate has been the driving force behind an exceedingly complex set of activities. This mandate applies only to communications systems in the United States. The FCC's original stated goal was to assure that a mobile unit making a 911 emergency call be locatable to within 125 meters of its actual position in 67% of all cases.

The response to this goal has involved a very large number of interested players, each with its own set of constraints and opportunities. These players include:

- ✦ The FCC
- ✦ Public safety organizations
- ✦ Wireless operators
- ✦ Standards organizations
- ✦ Wireless equipment vendors
- ✦ Public interest groups
- ✦ Location technology companies

The ensuing interaction of these players has resulted in our current state in which E911 Phase II solutions are in the process of being deployed. These deployments utilize numerous location technologies depending on the solution choice of the wireless service operators.

FCC E911 Mandate

The FCC Report and Order and Further Notice of Proposed Rulemaking covering E911 Phase II was issued on July 26, 1996 (CC Docket No. 94-102). This document mandated that a mobile unit making a 911 emergency call be locatable to within 125 meters of its actual position in 67% of all cases within five years after the effective date of the adopted rules. The resulting time goal was October 1, 2001.

In the following years the interested players engaged in complex negotiations that sought to address compliance within the context of their various constraints and opportunities. Some of the key issues were location solution flexibility (i.e., infrastructure vs. handset based solutions), performance accuracy goals and deployment timetables, among others.

The end result of this process was the issuance of final rules (Third Report and Order Concerning Wireless Carrier Location Technology Selection, CC Docket No. 94-102) that allowed the deployment of both infrastructure and handset based location solutions. Rules specific to these two solution classes were issued. The rules relevant to this article are the accuracy requirements, which are provided below.

Solution	Accuracy Goal (meters)	
	67%	95%
Infrastructure	100	300
Handset	50	150

Rules covering deployment timetables, compliance verification and carrier plan reporting were also issued.

Location Finding Fundamentals

Location finding is based on the measurement of specific parameters of a received signal that enables the position of a device to be inferred. The specific parameter(s) utilized determine the supporting requirements, performance constraints and complexity of the solution. The signal itself may be that used for the wireless communication or one specifically designed to support location finding. The two primary parameters upon which location is based are Time of Arrival (TOA) and Angle of Arrival (AOA). Additional information on this topic as part of a larger discussion of current 3G location standardization can be found in [1].

Location finding is a relative exercise. That is, the location of a device must be estimated relative to some known framework. For the systems discussed in this article the known framework elements consist of either the locations of the terrestrial sites (i.e., the cellular network's sites) or space-based satellites (i.e., the GPS system). The additional level of complexity introduced by movement of the GPS framework as the satellites orbit the earth will not be discussed. See [2] for a detailed overview of the GPS system.

Time of Arrival (TOA)

This system depends, not surprisingly, on measurement of the time of arrival of multiple signals to estimate location. In order to enable a two-dimensional calculation (i.e., latitude and longitude), TOA measurements must be made with respect to signals related to at least three geographically distinct framework elements.

These measurements allow either absolute or differential distance of signal propagation between the framework elements and the device to be inferred. A system that is based on differential distance estimation is generally referred to as *Time Difference of Arrival* or ***TDOA***.

TOA Location System

This system is based on a set of at least three non-linear equations with unknown variables x, y and t, where:

x and y represent the location of the device relative to the framework

t represents the time of transmission.

The location calculation is generally based on an iterative solution of linearized equations that approximate the underlying non-linear system. Measurements involving at least three framework elements are required in order to enable generation of three equations for the three unknowns.

TDOA Location System

The TDOA system consists of a set of at least two non-linear equations with unknown variables x, y where:

x and y represent the location of the device relative to the framework.

The location calculation is also generally based on an iterative solution of linearized equations that approximate the underlying non-linear system. Measurements involving at least three framework elements are required to enable the calculation of at least two time differences to create two equations in the two unknowns.

Practical Example: TDOA

The time differences of signal propagation can be used to infer path length differences between two pairs of sites. The set of locations whose difference in distance between two sites is a constant is a hyperbola. By the generation of two TDOA measurements two hyperbola can be defined. The intersection of these curves constitutes the location estimate. The following figure shows this situation.

Angle of Arrival (AOA)

This system depends on measurements of the angles of arrival of the signals involved in the location estimation. AOA measurement requires use of antenna arrays at the sites, generally with a one-half wavelength separation or less with respect to the carrier frequency. This antenna requirement ensures that the system is not spatially under-sampled.

In order to enable a two-dimensional calculation, AOA measurements must be made with respect to signals related to at least two geographically distinct framework elements. The location is calculated as the intersection of the two lines having the estimated angles relative to the respective framework elements.

Hybrid Systems

The use of TOA and AOA technology is by no means an either-or proposition. A hybrid system can be deployed that utilizes both time and angle information to generate the location estimate. Such a system could conceivably deliver higher accuracy, but at the cost of additional complexity.

Location Solutions

There are two main families of location solutions, those being infrastructure and handset based. Although both ends of the system must cooperate in order to enable location estimation, the fundamental information (i.e., the TOA, TDOA or AOA estimates) upon which the solution is based will usually be located in one or the other of these elements. The location of this fundamental information determines the classification of the solution.

Infrastructure Based

These solutions have the advantage of potentially not requiring changes to the cellular handset. Thus, this solution family can enable the location of legacy cellular handsets in the operators system. Overviews of the main infrastructure based solution types follow.

TOA Solution

These solutions add new functionality to the cellular infrastructure sites to enable accurate TOA measurement. The new functionality can be implemented either as an integrated upgrade or as an independent overlay system. The sites are often synchronized to a common time base. In this case, the unknowns are the x and y position of the handset and the time at which it transmitted the signal whose TOA is measured at the participating sites. The following figure shows a high level view of this solution. Note that in this and following figures a violet fill / shading denotes an element that has been either added to the system or modified in order to enable location finding.

AOA Solution

These solutions add new functionality to the cellular infrastructure sites to enable accurate AOA measurement. In most cases an overlay system is installed that uses the specialized antenna arrays required for accurate AOA measurement. The following figure shows a high level view of this solution.

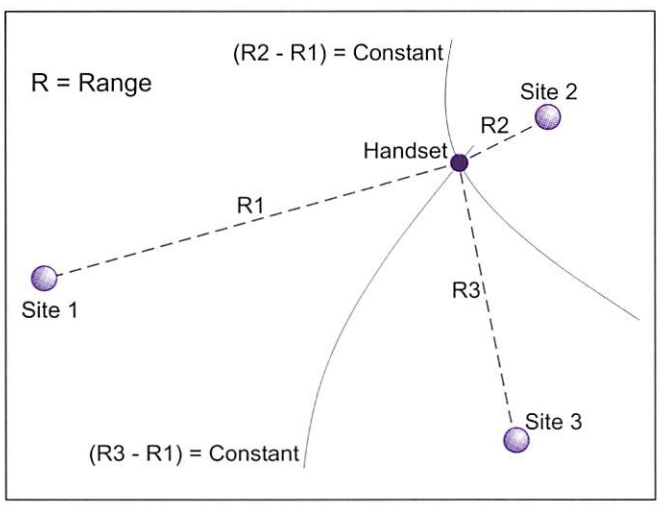

Figure 1 TDOA Location Example

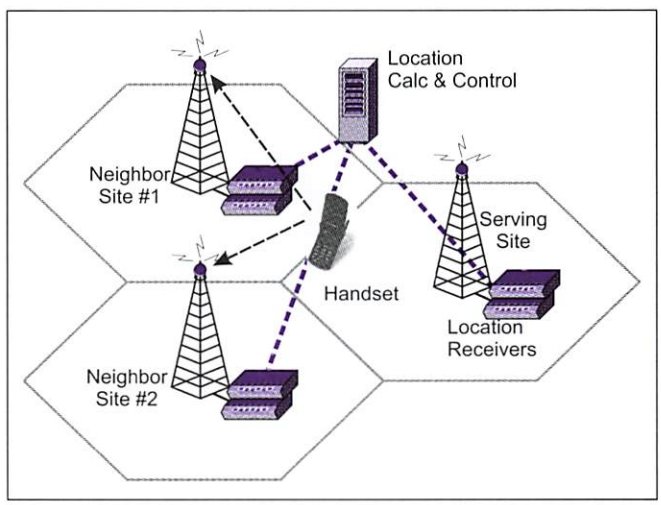

Figure 2 Infrastructure Based TOA Solution

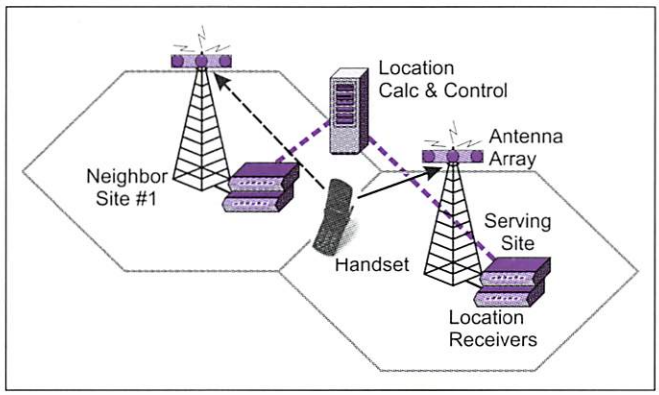

Figure 3 Infrastructure Based AOA Solution

Handset Based

Cellular handsets historically were not designed to enable location measurements. As a result, there is a large population of legacy handsets that do not support this function. On the other hand, handset based solutions can require less complex infrastructure upgrades. Overviews of the main handset based solution types follow.

Assisted GPS Solution

The GPS navigation system has been in operation for more than a decade. This system is specifically designed to support worldwide, high accuracy location estimation. It consists of a constellation of satellites orbiting the earth each of which transmits navigation signals that can be acquired and measured to support location estimation. The key signal parameter measured is the TOA.

However, the relatively long times required for signal acquisition from a cold start (i.e. no previous knowledge of the key signal parameters) made application of GPS technology to cellular emergency situations problematical. This problem has been solved through use of assistance information provided through the cellular infrastructure to significantly reduce signal acquisition time. Thus, functionality in the handset can acquire and measure the GPS signals in reasonable times.

Measurements to at least three GPS satellites are generally required to enable a two dimensional location calculation. The following figure shows a high level view of this solution. Note that SV stands for "space vehicle" in GPS system nomenclature.

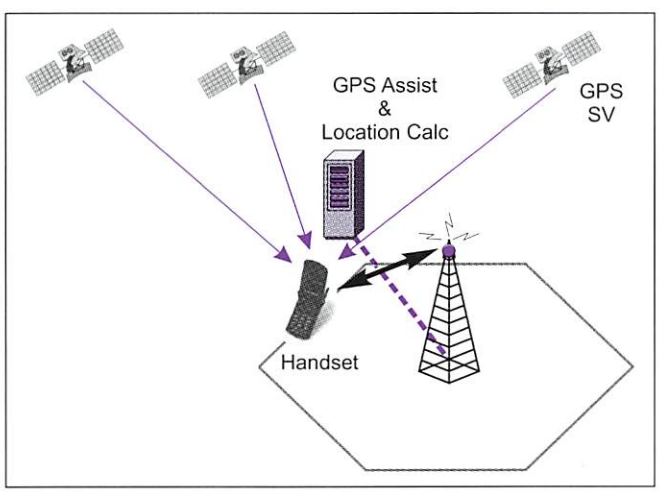

Figure 4 Handset Based A-GPS Solution

E-OTD Solution

The E-OTD (Enhanced Observed Time Difference) solution is based on TDOA measurements made at the handset. Measurements to at least three geographically distinct cellular sites are required to support a location solution.

Differences in the time of arrival of signals originating from numerous sites contain information on differential propagation distances only if they are interpreted relative to a common time base. This requirement can be met in two primary ways.

In a system such as GSM in which site transmissions are generally not synchronized to a common time reference, additional network devices called LMUs (Location Measurement Units) can be utilized. These devices are distributed throughout the desired coverage region in known locations. Based on a common time base, these devices measure TDOA among numerous sites and then calculate correction values. These values are collected and used to enable correction of the raw TDOA measurements. These corrections can be sent to the handset if the location calculation is implemented there. If a centralized network element implements the location calculation then the corrections would be sent there. Generally, the number of LMUs will be less than the number of sites. Also, LMUs need not be collocated with the sites.

Another method is to directly tie each site's transmissions to a common time base. In this case, no corrections need be collected.

Figure 5 shows a high level view of this solution. More detailed information on this solution can be found in [3].

Location Accuracy Degradation Sources

Now that the fundamentals have been covered it's time to face up to the awful truth that the laws of physics conspire against accurate location estimation. In this section three broad degradation categories will be discussed, those being geometric, environmental and implementation.

Dilution of Precision

In location estimation all geometric arrangements between the framework and device elements are not created equal. In fact, geometric arrangement can cause the accuracy of the location estimate to vary by an order of magnitude or more. This effect is called *Dilution of Precision*.

The Dilution of Precision can be calculated given knowledge of the framework and device element locations. In effect, this quantity is a scaling factor that establishes the re-

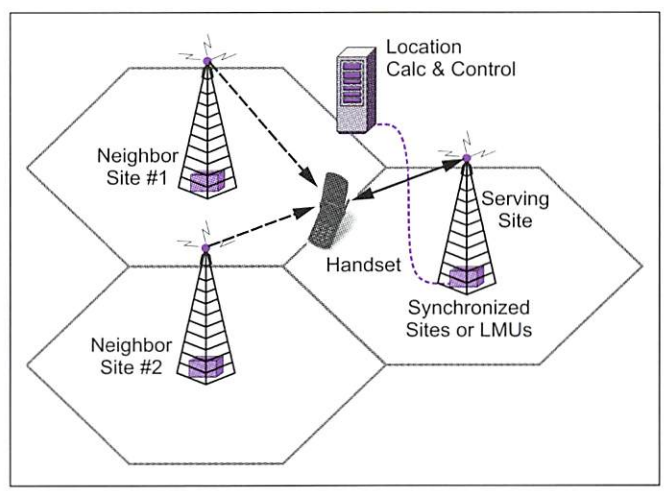

Figure 5 Handset Based E-OTD Solution

lationship between measurement errors and the resulting location errors.

The impact of geometry is also a function of the dimension or dimensions of interest in the location calculation. For the E911 application accuracy is defined with respect to only the position of the device in the horizontal plane. The Dilution of Precision relating to this situation is called *HDOP*, or Horizontal Dilution of Precision.

If we were also interested in location accuracy in the vertical dimension, then *VDOP*, or Vertical Dilution of Precision could be determined. Finally, for a total three-dimensional calculation that combines both horizontal and vertical, *PDOP*, or Position Dilution of Precision would be used.

A simple example of this effect can be demonstrated for the case of AOA. The following figure demonstrates the impact of a fixed error in AOA estimation on the location calculation as a function of geometry.

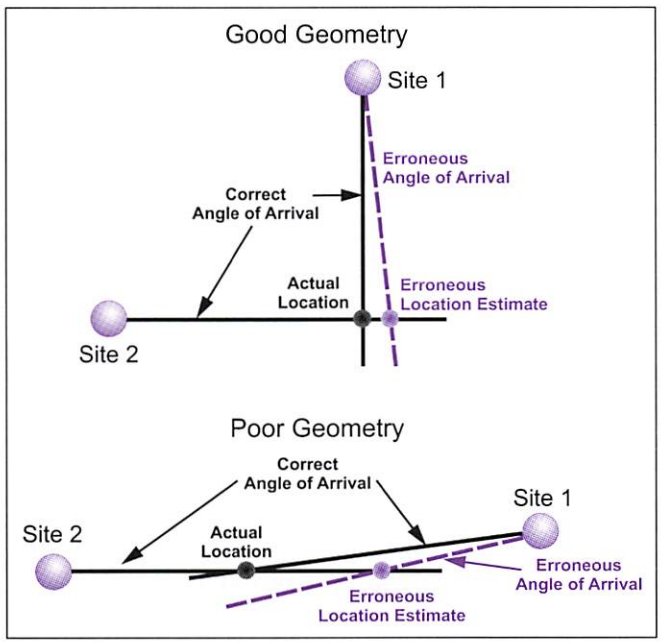

Figure 6 Geometric Impact on Location Error

These geometric effects impact the magnitude of location error induced by the following sources.

Environmental Degradation Sources

The Speed of RF Propagation

A fundamental source of difficulty for time-based systems is the speed of RF propagation itself. Radio signals propagate at the speed of light, or approximately 186,000 miles per second. Thus, one foot of propagation distance requires only approximately 1 nano-second (i.e., one billionth of a second).

The implication of this situation is that in order to estimate location to within 50 meters the supporting TOA measurements must be accurate to within 164 nano-seconds (assuming an HDOP of 1).

All other factors being equal, time measurement accuracy is an inverse function of the bandwidth of the signal being used. Cellular communication signals have bandwidths ranging from approximately 20 to 1250 kHz. For this range of bandwidths accurate TOA measurement to an accuracy of below 50 nano-seconds can be a challenging proposition.

Noise and Interference

All location measurements will be perturbed by undesired signals arising from thermal noise and interference from other cellular transmissions. In most cases these error sources can be modeled as random, zero mean processes. Thus, averaging over effective signal observation time can reduce the impact.

Fading

Due to large and small-scale environmental effects on RF signal propagation, the resulting spatial electro-magnetic field varies. Thus, as a device moves through this field fading occurs. Fading impacts the received signal as variations in its magnitude and phase. These variations corrupt location measurements either directly (by the variations themselves) or indirectly (e.g., by decreasing the ratio between the desired and undesired signals due to a "deep fade"). The impact of fading can also be reduced through averaging.

Multipath Propagation

Multipath propagation is in many cases the dominant source of error in location estimation. All of the primary technologies for location finding depend on the existence of a "line of sight" (LOS) propagation path between the device and framework elements. This is the case because it is the LOS path that provides true information about distance and angle.

Multipath propagation arises due to the reflection of the RF signal off of objects to create additional propagation paths between the transmitter and receiver. Degradation in the location measurement occurs via two primary scenarios, which are discussed below.

Biased Measurement Scenario

In this scenario the LOS path exists. However, additional paths are also in existence. In the best of worlds this situation would not be a problem because the LOS path could be extracted from the other paths and it alone used for location measurement.

In the real world this extraction of the true from the false information can be very difficult. We have already discussed the time measurement resolution limitations of cellular signals due to their limited bandwidths. Thus, if the time of arrival difference between the LOS and undesired path is too small these individual components become smeared together into an apparent single component. In this case the unresolvable undesired signal components create a bias error in the measurement. Since this bias error is not of a random nature, averaging the measurement over longer observation periods will not provide significant improvement.

Similar mechanisms having to do with limited angle and time measurement resolution limitations induce bias errors in AOA systems. Figure 7 provides an example of this multipath scenario.

False Measurement Scenario

In this scenario the LOS path is actually blocked by some object. However, the signal still gets to the receiver via the reflective paths. In this case *all of the information received and used for location estimation is false*. Thus, regardless of the ability to resolve received signal components, the location estimation will be in error.

This scenario sets an absolute lower limit on the accuracy that can be obtained by the location system. That is, no amount of averaging or other signal processing can alter the fact that the fundamental information being received is

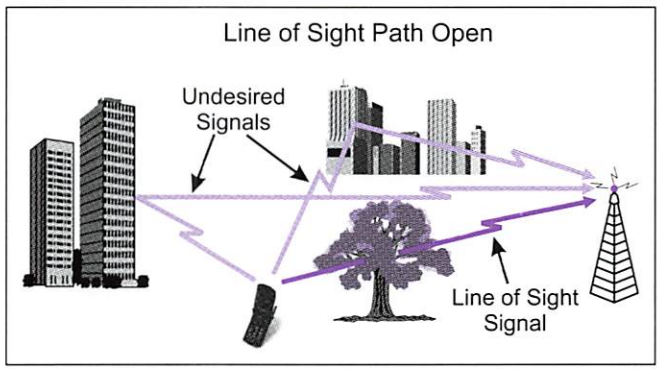

Figure 7 Biased Location Measurements

false. The only way in which this scenario could be detected would be if the location of the device were already known. However, in this case there would be no need for location measurement. Figure 8 provides an example of this multipath scenario.

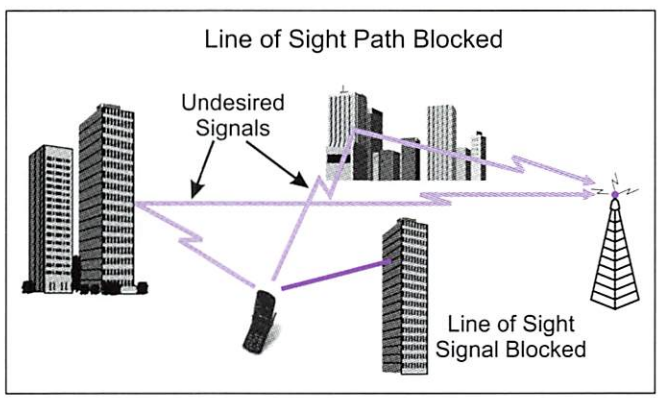

Figure 8 False Location Measurements

System Implementation Degradation Sources

These degradations arise due to imperfections in the implementation of communication and/or location systems.

Hardware & Software Limitations

Hardware and software components have performance limitations due to the state of the art in technology and/or cost limitations. Some examples of hardware limitations are filter magnitude and group delay variation, I/Q magnitude imbalance and carrier feedthrough. Some examples of software imperfections are fixed point truncation/rounding errors and data resolution limitations.

Calibration

Accurate location estimation depends on accurate knowledge of the framework element locations. Errors in this information will be passed on to the location estimate. TOA based systems depend on very accurate time calibration of the framework elements. Imperfect calibration will result in location errors.

Site Location

We have seen in the Dilution of Precision section that there are some geometries between the device and framework elements that result in large magnifications of any underlying measurement errors. Some of the challenging situations for cellular system based solutions include sites along relatively straight roads or areas on the fringe of the cellular coverage region. See [3] for more details.

For the GPS system poor geometries occur when there is a small angular dispersion of the satellites.

Location Accuracy Improvement

Many techniques exist to combat the degradation processes discussed in the previous section. The following techniques represent some specific examples.

Over-Defined Location Calculations

In the previous discussion the minimum number of measurements to enable a location calculation was specified. It is important to note that the availability of additional measurements (i.e., to additional framework elements beyond the minimum) can significantly improve both the location estimate accuracy and reliability. Therefore, an optimum system design will make use of all available measurement resources.

Weighted Location Calculations

Another means of improving location accuracy is to weight the individual measurements based on their reliability. For example, measurements based on a distant framework element may be of lower reliability than those from a close element. Proper weighting of the information obtained from these two elements (i.e., higher weighting given to the more reliable measurement) within the location calculation can significantly improve the resulting accuracy.

Of course, means must be devised to extract reliability information from the signals. Examples of reliability information are signal-to-noise and multipath severity estimates.

Super-Resolution Signal Measurement

As was previously discussed, accurate location estimation can require the availability of high-resolution time and/or angle measurement. Technical art has been, and continues to be developed to improve performance of these measurements. One class of this technology is often referred to as "super-resolution."

Super-resolution technology is of particular value for the identification of undesired multipath signal components, thus enabling them to be discarded. Recall that these undesired components induce error into the supporting location measurement.

Super-resolution techniques generally depend on the development of side-information about the received signal. For instance, the number of significant multipath signal components may need to be estimated in order to enable improved TOA/AOA measurement accuracy. Generation of this side-information constitutes a significant challenge for the practical application of this technology. More detailed discussions of this technology can be found in [4] and [5].

Conclusions

Emergency location finding for cellular devices will become a universal feature in the not too distant future. This capability will substantially increase the utility of cellular systems for emergency applications. In addition, location enabled services such as "find the nearest X," and driving directions, among many others, will be enabled.

Location technology will continue to progress in terms of accuracy and availability. The numerous solutions currently in the market may converge to a single, dominant so-

lution. It is also possible that hybrid solutions will be utilized in order to obtain the desired performance envelope.

It is also possible that location features will lead to unexpected consequences. For example, individuals may be more likely to move all communications to cellular in their home if an equivalent to the current E911 wireline capability is in place.

In conclusion, location capability will significantly increase the utility of cellular communications along numerous dimensions. The diversity of approaches and innovation that has been sparked by the E911 requirement will likely be just the down payment on an exciting investment in future location enabled products and services.

For more information on this topic, see [6] through [9].

References

[1] Zhao, Y, "Standardization of Mobile Phone Positioning for 3G Systems," *IEEE Communications Magazine*, **40** (7), July 2002, pp. 108-116.

[2] Milliken, R. J. & Zoller, C. J., "Principle of Operation of NAVSTAR and System Characteristics," Global Positioning System, Papers Published in Navigation, Volume I, pp. 3-14.

[3] Birchler, M, Jasper, S, Oros, N. & Jones, D, Makhlouf, S, and Tziortzis, A, "Subscriber Based TDOA Techniques for the Motorola iDEN System," Academia/Industry Working Conference on Research Challenges (AIWORC'00), Buffalo, New York, April 27 - 29, 2000.

[4] Featherstone, W. & Strangeways, H. J, "Mobile transmitter AOA estimation under multipath conditions using an MLE based superresolution algorithm and comparison with weighted spectrum methods", IEE Colloquium on Novel Methods of Location and Tracking of Cellular Mobiles and Their System Applications, 1999, Page(s): 4/1–4/5.

[5] Winter, J. & Wengerter, C, "High resolution estimation of the time of arrival for GSM location", Proc. VTC 2000-Spring, Tokyo. 2000, pp. 1343–7.

[6] Reed, J. H, Krizman, K. J, Woerner, B. D. & Rappaport, T. S, "An overview of the challenges and progress in meeting the E-911 requirement for location service", *IEEE Communications Magazine*, **36** (4), April 1998, pp. 30–7.

[7] Caffery, J. J. & Stuber, G. L, "Overview of radiolocation in CDMA cellular systems", *IEEE Communications Magazine*, **36** (4), April 1998 pp. 38–45.

[8] Lopes, L, Viller, E. & Ludden, B, "GSM standards activity on location", IEE Colloquium on Novel Methods of Location and Tracking of Cellular Mobiles and Their System Applications 1999 Page(s): 7/1–7/7.

[9] Wang, S. S, Green, M, & Malkawa, M, "E-911 location standards and location commercial services" Emerging Technologies Symposium: Broadband, Wireless Internet Access, 2000, pp. 1–5.

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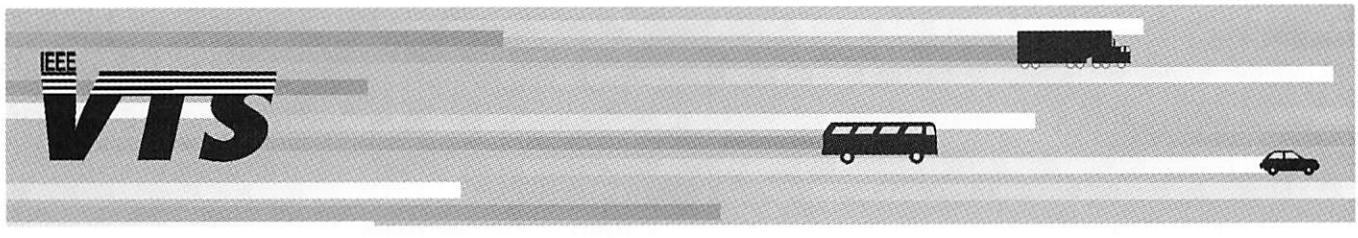

Advancements in Crash Sensing

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Editor's Note: *Thanks are extended to the Convergence Transportation Electronics Association for permission to reprint this article from its Convergence 2000 Proceedings.*

The Convergence Transportation Electronics Association is an organization dedicated to the advancement of transport electronics technology and the support of mathematics and science education.

The crash modes that occur each day on streets and highways have not changed dramatically over the past 50 years. The need to better understand those crash modes and their relation to rapidly emerging, tailorable restraint systems has intensified recently. The algorithms necessary for predicting a deployment event are based on an approach of coupling the occupant kinematics in a crash to the sensing technology that will activate the restraint system. This paper describes methods of computer modeling, occupant sensing and vehicle crash dynamics to define a crash sensing system that reacts to a complex set of input conditions to invoke an effective restraint response.

Introduction

In light of ever changing rulemaking and consumer interests and expectations, crash safety continues to play a major role in vehicle development. Over 50% of vehicle buyers cite safety features as an important factor in their purchasing decision [1]. This information, coupled with new U.S. Government rulemaking for passive vehicle restraints [2], has prompted automobile manufacturers and restraint system

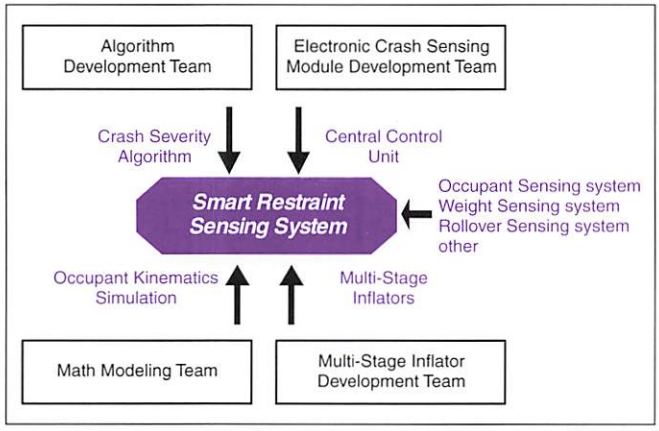


Figure 1 Multi-Disciplinary Effort for Sensing System Development

suppliers to develop more complex restraint systems to satisfy these substantial demands. These demands include the ability of a restraint system to detect and protect a wide range of occupant sizes, sitting in a wide range of vehicle designs, involved in a wide variety of crash types.

This broadening challenge must be undertaken by the combined efforts of a team of engineers (Fig. 1). The complete team is a multi-disciplinary effort of math modelers, sensor software and sensor hardware developers, and inflator developers. The math modelers concentrate on determining occupant kinematics under a wide range of crash conditions comprising different speeds and occupant types. The inflator engineers provide information to the modelers about the product's performance and make changes to the design based on the model results. Assessment of the model results and inflator fire time requirements are given to the software algorithm engineer who must decide if the required fire time can be achieved with the data taken from a vehicle crash. Finally, the sensor engineer needs to figure out how the signals need to be gathered from around the vehicle to make sure the software engineer can get the needed data for determination of proper fire time.

This continuous interaction of engineering talent is required to make the advanced sensing systems on today and tomorrow's vehicles work properly. The rest of the paper will be dedicated to describing sensing systems, the algorithms behind the systems and the computer modeling that helps determine the requirements.

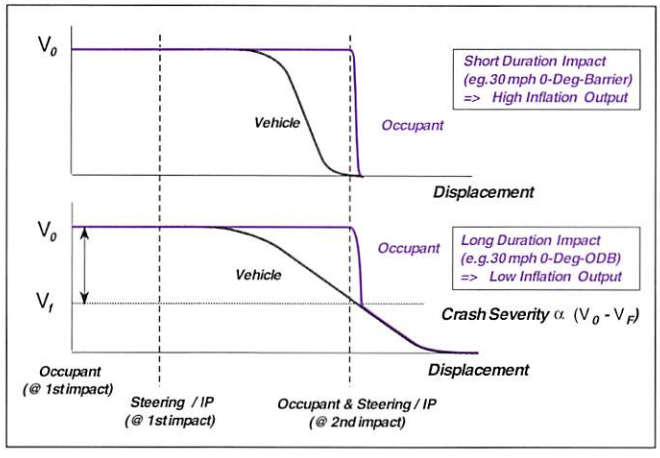


Figure 3 Measure of Crash Severity

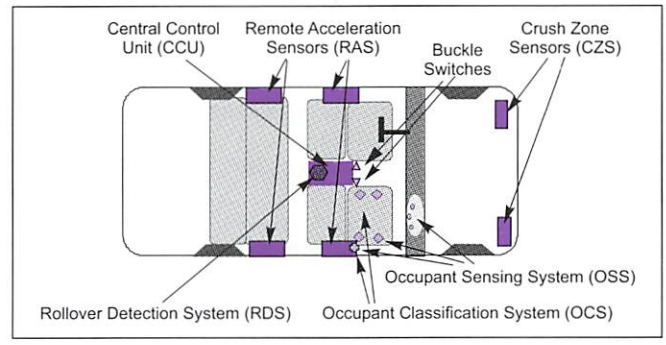


Figure 2 Advanced Sensing System Components

Advanced Sensing System Architecture

Sensing system architecture has evolved into a complex interaction of components. To handle all the different crash conditions, the system needs an array of sensor technology linked in a manner that can respond quickly and accurately. Figure 2 shows a system that is equipped not unlike vehicles that will be in production within the next few years. Some components shown are already in vehicles while others are under development.

At the heart of the systems is a central control unit (CCU) that receives the sensor input and controls the output to the various restraint components. Although standard in most vehicles today, the CCU will be a more complicated device. The device will be capable of delivering output to 16 squibs based on sensor input. The device will be configured to have several sensors within it for rollover and frontal crash discrimination. Also, the entire device will be part of a larger distributed system interface that will connect all the components together. The CCU's most important job is to carry the algorithms for crash severity detection that will control the timing and level of restraint system deployment. The crash severity algorithm will be discussed in more detail below.

Other important components in the system will be described below. They are each important to the overall algorithm development as they provide the critical inputs to the decision making process for restraint deployment.

Crush Zone Sensors

As their name implies, these sensors are located in areas of the vehicle where early detection of crash severity will help in the final restraint configuration for a specific crash. The ability of the sensors to withstand high G loads, sustain harsh environmental conditions and be lightweight and inexpensive is a particular challenge.

Occupant Classification System

The primary objective of an occupant classification is to help the Crash Severity Sensing System (CCU) optimize restraint protection relevant to infants, young children and small adults; specifically, the deployment and the level of deployment (inflator output level) decisions at the CCU (based on acceleration signals) is adjusted (and perhaps suppressed) by the occupant types. For example, if the passenger type is classified (by the occupant classification system) as Rear Facing Infant Seat (RFIS), the deployment will be suppressed, and if the driver type is a small adult, the deployment level may be reduced to low output level for all crash severities

In general, there are two major design approaches, namely:

- Occupant Classification based on occupant sensed/measured weight. A technology such as a strain gauge based weight sensing system is a typical example.
- Occupant Classification based on "Occupant Pattern" recognition. There have been seat pad based occupant classification systems demonstrated within the industry.

Occupant Sensing System

Occupant sensing system is the next logical extension of Occupant Classification System to include occupant relative distance (range) from the airbag. This requires range (or proximity) sensing capabilities; Ultrasound, Infrared, Optical Imaging, Seat Position Sensor and Weight Distribution (from Weight Sensing System) are some of the well-known approaches.

The primary objective of occupant sensing is to help the Crash Severity Sensing System (CCU) optimize restraint protection relevant to infants, young children, small adults and close proximity of occupants (of all sizes and types) to an airbag. For example, if a 50th percentile male passenger (prior to a high severity crash) is sensed to be too close to the air bag door (by the occupant sensing system), then the high deployment output decision made by the CCU may be adjusted (or even suppressed) to a low output deployment. Various Occupant Sensing Systems are in development phase at the present time, but may likely see initial introductions by 2004.

Crash Algorithm Development

Crash Sensing Algorithm has evolved in the last decade from simple frontal crash discrimination to include side impact discrimination, rear impact discrimination, and, most recently, to include multiple thresholds for frontal crash severity sensing. Also, the near future may witness the incorporation of Occupant Classification/Occupant Sensing information in the deployment decision.

This evolution has created major technical challenges in the following areas:

- Better understanding of vehicle crash dynamics and occupant kinematics during crash.
- More complex and sophisticated algorithm design at higher system level.
- More sophisticated and extensive modeling and simulation of occupant kinematics during a crash (to be discussed in more details under Modeling Methodology).

Vehicle Crash Dynamics and Occupant Kinematics

Types (modes) of vehicle crash tests to represent real world frontal crashes has expanded from 0-Deg-Rigid Barrier, 30-degree-Angular and Center-Pole crash events to include much more complex Offset- Deformable-Barrier crash events. This evolution created the necessity for a better and more consistent definition/measure of crash severity (instead of just simply the impact speed). Figure 3 illustrates such a definition/measure of crash severity.

Algorithm Design at Higher System Levels

- Frontal-Side Interaction – inclusion of side impact sensing capabilities in the algorithm design confronts the necessity to design the frontal discrimination algorithm with side impact as a frontal misuse condition, and vice versa for the design of side impact discrimination algorithm. In essence, the frontal and side algorithms have to be designed as a single system with multiple sensor inputs (acceleration signals along vehicle longitudinal and lateral directions).
- Incorporation of Crush Zone Sensors – as Offset- Deformable-Barrier events begin to be included into the crash matrix, to better represent real world crash events in sensing system development, crush zone sensors must be added to supplement the single point sensor (at the CCU) for some vehicle structures. This has essentially made the frontal crash sensing algorithm a multi-sensor-input algorithm, with or without side impact interaction.
- Crash Severity Sensing Algorithm – as capabilities of crash severity sensing expand along with the development of dual stage (multi-stage) inflators, algorithm design has to be performed with a good knowledge and understanding of the operating principle and constraints of the dual stage (multistage) inflators. One must also be concerned with the variety of inflators that (for both driver and passenger side applications) and their unique characteristics and limitations while developing deployment algorithms.
- Occupant Classification System & Occupant Sensing System – further expansion of the sensing system to include occupant classification systems and occupant

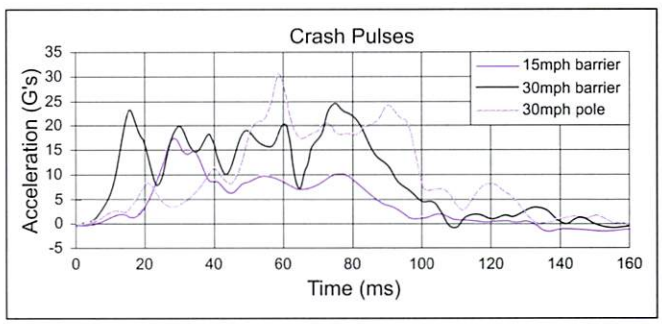


Figure 4 Vehicle crash pulses

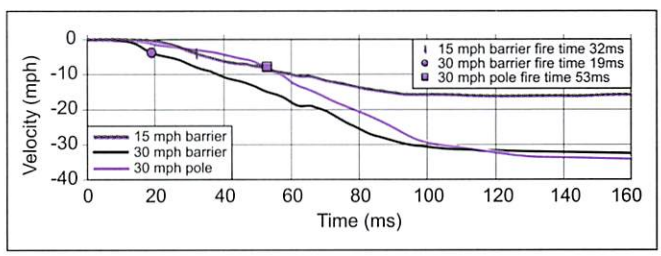


Figure 5 Crash velocity profiles and estimated airbag fire times

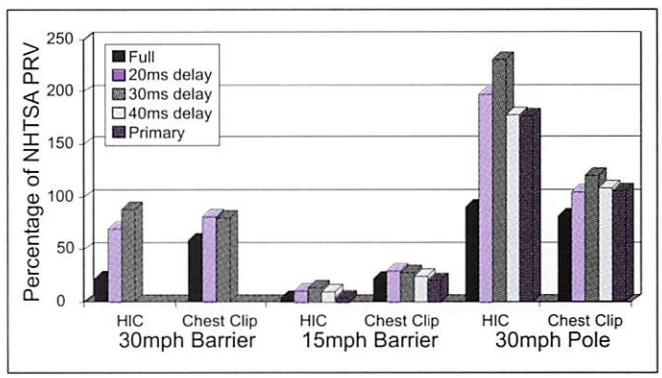


Figure 6 Modeling results based on staged inflator output and time to fire

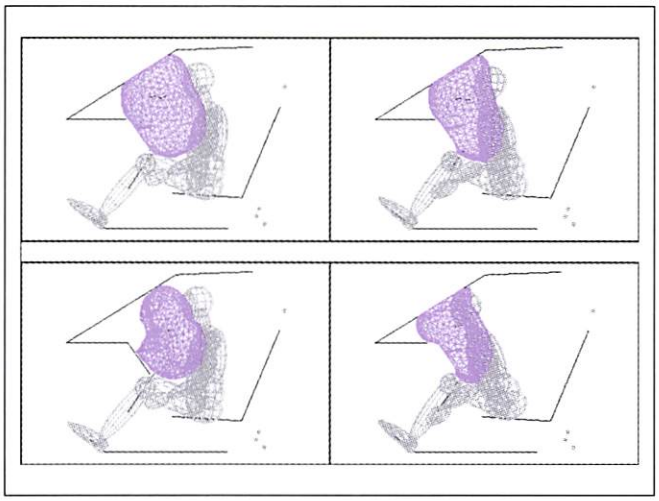


Figure 7 Occupant kinematics for 2 different staged outputs

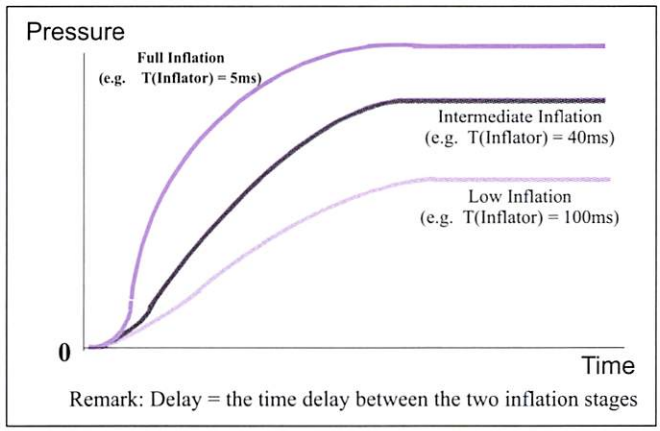


Figure 8 Occupant kinematics for 2 different staged outputs

sensing systems forces algorithm design to be performed with good knowledge and understanding of the operating principle of multiple types of sensors, such as ultrasound transducer, capacitive sensor, strain gauge, etc. In addition, the understanding of vehicle dynamics and occupant kinematics during pre-crash phase prior to impact has become an important part of crash sensing design. In summary, the crash sensing design has to be performed at system level that encompasses multiple sensors, sensor types and with time horizon than spans from pre-crash, in-crash and post crash phases.

Modeling Methodology

Computer Simulation For Sensor Development – Simulation of vehicle crash events using computer methods can take many forms. Whatever the form may be, the modeling allows parametric changes to be made that would be prohibitively expensive to test and also allows the same model to be run repetitively without inconsistent kinematic (vehicle or occupant) behavior. The aim of the model in sensor development is both interactive and predictive. The interactive parts entail receiving information from the sensor hardware engineer regarding the crash behavior of the vehicle for a variety of crash events. The information taken by the hardware in terms of accelerations (in three dimensions) within the occupant compartment or some undeformed area nearby are ideal inputs into a model of occupant kinematics during the crash event. In the example for this paper, the MADYMO (Mathematical Dynamic Modeling) software is regularly used to predict the occupant kinematics during a crash. The recorded acceleration fields are used as dynamic input conditions to the linked rigid body occupant model and the model solves the equations of motion. For each crash condition modeled, the predicted occupant dynamics and injury parameters are compared for various fire times and inflator outputs while leaving the bag parameters constant. In this manner, a database of responses is constructed that allows the inflator engineer, sensor engineer and performance engineer to agree on a strategy and restraint system design that is practical and achieves the desired goals.

The process can be illustrated in Figures 4 through 7. The original crash pulses from a series of vehicle tests at different speeds are converted to velocities and put through the algorithm scheme. Predicted fires times are derived. The pulses and fire times are given to the simulation engineer who has created a baseline model configuration of the vehicle. A series of computer runs are generated that result in Figure 6. Occupant kinematics are reviewed also as shown in Figure 7. The results indicate in this example that a 20 ms staged deployment of the inflator (delay between stages 1 and 2) is the maximum that could be allowed to keep head and chest injury numbers below targets for 30mph barrier. Also, occupant displacement must be considered since vehicles have varying amounts of "ride-down" distance. This could affect ultimate choice of inflator staging.

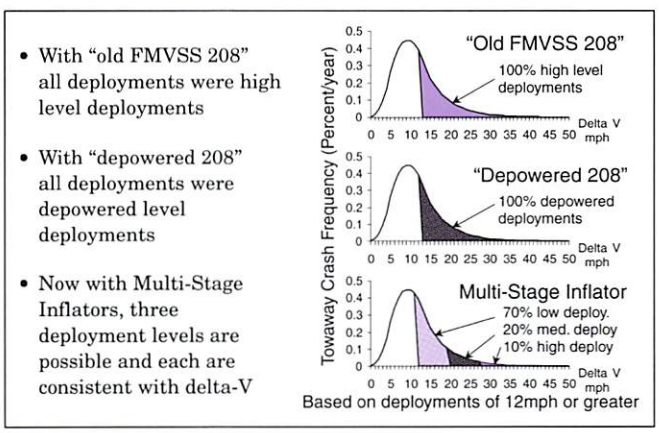


Figure 9 Benefits of crash severity sensing and multi-stage inflators

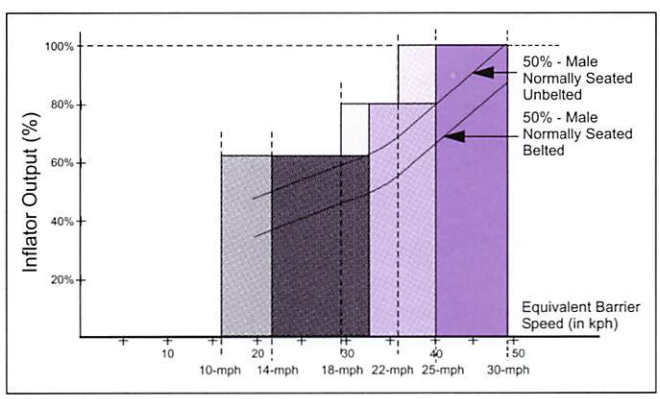


Figure 10 Inflator output based on belt use and crash severity

Dual Stage Inflator Development

The objective of dual or multistage inflators is to minimize the inflation energy required to satisfy a given crash condition. If the condition can be sensed, the model can predict the required inflation energy and the inflator engineer can tailor the output appropriately. This is not meant to be trial and error exercise, but methodology to involve a team in achieving the goals. Figure 8 shows a typical dual stage inflator static tank pressure curve. Inflation energy can take on many levels, but three are shown in the figure. The lowest stage, low inflation, is indicated for low severity or low-risk (per FMVSS 208, interim final rule) deployment conditions where a delay of 100ms or more may be applied between the firing of the first and second stages. An intermediate inflation could be instituted for a 40 ms delay between stages to cover mild severity crash conditions. Finally, a full inflation event or 5ms delay between stages covers the highest severity crash conditions.

The need and benefits of dual or multi-stage inflators is seen in Figure 9. Under previous FMVSS 208 (pre- 1997), all deployments received a high level of inflation energy regardless of sensed crash speed above threshold. This was also true for "depowered" deployments under FMVSS 208 from 1997-present. Future FMVSS 208 and market trends will be responsible for bringing these multi-stage inflators into production that have the benefit of altering deployment energy based on sensed velocity change and only the highest severity events will receive a high output. Even then, the crash severity algorithm couples to occupant sensing technologies will be able to make adjustments to the inflation or disable it altogether.

To emphasize that point, Figure 10 demonstrates an example firing strategy for a three level output inflator based on crash severity and occupant belt use. Along the continuum of crash severity, the unbelted occupant receives the various stages of inflation "before" a belted occupant would, i.e., for a given sensed crash speed, for example 18 mph, the unbelted occupant may be receiving an intermediate output while the belted occupant would receive a low inflation output. Again, checking for occupant sensing and classification could determine final inflation output delivered.

Summary

This discussion has shown that the complex world of vehicle crashes will require more interactive work between engineering disciplines to develop restraint systems appropriate for the crash condition. There is a perceived expectation that the restraint system market will get smarter in the future and advanced sensing systems coupled to advanced restraint systems will satisfy that expectation.

In summary, the advanced systems can be expected to include:

- ✦ Crash severity algorithms that respond to a variety of sensor inputs.
- ✦ Occupant sensing and classification systems.
- ✦ Tailorable inflator output related to crash severity and occupant sensing

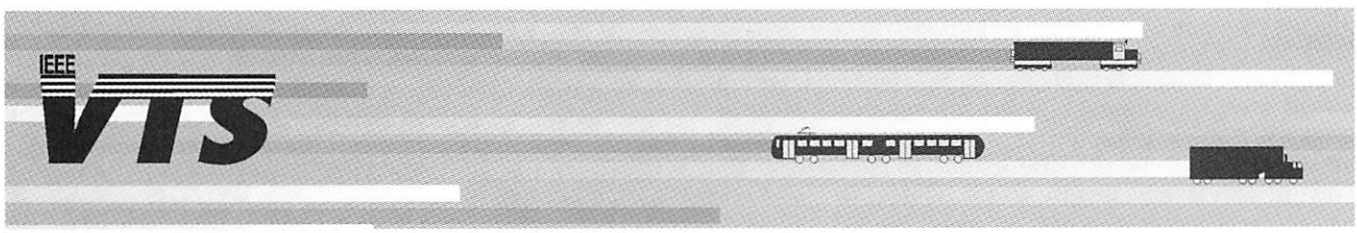
Acknowledgments

The authors would like to acknowledge Mr. Kurt Fischer, TRW Senior Staff Specialist, for his work on the contents of this paper. Ms. Ru Ling is acknowledged for her contributions to the modeling done for this paper.

References

[1] Wards Auto World, April 2000, p.33.

[2] U.S. Department of Transportation (2000) Federal Motor Vehicle Safety Standard. Occupant Crash Protection (Final rule; Interim final rule).



Mobile Messaging: SMS, EMS and MMS

Gwenaël Le Bodic, Alcatel Business Systems

Mobile messaging encompasses a number of technologies and services enabling the exchange of messages between mobile users. In the early days of mobile digital telephony, the Short Message Service was introduced in the market with GSM networks and rapidly became one of the most revenue-generating services for mobile network operators. The service allows the transfer of short text messages between mobile users. One of its application-level extensions was developed in the form of the Enhanced Messaging Service enabling the exchange of messages containing rich-media contents such as small bitmap pictures and ringtones. The forthcoming Multimedia Messaging Service, a major breakthrough in the roadmap of messaging services, is expected to unleash advanced capabilities of emerging mobile devices and networks by allowing the exchange of messages with truly multimedia content. This paper provides an insight of existing and forthcoming messaging services along with a description of enabling technologies.

Introduction

Most communications systems provide one or more messaging services [1]. Internet has the electronic mail whereas fixed telephony has the answering machine. Similarly, mobile network operators have long provided various messaging services to their subscribers. One can leave a voice memo in a voicemail server which can be later re-

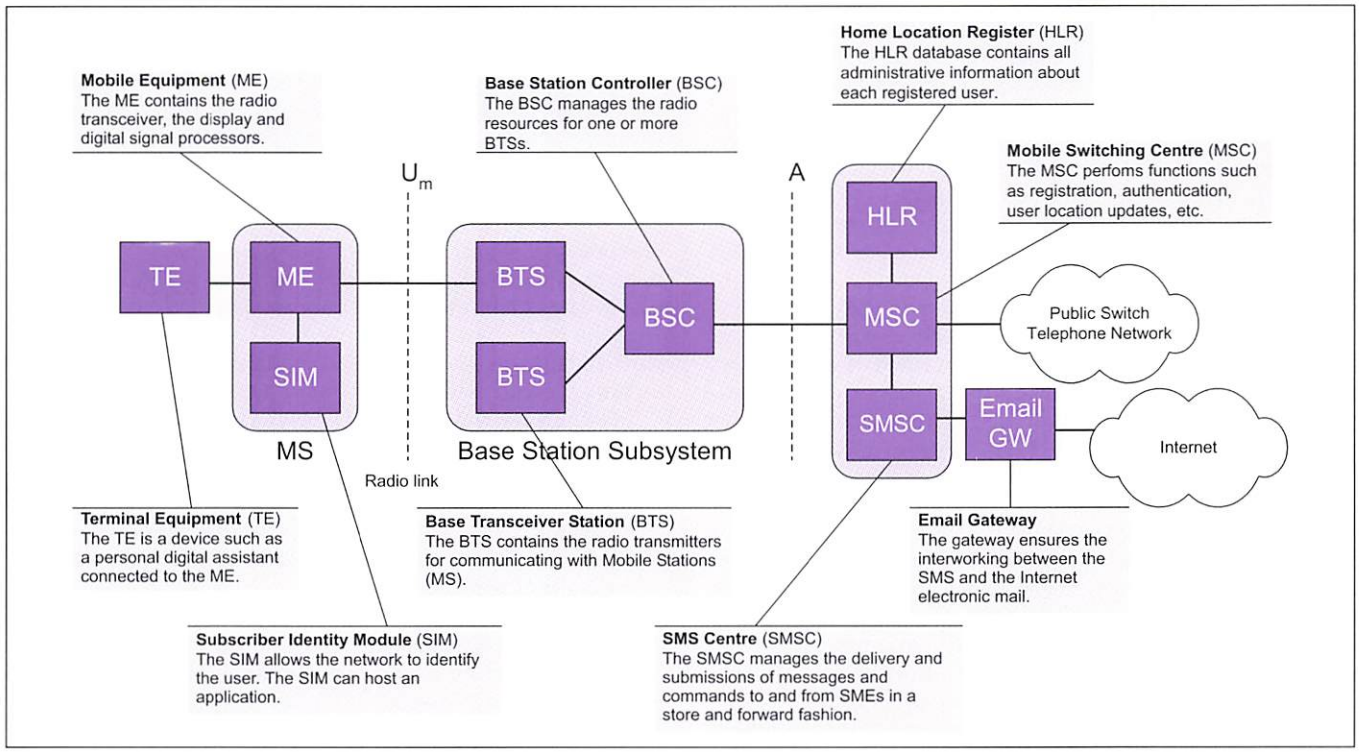


Figure 1 Architecture of an SMS-enabled GSM network

trieved by a mobile user. With 2nd generation networks such as GSM, the introduction of digital communications allowed the development of the Short Message Service (SMS). From its introduction in the 1990's, SMS has become a very successful service for mobile users. The GSM association[1] estimates at around 200-250 Billions the number of messages exchanged in 2001. Like all messaging services, SMS is characterised by the fact that messages are kept temporarily by the network until messages are retrieved by the recipients (store and forward paradigm). However, in its most basic form, SMS allows messages containing limited text only to be exchanged between users. This prevents the support of very compelling use cases. An application-level extension of SMS was later introduced on the market to overcome SMS limitations. This extension, known as the Enhanced Messaging Service (EMS), allows short messages containing elements such as small pictures and ringtones to be exchanged between users. With EMS, the transport of messages is carried out over SMS as a transport medium. First EMS products appeared on the market in 2001. In the pace of these simple mobile messaging services, emerging mobile communications systems such as GPRS and later 3G networks offer advanced transport capabilities. A new messaging service has been designed to leverage capabilities of these systems. This service is known as the Multimedia Messaging Service (MMS). With MMS, users are not limited anymore to the exchange of short text messages but are able to exchange messages with multimedia contents such as images, sounds, videos, animations as found over the Internet. With MMS, elements of a multimedia message can be choreographed over time and appropriately placed over a graphical layout by content designers. The roll out of the MMS has started in Europe in March 2002 and is continuing today in other parts of the world. It is expected that MMS will attract the mass market around 2004 or 2005.

This article presents the evolution of mobile messaging services and technologies. This presentation encompasses the following services: SMS, EMS and MMS.

A Short Message Service

Mobile messaging is based upon a series of evolutionary steps. One of the first messaging service to have been provided by mobile communications networks is SMS. Two types of basic services are available with SMS: SMS point-to-point (SMS-PP) [2,3] and the Cell Broadcast Service (CBS) [4].

With CBS, a cell broadcast centre instructs one or more base stations to broadcast a message. The message is not acknowledged by receiving mobile devices back to the cell broadcast centre. Furthermore, the centre does not store the message for mobile devices that were unavailable at time of broadcast. The CBS enables a one-way transmission of short messages to mobile devices for services such as traffic information, weather forecast, stock market, etc.

SMS-PP allows the exchange of short messages containing at most 140 bytes of payload. The first SMS-PP message is believed to have been sent in December 1992 from a personal computer over a European GSM network. In its most recent specifications, SMS-PP messages can be concatenated to allow the transfer of long messages. SMS-PP is further described in the following sections of this article.

A.1 SMS Point to Point

With SMS-PP, short messages can be sent from a mobile device to another mobile device. They can also be sent from a device connected to a fixed network (PSTN or Internet) to a remote mobile device, and vice-versa. In an SMS-enabled network, a central element called SMS Centre (SMSC or SC) is in charge of storing temporarily messages until they are delivered to the recipient's device or until the validity period of the message expires. The SMSC is also responsible for routing messages from the operator domain to external networks (e.g. via an Email gateway to the Internet). With

[1]GSM Association at http://www.gsm.org

SMS, a message originator can request a delivery report to be generated upon delivery of the message to the recipient or upon message deletion. The architecture of an SMS-enabled GSM network is shown in Figure 1.

A.2 SMS-PP Protocol Stack

The SMS protocol stack, as shown in Figure 2, consists of four layers: the application layer, the transfer layer, the relay layer and the link layer. SMS-based applications are directly based on the transfer layer. Consequently, any engineer willing to develop applications, for which SMS is a building block, needs to master the transfer layer.

The application layer is implemented in devices in the form of software applications that send, receive and interpret the content of messages (e.g. message editor, games, etc.). The application layer is also known as SM-AL for Short-Message-Application Layer. A device, which is able to receive or send SMS messages, is known as a Short Message Entity (SME).

At the transfer layer, the message is considered as an organised sequence of bytes containing information such as message length, message originator or recipient, date of reception, etc. The transfer layer is also known as the SM-TL for Short-Message-Transfer-Layer. At this layer, all transactions are acknowledged between the mobile device and the network in order to cope with message losses.

The relay layer allows the transport of a message between various network elements. A network element may store temporarily a message if the next element, to which the message is to be forwarded, is not available. At the relay layer, the Mobile Switching Centre (MSC) handles two functions in addition to its usual switching capabilities. The first function called SMS gateway MSC (SMS-GMSC) consists in receiving a message from an SMSC and interrogating the Home Location Register (HLR) to obtain routing information and further to deliver the message to the recipient network. The second function called SMS InterWorking MSC (SMS-IWMSC) consists in receiving a message from a mobile network and submitting it to the serving SMSC. The relay layer is also known as the SM-RL for Short-Message-Relay-Layer.

The link layer allows the transmission of the message at the physical level. For this purpose, the message is protected for coping with low-level channel errors. In GSM networks, SMS messages are transported over signalling channels and can therefore be handled by the mobile device even if a voice or data call is active. The link layer is also known as the SM-LL for Short-Message-Link-Layer.

For transport purpose, at the transfer layer, an application maps the message content and associated delivery instructions onto a Transfer Protocol Data Unit (TPDU). A TPDU is composed of various parameters indicating the type of the message, specifying whether or not a status report is requested, containing the text part of the message, etc. Each parameter is prefixed by the abbreviation TP for Transfer Protocol such as TP-Message-Type-Indicator (abbreviated TP-MTI), TP-Status-Report-Indication (abbreviated TP-SRI), TP-User-Data (abbreviated TP-UD), etc.

A.3 SMS-PP Message Transfer

At the transfer layer, the exchange of a message from the originator SME to the recipient SME consists of two to three steps. The three steps are shown in Figure 3.

After creation by the originator SME, the message is submitted to the SMSC (step 1). The SMSC may verify with other network elements that the message originator is allowed to send messages (e.g. sufficient pre-paid credit, user has a valid network subscription, etc.). The SMSC delivers the message to the recipient SME (step 2). If the recipient SME is not available for the message delivery, then the SMSC stores the message temporarily until the recipient SME becomes available or until the message validity period expires. Upon delivery of the message or upon message deletion by the network, a status report might be transferred back to the originator SME (step 3), only if this report had been requested by the originator SME during message submission.

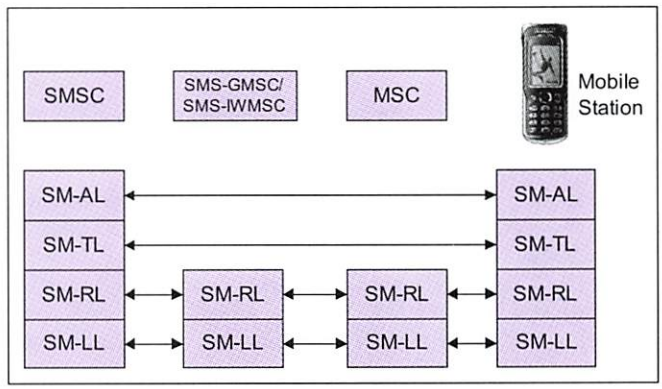


Figure 2 SMS protocol stack

The message concatenation is handled at the application layer. A long message may need to be split into a concatenation of several message segments. Note that not all mobile devices support message concatenation. For transport purpose, each message segment is mapped onto a TPDU at the SMS transfer layer as shown in Figure 4.

A.4 SMS-PP Transactions Types

At the transfer layer, six types of transactions can occur between an SME and the SMSC. A type of TPDU corresponds to each one of the transaction types.

- SMS-SUBMIT: this transaction corresponds to the submission of a message segment from the SME to the SMSC.
- Upon submission of the message segment, the SMSC acknowledges the submission with the SMS-SUBMIT-REPORT transaction.

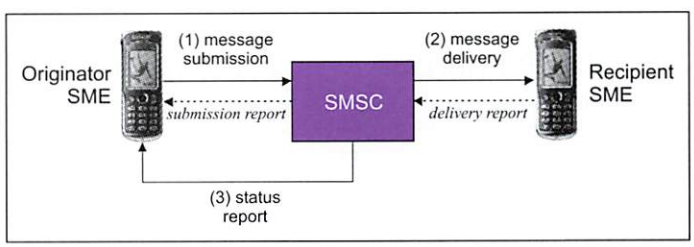


Figure 3 Message transfer between two SMEs

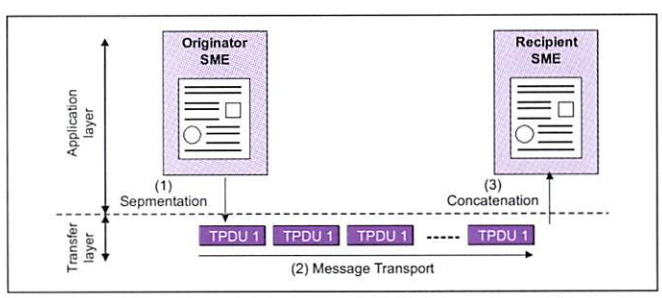


Figure 4 Message structure / concatenation

- SMS-DELIVER: this transaction corresponds to the delivery of a message segment from the SMSC to the SME.
- Upon delivery of the message segment, the SME acknowledges the delivery with the SMS-DELIVER-REPORT transaction.
- SMS-STATUS-REPORT: this transaction corresponds to the transfer of a status report from an SMSC back to an SME.
- SMS-COMMAND: this transaction corresponds to the request from an SME, usually an external SME (e.g. value-added server), for the execution of a specific command by the SMSC.

A.5 SMS-PP Text and Data Coding Schemes

The text part of a message can be encoded according to several text alphabets whereas the data is always 8-bit encoded. The two text coding schemes that can be used in SMS are the GSM 7-bit default alphabet defined in [5] and the Universal Character Set (UCS2) defined in [6]. The amount of text that can be included in a message segment needs to fit into 140 bytes. Since, the two text coding schemes utilise respectively 7 bits and 16 bits to encode a character/symbol, the amount of text that can be included in a message segment is indicated in Table 1.

Table 1: SMS - text and data coding schemes

Coding Scheme	Text/data length per message segment
GSM default alphabet, 7 bits	160 characters
8-bit data	140 bytes
USC2, 16 bits	70 complex characters

The value assigned to the TP-Data-Coding-Scheme parameter indicates which coding scheme has been used for encoding the message content. In its simplest form, the GSM 7-bit default alphabet is composed of 128 characters plus 9 additional characters (extension table) including the Euro sign. The Universal Character Set with 2-byte symbols (USC2) is used for encoding complex sets of non-Latin characters such as Chinese and Arabic.

A.6 SMS-PP Transport Protocol Data Unit

Depending on its type, a TPDU is composed of a varying number of parameters organised according to a predefined TPDU layout. High-level parameters in the TPDU inform on the transaction type (TP-Message-Type-Indicator), the presence of binary elements in the message such as concatenation instructions (TP-User-Data-Header-Indicator), etc.

One of the important parameters is the user data parameter (TP-User-Data). This parameter contains the text part of a message segment and may also contain binary elements such as concatenation instructions, pictures, melodies, etc. To cope with the complexity of this parameter, the parameter is divided into two sub-parts. The first sub-part, known as the User-Data-Header (UDH) contains binary elements whereas the remaining sub-part contains the message text. The User-Data-Header is itself structured as a sequence of sub-parameters. The first sub-parameter, the User-Data-Header-Length (UDHL), indicates the length of the User-Data-Header in bytes. A set of information elements immediately follows the UDHL and contains objects such as pictures, melodies, concatenation instructions, etc. Each information element consists of a sequence of three fields: an Information Element Identifier (IEI) identifying the element type (e.g. melody, picture), an Information Element Data Length (IEDL) and an Information Element Data (IED) containing the information element binary data (e.g. sequence of musical notes, picture bitmap). The partial representation of a TPDU is shown in Figure 5.

Whatever the coding scheme used for the TP-User-Data, the User-Data-Header is always 8-bit encoded. Consequently, if the TP-User-Data is 7-bit aligned, then fill bits may be inserted between the UDH and the remaining part of the TP-User-Data. With this method, a 7-bit data part always starts on a 7-bit data boundary of the TP-User-Data as shown in Figure 5. This allows older handsets, which do not support the User-Data-Header concept, to still be able to present the 7-bit text part of the message to the subscriber.

In addition to its type, a message belongs to a class. The TP-Data-Coding-Scheme (TP-DCS) parameter of the TPDU indicates the class to which belongs the message. Four classes have been defined and indicate how a message should be handled by the receiving SME. A short description of each message class is given in Table 2.

Table 2: SMS message classes

Class	Description
Class 0	Immediate display messageMessages belonging to the class 0 are immediately presented on the recipient device display.
Class 1	Mobile equipment specific messageIf possible, messages belonging to the class 1 are stored in the ME. Otherwise, class 1 messages may be stored in the Subscriber Identity Module (SIM).
Class 2	SIM specific messageMessages belonging to class 2 are stored in the SIM.
Class 3	Terminal equipment specific messageMessages belonging to class 3 are transferred to the terminal equipment (e.g. PDA, personal computer, etc.) which is connected to the ME.

It has to be noted that in most cases, a message does not belong to any of the four classes. In this situation the message is known as a no-class message and is usually handled as a class 1 or 2 message by the receiving SME.

A.7 SMS-based applications

Various applications are based on SMS. These applications can be classified into three general categories as shown below:

- Customer applications including person-to-person messaging, information services, voice message and fax notifications, Internet Email alerts, download service and chat applications.
- Corporate applications including vehicle positioning and remote monitoring.
- Operator applications including SIM lock, SIM updates, message waiting indicators and WAP push.

When the service was introduced on the market, nobody expected SMS to become such a successful service. A de-

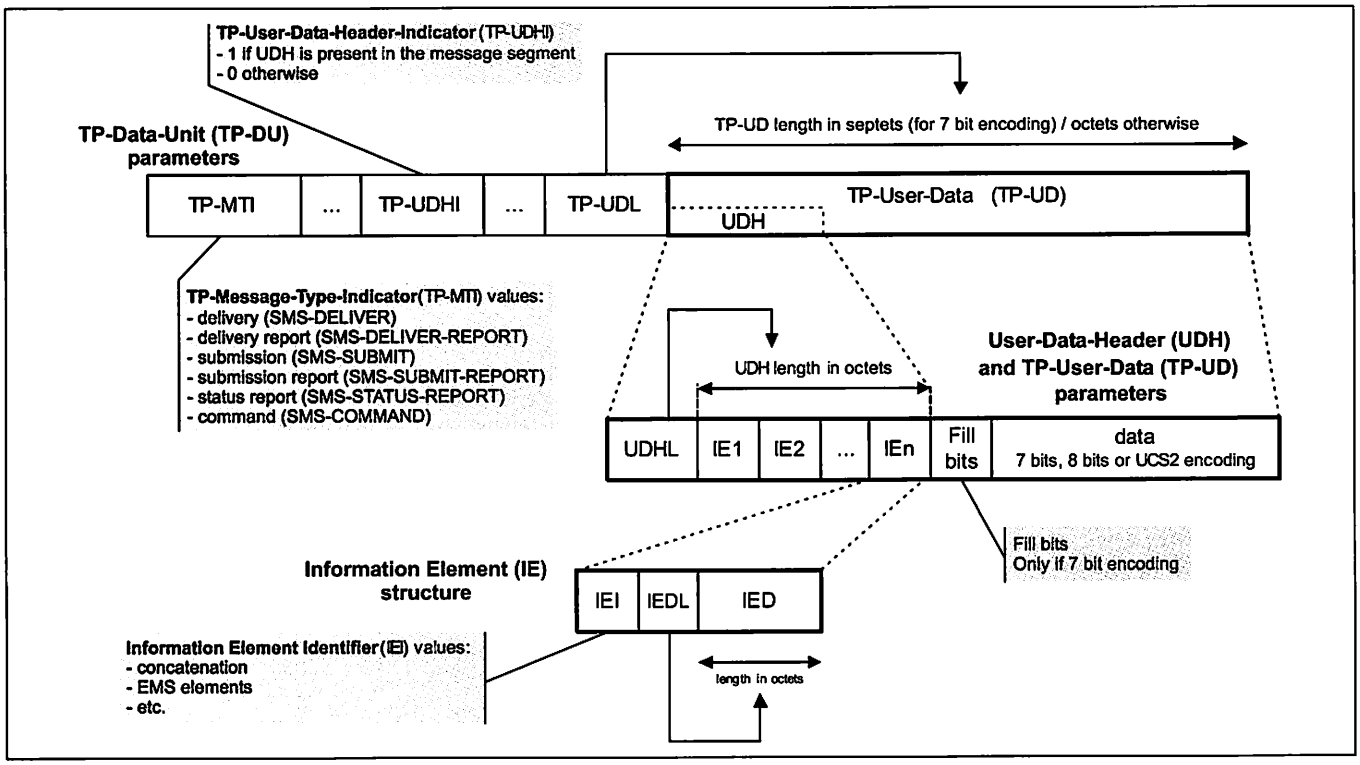


Figure 5 Structure of a TP-Data-Unit

cade after its introduction, SMS is still a widely used service but is not really in line with the ever-increasing demand for multimedia services. To give a further breath to SMS and to allow a smooth transition to full multimedia messaging services, an application-level extension of SMS has been designed to allow the exchange of messages containing rich-media contents. This application level, known as the Enhanced Messaging Service, is described in the next section.

B Enhanced Messaging Service

The Enhanced Messaging Service (EMS) [2] supersedes SMS capabilities by allowing the exchange of rich-media messages containing text with pictures, melodies, animations, etc. Standardisation work went on for almost two years to define and finalise EMS features. A close analysis of the standardisation work and availability of EMS handsets on the market leads to the identification of two EMS features sets. The first set of features is defined in 3GPP[2] technical specifications release 99 (with several updates in release 4-release 2000 and release 5-release 2001) whereas the second set of features is defined in 3GPP technical specifications release 5 - release 2001. Each 3GPP technical specification is associated to a release number which identifies its 'freezing' date. According to 3GPP working methods, the content of 3GPP technical specifications is frozen (roughly) once a year to allow implementers to start development on stable specifications, while allowing standardisation practitioners, in parallel, to propose evolutions to available specifications. In this article, according to the terminology introduced in [1], the first EMS features set is described as basic EMS (Release 99/4) and the second EMS features set is described as extended EMS (Release 5).

B.1 Basic EMS (release 99)

Basic EMS allows the exchange of rich-media messages. EMS messages can contain several of the following elements:

- Text, with or without formatting (alignment, font size and style, no support for colour).
- Black and white bitmap pictures.
- Black and white bitmap-based animations.
- Monophonic melodies.

One of the characteristics of EMS is that graphical elements (pictures and animations) and melodies are always placed in the message text at a specific position: that of a character. This method looks appropriate for graphical elements. However, the applicability of this positioning method is less appropriate for melodies. Indeed, a melody is rendered by the receiving device when its associated character position in the message text becomes visible to the user. In basic EMS, an element position is always expressed with a character position in the text of the message segment in which it is contained (relative positioning). Each element such as a picture or a short melody is inserted in a message segment as part of a dedicated information element in the User Data Header of the message.

In basic EMS, an element has to fit into a single message segment and cannot be positioned in the text part of another message segment. Such an element cannot be segmented and spread over several message segments. Consequently, its maximum size is equal to the maximum size of a message segment payload (î bytes). This can be seen as a significant limitation for the deployment of services such as the download of wallpapers and ringtones that typically require more than 140 bytes.

In addition, basic EMS supports the concept of Object Distribution Indicator (ODI) which can be associated with a

[2]3GPP stands for 3rd Generation Partnership Project. The 3GPP was set in 1999 by standardisation representatives of five parts of the world (ETSI for Europe, Committee T1 for the USA, ARIB and TTC for Japan, TTA for Korea and CWTS for China). The 3GPP offers a collaborative working environment for the design of interoperable mobile systems.

message element in order to indicate that the element should not be forwarded by SMS (e.g. copyrighted content). Similarly, in order to cope with the size limitation of message elements for the download service, basic EMS supports the concept of User Prompt Indicator (UPI). The goal of the UPI is twofold: it first indicates that the associated object is to be considered as a downloaded object (e.g. ringtone or wallpaper) rather than as an object that illustrates the message text. On the other hand, the UPI can also contain basic object concatenation instructions (applicable to melodies and pictures only) to allow the transfer of elements whose size is larger than 140 bytes. Note, however, that the UPI is not widely supported by mobile devices available on the market. A more sophisticated solution for transporting large objects in EMS messages is available in extended EMS as introduced in the next section.

B.2 Extended EMS (release 5)

Compared to SMS, basic EMS significantly improves user experience by allowing the exchange of rich-media messages. However, basic EMS is still very limited for the development of very compelling professional services. To cope with these limitations, a further extension has been designed and is covered in this article under the banner extended EMS. Extended EMS is again based on the concept of SMS User Data Header where message elements are inserted in a message in the form of dedicated information elements. Unlike basic EMS, extended EMS allows large objects to be spread over more than one message segments. It is recommended, by standardisation organisations, to limit the size of messages to eight segments in order to guarantee handset interoperability (corresponding to a maximum message payload of 1 Kbytes). In addition from elements already supported in basic EMS, extended EMS supports the following additional objects:

- Text formatting with support of colour.
- 4-level greyscale bitmap pictures.
- 64-colour bitmap pictures.
- 4-level greyscale bitmap animations.
- 64-colour bitmap animations.
- vCard data streams (used to define business cards).
- vCalendar data streams (used to define appointments, reminders, etc.).
- Polyphonic (MIDI) melodies.
- Vector graphics.
- Compression of message elements (LZSS-based).

B.3 Availability of EMS compliant devices

Major handset manufacturers such as Alcatel, Ericsson, Siemens and Motorola have produced devices supporting basic EMS. At the time of writing this article, there is no devices supporting extended EMS available on the market.

One of the key advantage of EMS is its ease of deployment. To become operational, the Enhanced Messaging Service only requires the availability of EMS-compliant handsets. There is no network infrastructure impact since the exchange of EMS messages is transparent to SMS service centres.

It becomes apparent that new business opportunities have been opened with the EMS extension. With EMS, content providers can design rich content messages to be transferred directly to mobile handsets over a standard transport mechanism. The Enhanced Messaging Service in the content server to mobile handset scenario may become the service that will boost-up the use of SMS as a transport technology.

C Multimedia Messaging Service

SMS has been a very successful service with 2G mobile networks such as GSM. The access to higher bandwidth, with 2.5G and 3G networks, enables the development of alternative and new services. Sophisticated capabilities are integrated to these services to meet the ever-increasing user demands for multimedia features. In addition, what is now expected by the mobile communications market is a better convergence with existing services available to Internet users. In order to meet this requirement, the 3GPP and the WAP Forum have designed a new messaging service to be supported by 2G, 2.5G and 3G networks. This new messaging service is known as the Multimedia Messaging Service (MMS) [7][8]. MMS allows the exchange of multimedia messages in the context of person-to-person and machine-to-person scenarios. In comparison with SMS and EMS messages, a message in the MMS environment is composed of truly multimedia elements. This includes the possibility to compose multimedia messages as 'slideshow' presentations (i.e. combination of text, audio and pictures, all choreographed over time).

However, the wheel has not been reinvented for the development of the Multimedia Messaging Service. MMS capitalises on the best features of existing fixed and mobile messaging systems such as SMS, EMS and the Internet electronic mail. Design objectives for MMS include the use of existing transport protocols and content formats widely used in the Internet world.

C.1 Standardisation work

The Short and Enhanced Messaging services have been specified almost entirely in the scope of the European Telecommunications Standard Institute (ETSI) and 3GPP standardisation activities. The setting of the Multimedia Messaging Service is more complex and the definition of MMS has required a tremendous workload from several standardisation development organisations. Mainly, the work has been carried out in the scope of the 3GPP and WAP Forum standardisation processes. The 3GPP deals with the high-level service requirements, architectural aspects of MMS, message structure and content formats. It also defines the technical realisations for selected interfaces allowing interactions between communicating network elements. On the other hand, the WAP Forum deals with the technical realisations of the interface bridging the mobile device and the network on the basis of WAP and Internet transport protocols. Consequently, specifications defining the service are scattered over a high number of documents maintained by different organisations. Practically, this does not facilitate the work of implementers. At the time of writing this article, the 3GPP has provided three releases of the service definition and the WAP Forum has finished the completion of two of them. The first technical realisation is based on WAP transport protocols and is named MMS 1.0. The second technical realisation is based on either WAP or Internet transport protocols and is named MMS 1.1.

In an MMS environment, network elements communicate via a set of interfaces. Each interface supports a number of operations such as message submission, message retrieval and message forwarding. Each operation is associated with a set of parameters (also known as information elements). Several interfaces have been standardised in order to ensure interoperability between devices produced by various manufacturers. Other interfaces have not yet been standardised and are therefore subject to proprietary implementations.

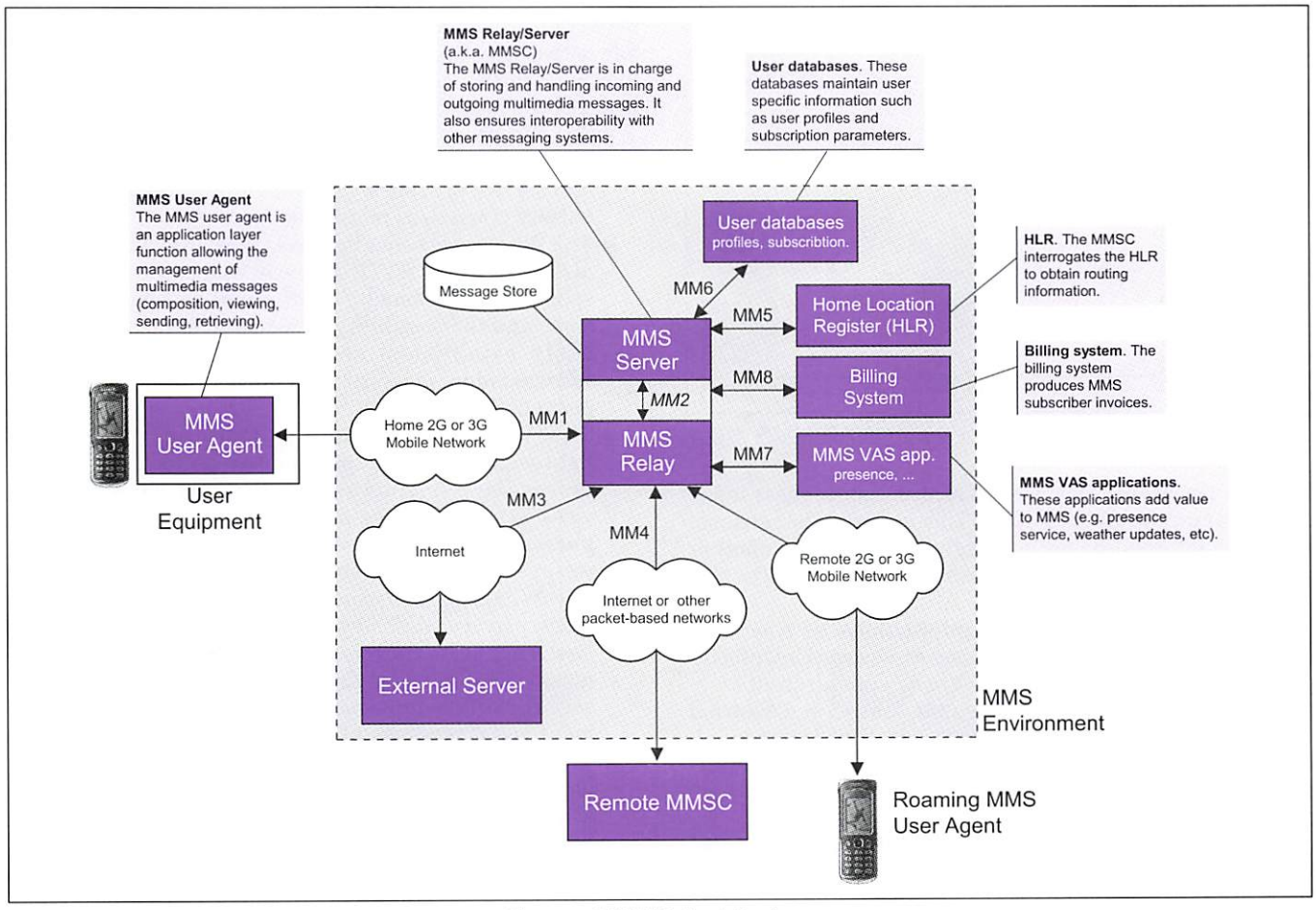


Figure 6 MMS Architecture

C.2 MMS Architecture

The MMS architecture includes the software messaging application in the MMS-capable mobile device necessary for the composition, sending and reception of messages. In addition, other elements in the network infrastructure are required to route messages, to adapt the content of messages to the capabilities of receiving devices, etc. Figure 6 shows a general architecture of a typical configuration of the MMS environment. The MMS Environment (MMSE) refers to the set of MMS elements, under the control of a single administration (MMS provider), in charge of providing the service to MMS subscribers.

The MMS user agent is the software application shipped with the mobile handset and which allows the composition, the viewing, the sending, and the retrieval of multimedia messages. For the exchange of a multimedia message, the MMS user agent, which generates and sends the multimedia message, is known as the originator MMS user agent, whereas the MMS user agent, which receives the multimedia message, is known as the recipient MMS user agent. Recipient and originator MMS user agents are attached respectively to the recipient and originator MMSEs. A key element in the MMS architecture is the MMS Relay/Server. The MMS Relay is responsible for routing messages within the MMSE but also outside the MMSE, whereas the MMS Server is in charge of storing messages that are awaiting retrieval. The MMS Relay and MMS Server may be provided separated or combined. In the latter configuration, the name usually given to the combined MMS Relay/Server is the MMS Centre (MMSC).

The MM1 interface is a key interface in the MMS environment. It allows interactions between the MMS user agent, hosted in the mobile device, and the MMSC. Operations such as message submission, message retrieval can be invoked over this interface. The 3GPP has defined the functional requirements of this interface. Based on these requirements, the WAP Forum has designed associated MM1 technical realisations for the WAP environment. At the time of writing this article, there is no known non-WAP implementation of the MM1 interface. However, such non-WAP implementations may be elaborated by standardisation organisations in the near future.

The MM2 interface is the interface between the MMS Relay and the MMS Server. Most commercial solutions offer a combined MMS Relay and MMS Server in the form of an MMSC. In this case, the interface between the two elements is developed in a proprietary fashion. At the time of writing this article, no technical realisation of this interface has been standardised.

The MM3 interface is the interface between an MMSC and external servers. Operations over this interface allow the exchange of messages between MMSCs and external servers such as Email servers and SMSCs. The MMSC or another network entity can adapt the content and structure of messages in order to guarantee interoperability with legacy messaging systems.

The MM4 interface is the interface between two MMSCs. This interface is necessary for exchanging multimedia messages between distinct MMS environments.

The MM5 interface is needed for allowing interactions between the MMSC and network elements such as the HLR.

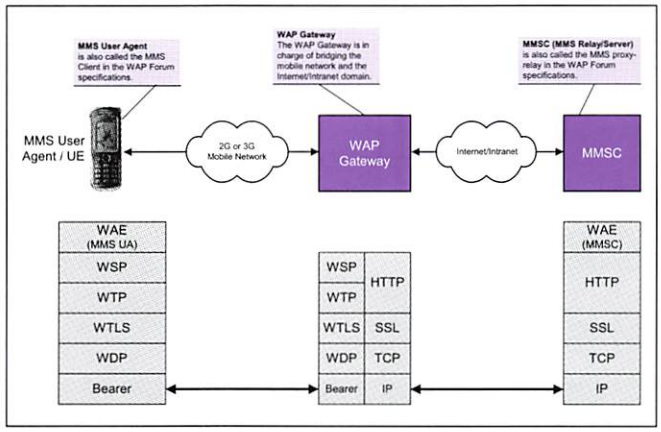


Figure 7 MMS Protocol stacks with WAP MMS 1.0

Through the MM5 interface, an MMSC can request information maintained by the HLR. This includes the retrieval of routing information for forwarding a message to another messaging domain or some information about a particular subscriber.

The MM6 interface allows interactions between the MMSC and user databases (e.g. presence server). Unfortunately, the MM6 interface has yet to be standardised.

The MM7 interface fits between the MMSC and external Value Added Service (VAS) applications. This interface allows a VAS application to request services from the MMSC (message submission, etc.) and to obtain messages from remote MMS user agents.

The MM8 interface is needed for allowing interactions between the MMSC and a billing system. Unfortunately, such an interface has not been standardised yet.

C.3 WAP Implementation of MMS

So far, the WAP Forum has published stable specifications for two technical realisations of the MM1 interface, for different network configurations of the WAP framework. The specification of a third technical realisation is under development in the scope of the WAP Forum standardisation process[3]. The two sets of published specifications are named MMS 1.0 [9][10][11] and MMS 1.1 [12][13][14] and correspond to two different levels of features. MMS 1.0 features represent a subset of features supported in MMS 1.1. MMS 1.0 maps MMS features in a WAP 1.x network configuration. In addition, the WAP 2.0 network configurations are also supported in MMS 1.1.

The advantage of using WAP as an enabler for the realisation of MMS resides in the fact that WAP hides the specifics of underlying transport technologies from MMS-based applications. Transport technologies that can be used in the WAP environment include SMS, GSM data, GPRS, EDGE and W-CDMA. Furthermore, WAP has become widely adopted by major network operators and therefore ensures interoperability between different MMS solutions, at the transport level, and facilitates the rapid deployment of MMS solutions. Note that GPRS is the targeted transport technology for the deployment of first MMS solutions on the market.

With WAP MMS 1.0, the configuration of elements interacting over the MM1 interface is based on recommendations of the WAP 1.x specification suite. In this configuration, a network element, called the WAP Gateway, bridges the mobile network and the Internet/Intranet domain as shown in Figure 7. In this configuration, the network stack is composed of the following layers:

- The Wireless Application Environment (WAE) is a general-purpose application environment where operators and service providers can build applications for a wide variety of wireless platforms.
- The Wireless Session Protocol (WSP) provides features also available in HTTP (requests and corresponding responses). Additionally, WSP supports long-lived sessions and the possibility to suspend and resume previously established sessions. WSP requests and corresponding responses are binary encoded for transport efficiency.
- The Wireless Transaction Protocol (WTP) is a light-weight transaction-oriented protocol. WTP improves the reliability over underlying datagram services by ensuring the acknowledgement and retransmission of datagrams. WTP has no explicit connection set-up or connection release.
- The Wireless Transport Layer Security (WTLS) provides privacy, data integrity and authentication between applications communicating with the WAP technology. This includes the support of a secure transport service. WTLS provides operations for the establishment and the release of secure connections.
- The Wireless Data Protocol (WDP) is a general datagram service based on underlying low-level bearers. WDP offers a level of service equivalent to the one offered by the Internet User Datagram Protocol (UDP).
- At the bearer-level, the connection may be a circuit-switched connection (as found in GSM networks) or a packet-switched connection (as found in GPRS and UMTS networks). Alternatively, the transport of data may be performed with the Short Message Service.

Interactions between the MMS user agent and the MMSC are carried out over a wireless section and a wired section. The transport of data over the wired section, between the MMSC and the WAP gateway, is performed over the HTTP protocol. On the wireless section, between the MMS user agent and the WAP gateway, the transport is performed over the WSP protocol. In this configuration, the WAP gateway transcodes HTTP requests/responses into equivalent WSP requests/responses, and *vice-versa*. The objective of this network configuration is to optimise the transport of data over the wireless section by transcoding requests/responses into a compact binary format and by performing other transport-level optimisations.

At the low level of the protocol stack, several technologies can be used for the transport of data over the wireless section. The choice of transport technology depends on the user subscription, terminal capabilities/state and network conditions.

C.4 Structure of a multimedia message

A scene description (also known as a message presentation), contained in a multimedia message, organises the way elements should appear over the regions of a graphical layout and defines how elements should be rendered over a common timeline. A scene description allows message objects (sounds, images, etc.) to be rendered by the receiving device in a meaningful order. The scene description of a multimedia message can be adapted to the receiving device capabilities by means of content adaptation. The 3GPP recommends the use of three formats/languages for presentation/scene description: WML, SMIL and XHTML. Note, however, that

[3]The Open Mobile Alliance (OMA) is a recent standardisation body organised as a consolidation of several forums including the WAP Forum. MMS activities of the WAP Forum are currently being integrated to OMA.

SMIL is becoming the *de-facto* format for scene descriptions in MMS and its support is mandatory for release 5 devices accepting scene descriptions.

The Synchronised Multimedia Integration Language (SMIL), pronounced 'smile', is an XML-based language published by the World Wide Web Consortium (W3C). A major version of this language, SMIL 2.0 [15], is organised around a set of modules defining the semantics and syntax of multimedia presentations (for instance, modules are available for the timing and synchronisation, layout and animation, etc.). SMIL is not a codec nor a media format but rather a technology that allows media integration. With SMIL, the rendering of a set of media objects can be synchronised over time and organised dynamically over a predefined graphical layout to form a complete multimedia presentation. SMIL is already supported by a number of commercial tools available for personal computers including RealPlayer G2, Quicktime 4.1 and Internet Explorer (from version 5.5). Because of small device limitations, a subset of SMIL 2.0 features has been identified by the W3C for being supported by devices such as PDAs. This subset, called SMIL basic profile, allows mobile devices to implement some of the most useful SMIL features without having to support the whole set of SMIL 2.0 features. Unfortunately, the SMIL basic profile appeared to be still difficult to implement in first MMS-capable mobile devices. To cope with this difficulty, a group of manufacturers designed an even more limited SMIL profile, known as the MMS SMIL [16], to be supported by early MMS-capable devices. In the meantime, the 3GPP is producing specifications for an extended SMIL profile, known as the packet-switched streaming SMIL profile (PSS SMIL profile), that is to become the future standard profile for all MMS-capable devices. The MMS SMIL is an interim *de-facto* profile until devices can efficiently supports the PSS SMIL profile. The PSS SMIL profile is still a subset of SMIL 2.0 features and a superset of SMIL basic profile and is published in [17]. With existing implementations, message sizes can range from few bytes to a maximum of 100 Kbytes. However, in order to guarantee mobile device interoperability between mobile devices, a maximum message size of 30 Kbytes is often recommended [16].

C.5 Commercial availability of MMS

Telenor was the first operator to launch MMS in Norway in March 2002. This initiative was followed in Germany by D2 Vodafone in April 2002 and in the United Kingdom by T-Mobile UK in May 2002. In addition, Telecom Italia Mobiles launched the service in May 2002 in Italy, Swisscom in June 2002 in Switzerland and T-Mobile Germany/Austria during the summer 2002. Other major operators such as France Telecom, Telia, Telefonica Moviles, mmO2, Vodafone UK are expected to launch the service by the end of 2002. Industry analysts expect a significant market impact from MMS around 2003 with the support of MMS in the mid-to-lower price range. The adoption of MMS by the mass market is expected around 2004/2005.

Conclusions

This article has presented the roadmap of mobile messaging services from SMS to MMS. Commercially, SMS has been a very successful service but its use shows early signs of reaching a plateau in the near future. Application-level extensions of SMS exist in the form of EMS for the exchange of messages containing rich media content. A major milestone for mobile messaging is happening now with the recent introduction of MMS on the mobile market. MMS intends to offer a full multimedia messaging service to mobile subscribers. MMS is ideally scaled for exchanging pictures and videos in an interoperable environment. In the coming years, MMS should open a wide range of new business opportunities for content providers, network operators and application developers.

References

[1] G. Le Bodic, Mobile Messaging, technologies and services, John Wiley & Sons, 2002.

[2] Technical Spec. 23.040, Technical Realisation of the Short Message Service, 3rd Generation Partnership Project.

[3] G. Peersman, S. Cvetkovic, P. Griffiths and H. Spear, The Global System for Mobile Communications - Short Message Service, IEEE Personal Communications pp.15-23, June 2000.

[4] Technical Spec. 23.041, Technical Realisation of the Cell Broadcast Service, 3rd Generation Partnership Project.

[5] Technical Spec. 23.038, Alphabets and language-specific information, 3rd Generation Partnership Project.

[6] ISO/IEC 10646-1 Universal multiple-Octet Coded Character Set (UCS), 1993.

[7] Technical spec. 22.140, Multimedia Messaging Service - stage 1, 3rd Generation Partnership Project.

[8] Technical spec. 23.140, Multimedia Messaging Service - stage 2, 3rd Generation Partnership Project.

[9] WAP MMS architecture overview, version 1.0, WAP Forum, April 2001 (reference: WAP-205-MMSArchOverview-20010425-a).

[10]WAP MMS client transactions, version 1.0, WAP Forum, June 2001 (reference: WAP-206-MMSCTR-20010612-a).

[11]WAP MMS encapsulation protocol, version 1.0, WAP Forum, June 2001 (reference: WAP-209-MMSEncapsulation-20010601-a).

[12](draft) WAP MMS architecture overview, version 1.1, WAP Forum, April 2002 (reference: WAP-274-MMS ArchOverview-20020409-d).

[13](draft) WAP MMS client transactions, version 1.1, WAP Forum, April 2002 (reference: WAP-275-MMSCTR-20020410-d).

[14](draft) WAP MMS encapsulation protocol, version 1.1, WAP Forum, April 2001 (reference: WAP-276-MMSEncapsulation-20020409-d).

[15]Synchronised Multimedia Integration Language (SMIL), W3C, (http://www.w3.org/TR/smil20)

[16]MMS conformance document, version 2.0, MMS Interoperability Group, February 2002. Available from Nokia and Ericsson developer support sites at respectively http://www.forum.nokia.com and http://www.ericsson.com/mobilityworld

[17] Technical spec. 26.234, End-to-end transparent streaming service, protocols and codecs, 3rd Generation Partnership Project.

The author of this article has written 'Mobile Messaging Technologies and Services' due to be published in November 2002 by John Wiley & Sons Ltd, 0470 84876 6. For further details, please see http://www.wileyeurope.com

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Transportation Systems

Harvey Glickenstein, Senior Editor

The Mission Valley East Project of the San Diego Trolley is a 5.8-mile extension of the Blue Line east of its present terminal at Mission San Diego to join the Orange Line in La Mesa. It will include two new at-grade stations, one new elevated station, and a new station in a tunnel—the first underground section of the system.

The line is being built in three segments: Grantville, San Diego State University (SDSU), and La Mesa. The Grantville and La Mesa segments started construction early this year. They consist of at grade and elevated portions.

The SDSU segment consists of a ¾-mile tunnel. Since SDSU is located atop a hill, there was a great deal of controversy over how to serve the University. The final decision was to build a tunnel, with a station for SDSU in the tunnel. One fourth of the tunnel will be constructed using the New Austrian Tunneling Method, while the balance will be constructed using the cut-and-cover method.

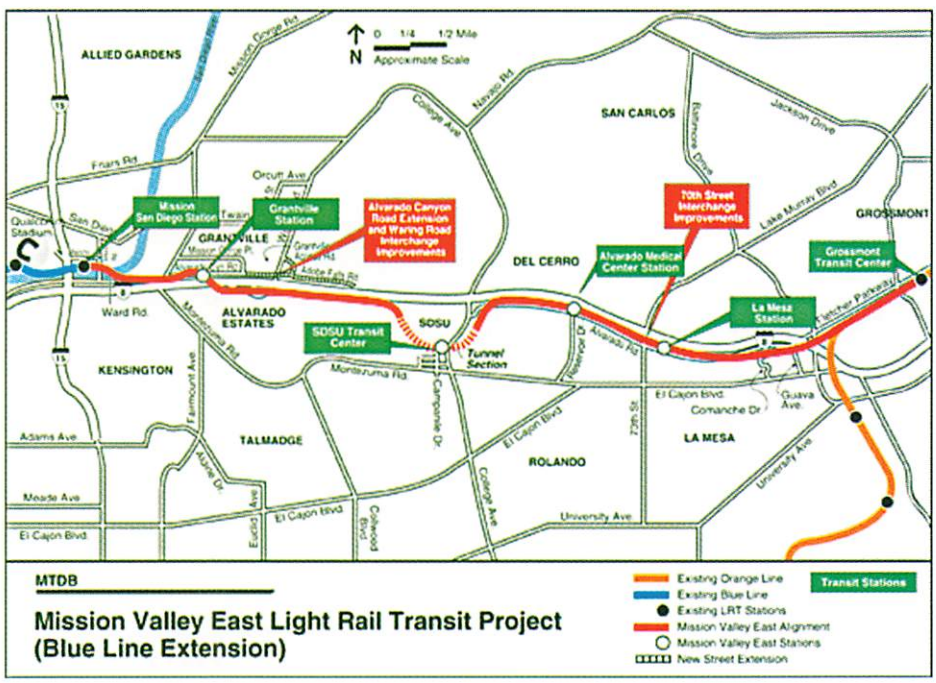
Groundbreaking for the Mission Valley East Project was on November 17, 2000. The project is planned to enter revenue service in late 2004.

The Metropolitan Transportation Authority of New York awarded the R-160 Contract to a partnership of two car builders. Alstom and Kawasaki will share the $962 million contract.

The base contract calls for 660 new heavy rail transit cars for the New York City Transit system. Two options are included in the contract that could raise the total number of cars supplied to 1,040, potentially making this order equal to more than 15% of the entire NYCT fleet.

PICTURE COURTESY OF KAWASAKI

R-143 car

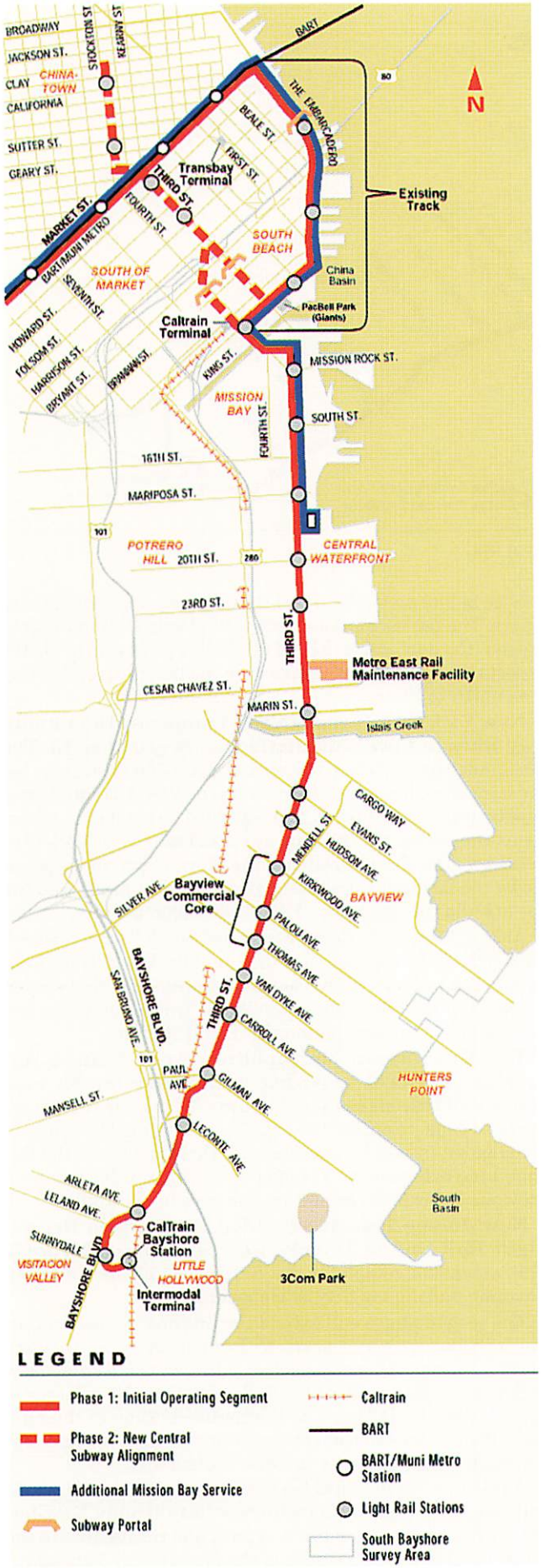


The cars will be supplied in 85 four-car units and 64 five-car units. The base order is scheduled to arrive beginning in 2006.

Alstom will assemble the new cars they are furnishing in Hornell, New York, while Kawasaki will assemble the new cars they are furnishing in Yonkers, New York.

New York City Transit operates cars of different widths on their former IRT (A Division) and former IND-BMT (B Division). The new cars are designed to operate on the B Division, where the car is wider. In order to increase the number of passengers accommodated, these cars will only feature longitudinal seating as in the narrower A Division cars.

Like the R-143 cars, these cars feature longitudinal seating. Older B Division cars provided a mix of longitudinal and transverse seating.



Kawasaki had previously furnished the R-143 cars, with which these cars are intended to be fully operationally compatible.

The Federal Transit Administration (FTA) has authorized the San Francisco Municipal Railway (Muni) to start preliminary engineering for their Central Subway Project. This project is Phase 2 of the Third Street Light Rail Project.

Phase 1, which is currently under construction, consists of extending Muni Metro service from the Caltrain commuter rail station at Fourth and King Streets along Fourth Street, Third Street, and Bayshore Boulevard to the Bayshore commuter rail station. This extension is planned to open for revenue service in 2005.

Phase 2 will extend the line north on King and Third Streets and then into a Central Subway beneath Market Street and Stockton to a terminal near Clay Street in Chinatown. Along the way, the line will serve the Moscone Center, Market & Third Streets, and Union Square. Phase 2 is scheduled to enter revenue service in 2011.

St. Louis MetroLink Extension exceeds expectations. The extension of the original light rail system further into St. Clair County, Illinois opened up for revenue service on May 7, 2001. Ridership was originally projected at 10,052 passengers boarding at the combination of all St. Clair County stations each weekday. Between its opening and February 2002, the average number of passengers boarding at these stations was 12,069 each weekday. A further 3.5-mile extension, from Southwestern Illinois College in Belleville, IL to Shiloh-Scott Station is under construction.

The St. Louis County Council approved a Memorandum of Agreement with the Bi-State Development Agency, operator of the MetroLink light rail line, to enable Bi-State to use Proposition M funds for the 8-mile Cross County extension. Final design and property acquisition of the extension is underway. Construction is planned to begin this year, with the extension going into revenue service in late 2005.

The Southeastern Pennsylvania Transportation Authority (SEPTA) has advertised for 104 new electric multiple unit (EMU) commuter cars. The new Silverliner V cars will replace 73 Silverliner II and Silverliner III cars that SEPTA inherited when they took over the commuter rail service from Conrail. The Silverliner I cars have already been retired. The existing Silverliner IV cars, which were built by General Electric, will be retained.

All of the existing SEPTA commuter rail EMU cars have doors only at the ends. A small number of locomotive-hauled cars have center doors in addition to the end doors. The

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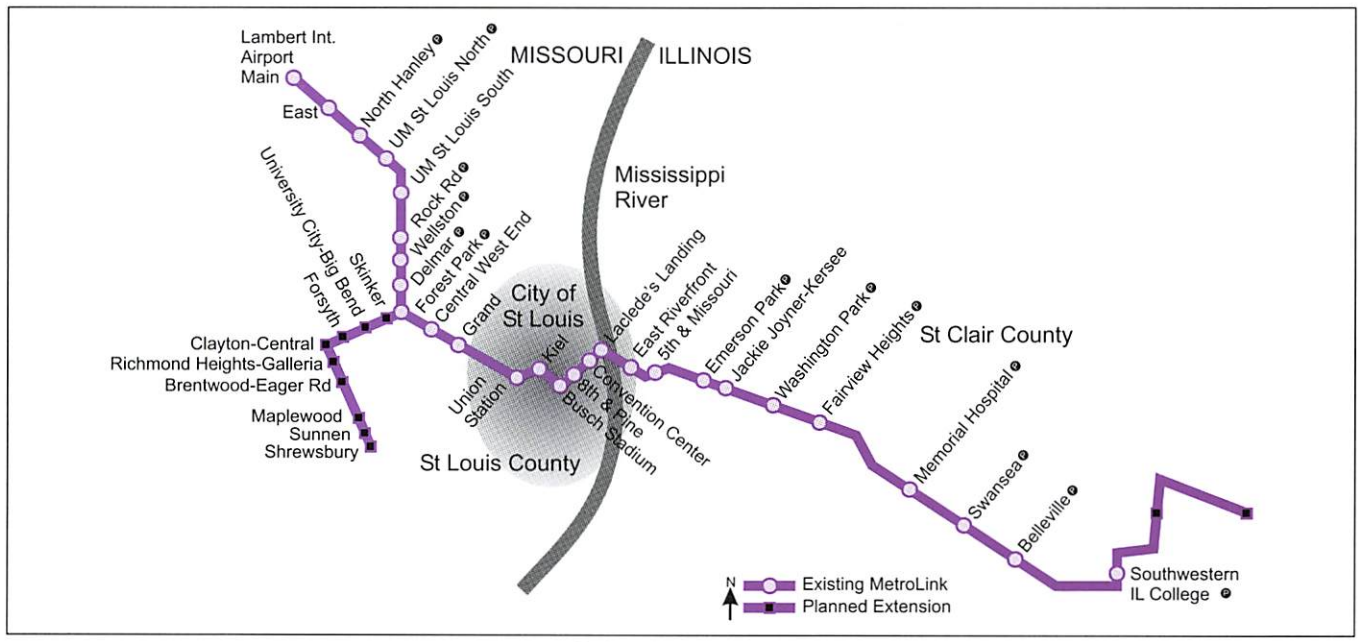
St Louis MetroLink train



St Louis MetroLink

Silverliner V cars will have two sets of double doors located about 1/4 to 1/3 of the way from each end. This will facilitate loading and unloading.

Another unique feature of the Silverliner V cars will be the seating arrangement. In the center of the car, seats will be arranged in a 2+2 arrangement. Between the doors and the ends of the cars, the seats will be arranged in the 3+2 arrangement that is standard on all of the existing SEPTA equipment. There was a strong feeling among passengers that the 3+2 seating in the existing cars is too narrow. SEPTA was not willing to give up the seating capacity by specifying 2+2 seating in the entire car and so they compromised by only specifying 2+2 seating in the center of the cars.

The new cars are planned to enter revenue service in 2006.

Bay Area Rapid Transit (BART) has run a test train over the new extension to the airport. The 9.7-mile extension from the Colma Station is expected to go into revenue service by early next year.

BART put the first segment of its Advanced Automatic Train Control System (AATC) in service on a segment of its Alameda Line on July 15. AATC is an overlay on the primary train control system. It replaces a computer-controlled check in-check out system that was imposed on BART after a train disappeared from the control system due to a track circuit failing to detect the train not too long after the system opened.

AATC, a proprietary system of General Electric Transportation Systems (GETS) Global Signaling, is based on radio positioning technology originally developed by Hughes. It is a true communications based train control system. Train location is received at each wayside controller every half-second and speed control information is transmitted to the train in the same time frame.

In August BART exercised a $23 million option to extend AATC to the next phase. This phase would provide AATC on a 25-mile section from San Leandro and Oakland through the transbay tube into San Francisco.

Dallas Area Rapid Transit (DART) opened seven additional stations on July 1. As a result of the new opening, trains are leaving Richardson with standing room only during the morning rush hour. DART has expanded service before 8:00 AM in an attempt to accommodate more riders. The parking lot at the Galatyn Park Station in Richardson (the new end of the red line) fills up very early. DART expects that problem will ease once the line is extended further north to Plano.

New York City Transit (NYCT) reopened the 1/9 subway lines in lower Manhattan on September 15. The Cortlandt Street, Rector Street, and South Ferry stations became inaccessible due to debris from the World Trade Center penetrating the tunnel. NYCT awarded a contract to reconstruct the portions of the subway tunnel that were blocked in February. The short duration of the contract was made possible by the fact that the same contractor had already won the bid to build the temporary PATH station on the site.

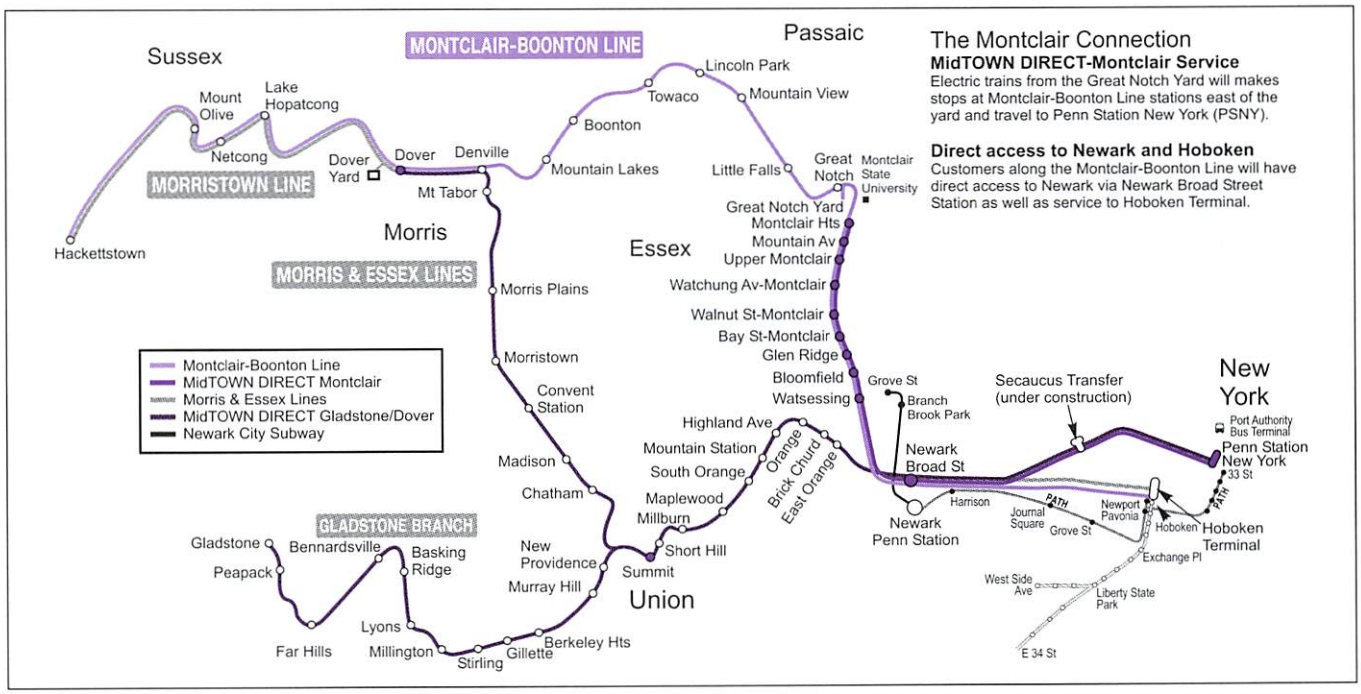
Although service to Rector Street and South Ferry reopened, the Cortlandt Street Station at the site of the World Trade Center was not included in the contract. Reopening of that station will wait for the rebuilding of the World Trade Center site and the opening of the new permanent PATH station.

The Washington Metropolitan Area Transit Authority (WMATA) awarded a contract for 62 new heavy rail transit cars to Alstom. The cars are for use on the Blue Line extension to Largo Town Center. The contract includes an option for another 120 cars for use on the Orange Line extension to Tysons Corner. This order follows a previous order for overhauling 364 cars for WMATA.

New Jersey Transit extended the Hudson Bergen Light Rail line to Hoboken on September 29, 2002. This extension completes the first phase of the line from Bayonne and Jersey City to Hoboken.

The second phase will extend the line one station further south in Bayonne and north to Tonnelle Avenue in North Bergen. The northern extension will use the former New York Central Railroad tunnel at Weehawken, New Jersey to go under the Palisades. The Bergenline station in the middle of the tunnel will open at the same time. Design and construction of this phase is currently underway.

A third phase has also been proposed. This third phase will extend north from Tonnelle Avenue to Tenafly, New Jersey, with a short branch line to a park and ride facility in the Vince Lombardi service area of the New Jersey Turnpike.



MAP COURTESY NJ TRANSIT

Montclair – Boonton Line Area. Former Boonton Line service east of Montclair through to Hoboken not shown as this line no longer has passenger service. Also shown is the Hudson Bergen Light Rail extension to Hoboken

New Jersey Transit officially opened its long-awaited Montclair Connection on September 30, 2002. It connects the present Boonton Line service with the Montclair Branch and extends the electrified Montclair service to Great Notch. The Boonton Line service east of Montclair was abandoned with the opening of the connection.

The connection allows some trains from Great Notch and Montclair to operate through to Penn Station, New York instead of terminating at Hoboken, New Jersey.

The Regional Plan Association originally proposed the Montclair Connection in 1929. At that time the two lines were operated separately by the Erie Railroad and Delaware, Lackawanna & Western Railroad before they merged to form the Erie Lackawanna Railroad. When NJ Transit acquired the commuter rail operation of the Erie Lackawanna Railroad, the plan was resurrected. Actual construction of the connection began in 1999.

The portion of the Boonton Line east of the connection was not acquired by NJ Transit, as the plan for the connection would have eliminated the need for that portion of railroad.

The final portion of the SkyTrain Millennium Line in Vancouver, British Columbia opened August 31. The opening of the final portion of the 11-station line took place only three years from the groundbreaking.

Ten miles of the 12.7-mile line are on elevated structure. The elevated portion took only 18 months to complete.

As described in the May 2002 issue of *VTS News*, the new line will use 40 Mark II cars.

Like the original SkyTrain Line that is still in service, the new line is fully automated. The system uses linear induction motors for propulsion and a communications-based signal system. Similar systems are in service in North America between Toronto and Scarborough, Ontario and in Detroit, Michigan.

The new JFK light rail system that will serve the Jamaica Station of the Long Island Rail Road and New York City Transit and the Howard Beach Station of New York City Transit will use the same basic technology. The portion of the JFK line between Howard Beach and the airport and the portion that will run as an on-airport circulator loop are scheduled to go into service this year. The connection to Jamaica will go into service next year.

JAMES IRVINE

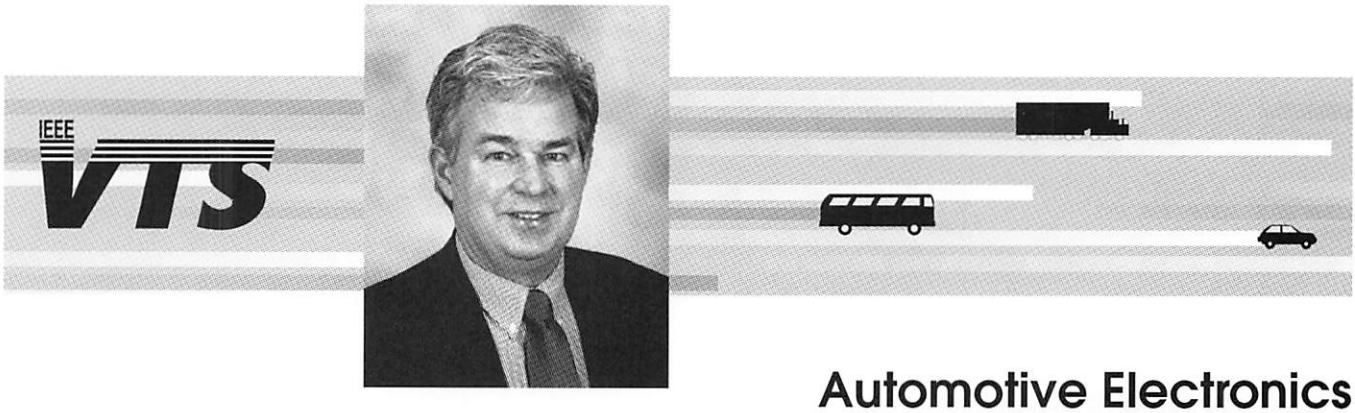
Train of Mark II cars at Commercial Drive, at the end of the new line

A mockup of the new Hiawatha Light Rail Vehicle was displayed at the Minnesota State Fair. The 94-foot long low-floor vehicle accommodates 66 seated passengers, with a crush load of 187. The vehicles are being assembled by Bombardier at their plant in Barre, Vermont.

The light rail line will operate between Minneapolis and the Mall of America. It is scheduled for opening in late 2004.

The European Rail Traffic Management System (ERTMS) will be installed on the new suburban line between Athens and the new airport at Spata. The first 6.2 miles of the 18.5-mile line, from the center of Athens to the city limits, are an existing line that will be upgraded. The rest of the new line from that point to the airport will be new.

The new electrified service is planned to be opened in time for the Olympic Games in the summer of 2004.



Automotive Electronics

Bill Fleming, Senior Editor

TV in the Steering Wheel?

People who want to show off their wealth — which includes pro athletes, rap artists, and urban youths — are installing TVs throughout their luxury cars, and even in the middle of the steering wheel [1]. But TVs, viewable by drivers, are prohibited in 37 U.S. States. Moreover, Federal safety officials think that up to 30% of accidents involve distracted drivers. Steering-wheel-mounted TV therefore is thought to be a big problem from a safety point of view. On the one hand, a clearly proven safety device that will save a life is being removed, and you're putting something in its place that could be distracting.

NHTSA's Federal jurisdiction is limited to new vehicles, while State police in the U.S. govern modifications subsequently made to street vehicles. Owners spend thousands of dollars, adding accessories such as TVs, to make their urban street custom cars more unique. Some custom car builders won't remove air bags to put in TV screens unless the customer signs a waiver saying the car will be used only for auto shows. Customers, such as the rap singer Kaleidaskope, have removed the driver air bag in their Mercedes CL55 and installed a TV. The singer said, "It was all for show, and he rarely drives outside his neighborhood." He adds that, "It makes a statement, it says you're making some serious cheddar (money) [1]."

Update on the Headlight Glare Issue

In February, I noted that, "No other vehicle safety Notice from NHTSA has ever received so many responses from the public as did the headlight glare issue [2]." Federal regulators have since announced that they have a plan for dealing with mounting complaints about high-intensity discharge headlights. New rules will be proposed in the first half of 2003, and rules will be adopted in the second half of the year [3]. The proposed rules will deal with:

- ✦ maximum permissible height of auxiliary lamps
- ✦ light emitted by xenon-gas-filled, high-intensity discharge, headlights (currently used mostly on imported luxury vehicles)
- ✦ brightness of daytime running lights

Attention will especially be paid to the increasing numbers of older drivers who most often are sensitive to glare [3].

New Inventors Inducted into the National Inventors Hall of Fame

Among 16 new inventors recently inducted into the National Inventors Hall of Fame [4], there were two who also contributed to the automotive electronics industry.

- ✦ Nils Bohlin, a retired Volvo engineer, was cited for his invention of the three-point seat belt, where in the U.S., NHTSA credits seat belts with saving 11,000 lives each year. [Note. With today's increasing use of buckle status sensors, belt pretensioners, and force limiters; seat belts are becoming more and more a part of the automotive electronics systems mix].
- ✦ Three researchers from Corning Inc. — Rodney Bagley, Irwin Lachman, and Ronald Lewis — were cited for their invention of a practical exhaust gas catalytic converter. The trio developed a sturdy ceramic substrate that packed the surface area of a football field into a compact metal exhaust canister. A small amount of platinum catalyst embedded in the substrate converts unburned hydrocarbons, carbon monoxide and oxides of nitrogen into water vapor, nitrogen, and carbon dioxide. To date, more than 500 million vehicles have been equipped with converters containing Corning's substrate. [Note. With today's introduction of fast light-off oxidation catalysts, oxides-of-nitrogen trapping converters, along with the traditional three-way catalysts — all governed by electronic engine control and exhaust gas feedback sensors (switching-type O_2 sensors, wide-range O_2 sensors, NO_x sensors, and temperature sensors); catalytic converters are also firmly established as part of the automotive electronics systems mix].

New Ideas from Inventors

The above inventors have all passed the test of time and made the National Inventors Hall of Fame. Here are three inventions that are quite new and may be of interest to our automotive electronics readers.

1. Gentex Corp., Zeeland, MI, patented an automatic high-to-low headlight beam control system, where the headlights are controlled via a vehicle-detecting radar, distance-sensor, using input signals found in present-day Adaptive Cruise Control (ACC) systems [5].

2. Lear Corp., Southfield, MI, patented a speed-limiting system that only allows vehicle speeds appropriate to sensed tire pressure. If, for example, any one of the measured tire pressures is too low, vehicle speed can be reduced by one or more means, including: decreased engine fuel delivery, retarded spark timing, or decreased air flow [6].

3. Gentex Corp., Zeeland, MI, also patented a vehicle rear-view mirror that includes what one might call "the works." Besides the usual electrochromic dimming

control, the mirror assembly includes: headlight high-low beam sensory control, navigation system, tire pressure monitor, ambient temperature sensing and display, vehicle compass and readout, vehicle event data recorder, vehicle odometer verification, and finally in this invention, "a GPS or GLONASS microwave antenna for use in an OnStar or AutoLink telematics system [7]."

Carbon Nanotubes — Ideal Gas Sensors?

According to researchers at Pennsylvania State University, "since carbon nanotubes are essentially all surface; they offer the possibility of creating gas sensors with excellent sensitivity and rapid response times [8]." The sensors consist of the following components:

1. a printed inductor-capacitor resonant passive circuit/antenna, wirelessly coupled to an external monitoring circuit.
2. a protective, electrically insulating SiO_2 coating, deposited over the resonant circuit/antenna.
3. a second layer, composed of a mixture of multiwall carbon nanotubes in a SiO_2 matrix (the SiO_2 physically binds the nanotube material onto the sensor).

When the sensor is exposed to various gases, the relative permittivity ε' and conductivity (proportional to ε'') of the nanotubes vary, changing the resonant frequency of the sensor. Relationships between CO_2, O_2, and NH_3 concentrations vs. sensor output signal are described in [8]. Because the sensors are inductively coupled to remote query electronics, no direct wire connections, or internal batteries, are needed to power the sensors. The authors concluded that nanotube sensors may have application as UEGO (Universal Exhaust Gas Oxygen) sensors for automotive engine control.

Update on Electromagnetic Radiation and Personal Health

In the November 2000 issue of *VTS News*, it was reported that [9], "epidemiological studies **have not found evidence** that cell phone use increases the risk of brain cancer — in fact, the only certain danger from cell phones is that they lead to higher rates of traffic accidents when drivers use them while driving." This year, a scientist at CS Medical Technologies, Great Barrington, MA, reported that, "we have more than enough experimental evidence to question the validity of formulating standards that take only thermal effects into account [10]." The article points out that, "Amid the increasingly dense 'electro-smog,' we're still using outdated and inadequate standards to calculate our exposure to radio and microwaves. Instead of continuing to base our standards on the assumption that nonionizing radiation only affects living cells and tissue via heating, studies of tissue damage mechanisms due to radar or cellphone transmitted pulses that cause precursors (secondary bursts of radiation that occur inside living tissue when the tissue is exposed to pulses) need to be done."

Automotive Electronics and the Hype Cycle

As cited in Paul Hansen's column [11], Gartner Inc. (a firm that tracks global R&D and market trends) defines a Hype Cycle to explain scenarios that often occur after new technologies first come into widespread public awareness. The Hype Cycle consists of the following five stages:

Stage 1. Technology Trigger —new technologies start with a flurry of news releases and stories that wildly exaggerate how quickly markets based on the technology will emerge (this stage typically lasts less than six months)

Stage 2. Peak of Inflated Expectations — peak funding and expectation hype ultimately occur, even in the absence of viable commercial products (this stage lasts briefly, maybe one or two months)

Stage 3. Trough of Disillusionment — the amount of internal and/or external interest and investment will fall due to business reality (this stage happens fast, within a few months, and may linger for years)

Stage 4. Slope of Enlightenment — much hard work brings the technology closer to meeting market realities. During this stage, the technology gradually becomes viable (this stage may take years)

Stage 5. Plateau of Productivity — eventually, commercially viable products will be offered (during this stage, if it's achieved, ultimate product success is obtained and it can last for several years)

Hansen applied the Hype Cycle to some emerging automotive electronics technologies. He also estimated where exactly in the Hype Cycle he believed that each technology fits today. Hansen made the following judgments [11]:

A. **OnStar/General Motors' telematics** was positioned between Stages 2 and 3 because, "It's still losing money, and its hardware doesn't yet exploit the Internet or personal computers."

B. **Advanced telematics**, which does include onboard Internet and computing, was positioned in Stage 3 because, "It currently lacks a killer application, and it also lacks a realistic business model to make this technology inexpensive and/or appealing." Nonetheless, Microsoft recently announced that five automakers (BMW, Citroen, Mitsubishi, Subaru, and Volvo) would use their Windows CE operating system in twelve future car models [12]. It's noted that North American automakers (which don't see Windows CE as a long-term solution) are notably missing from this list.

C. **Automotive Bluetooth's** in-car wireless connectivity was positioned between Stages 3 and 4 because, "It doesn't yet have high-volume applications, and it must overcome the high cost of Bluetooth-enabled phones and the lack of standards." But this technology is definitely emerging from the Trough of Disillusionment. An example of recent progress is Cambridge Silicon Radio's (Richardson, TX) unveiling of an automotive-grade Bluetooth electronics chip [13] that has the processing power to run a hands-free cell phone in an automobile, and the ruggedness to operate in environments ranging from –40 to +85 °C.

D. **Satellite Radio**, offers 100 channels of uninterrupted, coast-to-coast, digital-quality sound, using signals transmitted from 2-to-3 geostationary satellites. This technology can also be positioned between Stages 3 and 4. This is because, "It's costing more than expected, and there is in-car receiver unavailability [14]." However, XM Satellite is faring better than Sirius (both companies are satellite radio providers) because, for the upcoming 2003 model year, XM has secured original equipment pur-

chase agreements from General Motors (twenty-five vehicle models), plus three Honda models [15].

Organic LEDs

Organic Light-Emitting Diodes (OLEDs) consist of layers of organic polymer thin films sandwiched between two conductors. When an electric current is applied; bright, visible, light is emitted. The devices are lightweight, durable, **flexible** (a unique feature), power efficient, and hence ideal for portable and automotive applications. They need fewer process steps and use fewer and cheaper materials than their marketplace rivals, the well-established liquid-crystal displays (LCDs). Organic LEDs are said to be, "perfect for car IP displays [16]."

An obvious feature is that, "Transparent OLED displays can be sandwiched into the front windshield, invisible to the driver unless turned on. They could therefore be used to flash warning information picked up by sensors [17]." Compared to LCDs, Organic LEDs currently also have better quality in terms of color, contrast, and viewing angle; thereby offering higher information content than available from the same-size LCD display. It's predicted that, OLEDs will allow for thinner packages that can be made flush, and thin enough to fit into, for example, a sunvisor. This will open many new locations for storing information [18].

References

[1] E. Eldridge, "TVs In Steering Wheels Raise Safety Concerns," *USA Today*, p.1B; Aug. 13, 2002.

[2] W. Fleming, "Spotlight On Headlight Glare," *IEEE VTS News*, p. 28; Feb. 2002.

[3] H. Stoffer, "Feds Plan Lighting Rules," *Automotive News*, p.14; Aug. 12, 2002.

[4] J. Quinn, "Hall of Fame Report — The Class of 2002," *Invention & Technology,* pp. 6-7; Fall 2002.

[5] J. Stam (Gentex Corp.), "Automatic Headlamp Control System Utilizing Radar And An Optical Sensor," U.S. 6,403,942; issued June 11, 2002.

[6] J. Nantz (Lear Corp.), "Tire Pressure Vehicle Speed Limiting," U.S. 6,434,470; issued Aug. 13, 2002.

[7] R. Turnbull et al. (Gentex Corp.), "Rearview Mirror With Integrated Microwave Receiver," U.S. 6,407,712; issued June 18, 2002.

[8] K. Ong et al., "A Wireless, Passive, Carbon Nanotube-Based Gas Sensor," *IEEE Sensors Journal*, Vol. 2, No. 2, pp. 82-88; April 2002.

[9] W. Fleming, "Cell Phones and Brain Cancer," *IEEE VTS News*, p. 26; Nov. 2000.

[10] R. Kasevich, "Cellphones, Radars, and Health," *IEEE Spectrum*, pp. 15-16; Aug. 2002.

[11] P. Hansen, "Electronics And The Gartner Hype Cycle," *Automotive Industries,* p. 23; Aug. 2002.

[12] C. Murray, "Microsoft Hopes to Rev Poky Telematics Market," *Electronic Engineering Times,* p. 4; July 15, 2002.

[13] C. Murray, "Bluetooth Rolls Toward Deployment In Automobiles," *Electronic Engineering Times,* p. 4; Aug. 26, 2002.

[14] "Satellite Radio Firms Issue Warning," *Associated Press News Release,* two pages; Aug. 15, 2002.

[15] "Honda Deal Lifts XM Satellite Radio Stock," *Washington Post,* one page; Sept. 2, 2002.

[16] P. Savage, "Betting On a New Idea," *IEEE Spectrum*, pp. 63-64; June 2002.

[17] G. Robinson, "Materials Shape View of World," *Electronic Engineering Times,* pp. 56, 74; April 29, 2002.

[18] T. Steding, "OLEDs Lead the Way for Next-Generation Displays," *Auto Interiors,* pp. 22-23; June/July 2002.

Standards

Dennis Bodson, Senior Editor

New Version of DECT DMAP Published

The post DECT (Digital Enhanced Cordless Telecommunications) base standard standardization work has focused on two major streams of standards for a long time: a stream dealing with voice services and a stream dealing with data services.

This has reflected the two major spheres of interest of the DECT community:

- ✦ voice media (transmission of voice over wireless telephone equipment);
- ✦ data related media (transmission of data between wireless PCs, peripherals, etc.)

The main objectives of this interest have been better quality of transmission, avoiding cable installation, the convenience of not being attached to a cable (i.e. personal mobility), the number of accessible services, etc.

With increased user interest in wireless voice media, DECT has proved to be one of the favored technologies to provide wireless telephone terminals providing a great variety of voice services. The basic general voice services that DECT could offer and the requirements to the terminals in regard to provision of such services are described in EN 300 444, the DECT Generic Access Profile (GAP).

With the constantly increasing usage of computers, computer-like devices and peripherals, especially in the home, as users are highly satisfied with wireless voice services, they are turning their attention to the world of wireless data media. The basic general packet oriented data services that

DECT could offer and the requirements to the terminals in regard to provision of such services are described in EN 301 649, the DECT DATA Packet Radio Service (DPRS) Profile. This profile focuses on a Multi Media application solution combining Voice media and Data media services and requirements.

The DECT Application Specific Access Profiles (ASAPs) is a new family of industry-driven standards intended to enhance interoperability. Each of them identifies a specific application scenario and selects a subset of DPRS services plus a voice service for such application.

EN 301 650 DECT Multimedia Access Profile (DMAP), developed for residential / small office - home office applications, was the first of these Application Specific Access Profiles to be ready. DMAP allows for design of low-cost domestic devices for local data interconnection and Internet connection via PSTN/ISDN, which remain compatible with existing Generic Access Profile (GAP) handsets as it includes Voice service as a GAP plus either wireless LAN service and/or wireless V.24 service. The aim of the standard is to guarantee a sufficient level of interoperability and to provide an easy route for the development of DECT DATA applications, with the features of the standard being a common fall-back option available in all compliant to this profile equipment.

The new version of DMAP published recently contains improvements related mainly to interoperability, including Mobility Management (MM) procedures between terminals when supporting GAP and DPRS, namely that no different subscriptions for the voice (GAP) and the data (DPRS) service within one and the same terminal (subscription is related to IPUI/PARK pair only and not to services). The type of underlying MAC bearer service with procedures that do not require U-plane (e.g. MM) is based on the capability supported by the terminals, e.g. a receiving side that supports both GAP and DPRS shall be able to handle MM procedures either on basic or advanced connections.

For a high level guide to DECT Standardization, Technical Report TR 101 178 may be useful. For more information please visit http://www.etsi.org/frameset/home.htm?/pressroom/Previous/2002/ETSI-HYPERACCESS.htm

ETSI Approves HIPERACCESS Core Standards for Broadband Fixed Wireless Access

ETSI Project Broadband Radio Access Networks (EP BRAN) has approved the core technical specifications (i.e. the specifications for the Physical (PHY) Layer and for the Data Link Control (DLC) Layer) for the High Performance Radio Access (HIPERACCESS) standard. The development of the convergence layer for support of different core networks, such as Internet Protocol (IP), Ethernet and Asynchronous Transfer Mode (ATM), will be completed later this year.

HIPERACCESS is an interoperable standard tailored to give broadband access to both the home and small- and medium-sized enterprises, as well as to provide backhaul for mobile systems (e.g. the Universal Mobile Telecommunications System (UMTSTM) and the General Packet Radio Service (GPRS)). HIPERACCESS is a truly broadband system, and supports bit rates of up to approximately 100 Mbit/s.

Mr Jamshid Khun-Jush, Chairman of ETSI Project BRAN, comments: 'The completion of this standard marks a significant milestone in the development of Broadband Fixed Wireless Access. This gives network operators an important tool to offer broadband IP and multimedia services to their customers.'

To ensure the interoperability of HIPERACCESS implementations, the DLC protocol specification is detailed and precise. The key component is the specification of protocol messages in Abstract Syntax Notation 1 (ASN.1). The use of ASN.1 increases the productivity and precision of product development and facilitates future upgrades, allowing even the different protocol versions to interoperate. The behavior specification is given in Specification and Description Language (SDL) models covering more complex protocol aspects. The correctness of the models has been validated with appropriate tools. The .../... 2 models allow for simulations that generate graphical protocol traces. The SDL model can even be seen as a reference implementation of the protocol. To further ensure the interoperability of devices and products produced by different vendors, ETSI Project BRAN is currently developing conformance test specifications, including both radio and protocol testing, which will be completed later this year.

Mr Per Emanuelsson, representing Telia, adds: 'The quality of both the protocol specification and the related test specification will ensure interoperability of products from different vendors, and therefore increase the confidence of operators in their investment in HIPERACCESS products.'

The HIPERACCESS PHY specification (ETSI TS 101 999) is already available on the ETSI web site at http://portal.etsi.org/Portal_Common/home.asp, where the HIPERACCESS system overview (ETSI TR 102 003) can also be found.

IEEE Approves IEEE 802.15.1 Standard for Wireless Personal Area Networks adapted from the Bluetooth® Specification

The Standards Board of the Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA) has approved the IEEE Standard 802.15.1 ("Wireless MAC and PHY Specifications for Wireless Personal Area Networks (WPANs™)", which is adapted from portions of the Bluetooth™ wireless specification. IEEE licensed wireless technology from the Bluetooth SIG, Inc., to adapt and copy a portion of the Bluetooth specification as base material for IEEE Standard 802.15.1-2002. The approved IEEE 802.15.1 standard is fully compatible with the Bluetooth v1.1 specification. Bluetooth technology defines specifications for small-form-factor, low-cost wireless radio communications among notebook computers, personal digital assistants, cellular phones and other portable, handheld devices, and connectivity to the Internet.

"The new standard gives the Bluetooth spec greater validity and support in the market and is an additional resource for those who implement Bluetooth devices," says Ian Gifford, IEEE 802.15 Working Group Vice Chair. "This collaboration is a good example of how a standards development organization and a special industry group (SIG) can work together to improve an industry specification and also create a standard.

Under the agreement between the two, the IEEE brought together a great many experts from around the world to scrutinize and enhance the Bluetooth specification. We received thousands of comments, and the Bluetooth SIG applied more than 300 of them to the original Bluetooth spec." In speaking about the collaboration, Tom Siep, General Manager, Bluetooth SIG, Inc., says: "The peer review process the IEEE-SA brought to bear in standardizing the lower layers of our specification was an invaluable service; it created many changes and additions that improved the

overall document. We appreciate our ongoing relationship with the IEEE-SA."

The IEEE standard also added a major clause on Service Access Points, which includes an LLC/MAC interface for the ISO/IEC 8802-2 LLC, a normative annex that provides a protocol implementation conformance statement (PICS) pro forma, and an informative, high-level behavioral ITU-T Z.100 specification and description language (SDL).

The IEEE-SA also plans to further develop the 802.15.1 SDL model source to support the standard. The SDL code, which will be available on CD-ROM, will include a computer model for use with any SDL tool that supports the SDL-88, SDL-92 or SDL-2000 update of ITU-T Recommendation Z.100. The IEEE 802.15.1 Working Task Group used the SDL to translate the natural language of the Bluetooth Specification into a formal specification that defines how the Bluetooth protocols react to events in the environment that are communicated to a system by signals.

Bluetooth™ wireless technology aims to revolutionize the personal connectivity market by providing freedom from wired connections for portable handheld devices. The Bluetooth SIG is driving development of the technology and bringing it to market. The SIG is comprised of telecommunications, computing, network, and consumer electronics industry leaders and includes Promoter group companies 3Com Corporation, Ericsson Technology Licensing AB, IBM Corporation, Intel Corporation, Agere Systems, Inc, Microsoft Corporation, Motorola Inc., Nokia Corporation, Toshiba Corporation, as well as hundreds of Associate and Adopter member companies.

IEEE 802® Committee Forms New Radio Regulatory Advisory Group

The IEEE 802® Local and Metropolitan Area Networks Standards Committee (LMSC), at its 11-15 March plenary, approved the formation of a new technical advisory group (TAG) dedicated to addressing radio regulations as they impact the committee's groups developing wireless standards. As IEEE 802.11™ (Wireless LANs), IEEE 802.15™ (Wireless Personal Area Networks) and IEEE 802.16™ (Wireless Metropolitan Area Networks) standards gain worldwide acceptance, and as each group continues to address evolving needs of the wireless industry, coordination and knowledge of radio regulations are a vital part of the IEEE 802 LMSC's work.

The overarching objective of the IEEE 802.18 Advisory Group is to act as the 802 radio regulatory expert and interface with national regulatory bodies, such as the U.S. Federal Communications Commission (FCC), as well as with international regulatory bodies, such as the European Conference of Postal and Telecommunications Administrations (CEPT), the Inter-American Telecommunication Commission (CITEL), and the International Telecommunications Union (ITU). Because the group will operate by seeking a balanced consensus position in an open technical environment, its advice is expected to be carefully considered by regulatory bodies.

The IEEE 802 LAN/MAN Local Area Network standards and Metropolitan Area Network standards are the most widely used standards are for the Ethernet, Token Ring, Wireless LAN, Bridging and Virtual Bridged LANs. An individual Working Group provides the focus for each area. More information about each group can be found at http://grouper.ieee.org/groups/802/dots.html.

IEEE Starts Work on Five Standards for Overhead Contact Systems for Light and Heavy Rail, Trolleys

The Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA) Standards Board has approved the start of work on five new standards concerning the overhead contact systems used in heavy rail, light rail and trolley buses. The new standards, sponsored by the Vehicular Technology Society, address insulation, grounding, maintenance, current collectors and support structures. The standard are as follows.

IEEE P1626, "Standard for dc Overhead Contact System Insulation Requirements for Transit Systems," will provide minimum insulation standards to control hazards and improve life cycle costs in the dc overhead contact systems used in heavy and light rail and trolley bus systems.

IEEE P1627, "Standard for Grounding Practices for dc Electrification Overhead Contact Systems, Including Application of Lightning Arrestors for Transit Systems," will define the first set of uniform practices for grounding overhead contact systems and the proper use of lightning arrestors in heavy and light rail and trolley buses. The standard aims to protect passengers, personnel and equipment, reduce maintenance and initial costs, and improve performance.

IEEE P1628, "Recommended Practice for Maintenance for dc Overhead Contact Systems for Transit Systems," will offer the first industry wide guidelines for inspection, testing and other maintenance practices for the overhead contact systems used in heavy and light rail and trolley buses.

IEEE P1629, "Standard for Performance of dc Overhead Current Collectors for Transit Vehicles," will provide minimum acceptable performance requirements for overhead current collectors in heavy and light rail and trolley buses to control hazards, improve performance and reliability, and reduce life cycle cost. The standard will address such areas as collector oscillation, arcing, electrical transients, all-weather operation, the wire-collector interface, and dewirement and entanglement hazards.

IEEE P1630, "Standard for Supporting Structures for dc Overhead Contact Systems for Transit Systems," will be the first suitable standard governing minimum structural requirements for overhead contact system supports for heavy and light rail and trolley buses. It will cover such topics as loading, safety factors and deflection.

References

[1] Sophia-Antipolis, France, ETSI Press Release, May 2002.

[2] IEEE Standards Announcement, June 2002.

[3] Reuters Press Release, March 2002.

Mobile Radio

Javier Gozalvez, Senior Editor

Spectrum Licenses

Ireland's telecoms regulator, ODTR, announced the winners of the country's 3G licenses. Hutchison Whampoa has been awarded the 'A' license due to its strong promotion of competition, MVNO access and quality of service. Vodafone and O2 won 'B' licenses. The 'A' license has more spectrum but requires at least 80% population coverage where as the 'B' license only requires 53% coverage, equivalent to coverage of the five major cities. The 'B' license has also slower minimum roll-out conditions compared with the 'A' license. A third 'B' license has not been awarded. Slovakia's telecoms regulator has awarded its three 3G licenses to Orange, Eurotel and Profinet.sk. The license awarded to Profinet.sk, the only entrant mobile operator in the country, includes as well a GSM license. From the date of the formal license award, Profinet.sk has to launch a GSM service within six months and its 3G service within 30 months. Romania is planning to offer 3G licenses by the end of this year with plans for network launches early in 2005. According to the country's Communications Ministry there will be up to four 15-year licenses available, with the licenses being awarded by beauty contest and a fixed fee of $35 million. Greek Cyprus is planning to auction the country's second GSM license by the end of this year. The new entrant operator and the incumbent CyTA will also be offered a free 3G license if they commit to a launch within 10 years.

Malaysia has awarded just two of its three available 3G licenses. The two licenses were awarded to the country's two biggest telecom firms, Telekom Malaysia and Maxis Communications. The other bidders failed to meet the regulators minimum limits for the license. New Zealand has raised $4.17million in the auction of nine blocks of spectrum in the 3.4 to 3.6GHz band, five blocks in the 24.5 to 26.4GHz band and in the 900MHz band. Provisional winners include Vodafone, TelstraClear, Broadcast Communications and Counties Power. The spectrum will be used for cell phone service, wireless local loop and local multipoint distribution service.

Vodacom has confirmed it has won the country's second GSM license in Mozambique after offering $15million. The operator already operates in South Africa, Tanzania, the Democratic Republic of the Congo and Lesotho.

Chile has awarded additional 2G spectrum to Telefónica Movil and BellSouth Chile through a beauty contest. Telefónica Movil was awarded the 1865-1870, 1945-1950, 1885-1890 and 1965-1970MHz bands whereas BellSouth Chile was allocated the 1890-1895 and 1970-1975MHz bands. Both operators already operate TDMA networks in the 800MHz bands. Telefonica Movil is expected to deploy a GSM network whereas BellSouth Chile should deploy a new CDMA network.

Industry Forecasts and Surveys

According to a new report from In-Stat/MDR, wireless home networking will be the key to adoption of ultra wideband (UWB) in the marketplace. The company expects that UWB will gradually grow its market share in the home market, with the first UWB devices unveiled at next January's Consumer Electronic Show, followed by shipping products by Christmas season 2003. The company anticipates UWB will not comprise more than 5% of the total shipments through 2006.

In a new report, Strategy Analytics revealed it expects that 16million camera phones will be sold worldwide in 2002, growing strongly to 147million in 2007. By comparison, although 22million digital cameras will be sold worldwide in 2002, their slower growth rate of 34% will result in only 95million sales in 2007. The company also predicts that 20% of all cellular handsets sold in 2007 will contain an embedded camera. In Japan, about 5.4million of J-Phone's 12million subscribers now carry camera phones that can be used for its 'sha-mail' service which allows photos to be swapped between phones. According to the Yano Research Institute, camera-phone shipments in Japan will nearly quadruple by next March to 23million.

The firm Frost & Sullivan has said that revenues from wireless games totalled $436.4million in 2001. The company also predicts that steady growth for messaging-based, web-based and downloadable mobile gaming could push total revenues to $9.34billion in 2008. However, the company also warns that in order to realize its full potential companies will have to implement micro-billing systems. Another firm, Ovum, expects the wireless gaming market to grow to $4.4billion in 2006 and In-Stat/MDR sees growth of $2.8billion by 2008. Datamonitor expects the revenues in Asia to top $1.1billion this year, making the area the leader in wireless gaming as it currently accounts for 87% of the global wireless gaming revenues. Digital Bridges has revealed that they have recorded over 10million WAP user sessions in the past 18months on its WAP games. Users have played the company's games for approximately 71.4million minutes in this period.

According to a report from In-Stat/MDR, the total worldwide count of analogue, CDMA, TDMA, GSM, PDC, PHS and UMTS base stations will grow at a Compound Annual Growth Rate (CAGR) of 13.7% through 2006. During this same period, UMTS will lead the growth with 110% with CDMA and GSM expected to come in at a not so very close second and third. The company also expects that in 2006 CDMA will have a 20.8% Share of Market, GSM a 69.2% and

UMTS only a 4%. A report from Dell'Oro Group predicts the Mobility Infrastructure market will return to growth in 2003 due to the first material revenues associated with WCDMA or UMTS systems (nearly $5billion). The company also forecasts the worldwide infrastructure market will reach $34.3billion in 2006. ABI estimates that sales of wireless base stations will be down 15% this year to a total of $17.4billion from $20.3billion in 2001. In terms of wireless handsets, Strategy Analytics expects sales will remain flat in 2002. The firm expects replacement sales to account for over 70% of new handset sales in 2002. On the other hand, In-Stat/MDR forecasts Internet enabled devices shipments will increase from approximately 430million in 2002 to approximately 760million in 2006. The primary drivers of growth will be mobile handsets.

3G News

The European Commission has granted preliminary approval for mmO2 and T-Mobile's 3G network sharing agreements in the UK and Germany. The Commission's analysis of the two deals is that the significant cost savings anticipated from the sharing of network elements should lead to quicker 3G roll-out and services competition, which will benefit consumers, without leading to undue restraints on network competition. These agreements should provide greater network coverage and a more limited environmental impact. The agreement allows companies to share base stations and antennas and also permits them to share radio access networks. Final clearance still depends on regulators considering comments from competitors or other interested parties. The operators have estimated they could save as much as 30% by sharing infrastructure costs. The European Commission has also accepted a report into the European 3G market as a guideline for its position on 3G auctions. The report, "Towards the Full Roll-Out of Third Generation Mobile Communications", notes that the current financial environment constitutes a heavy burden for the communications sector overall, which also affects 3G roll-out plans. The Commission said that, in principle, the 3G licenses should not be changed, but that there should be some flexibility to take into account unpredictable changes of circumstances. In the short term, the national public authorities should speed the physical deployment of 3G networks by harmonising the planning rules for base stations and speeding up the procedures for the acquisition of sites.

mmO2 has announced trial pricing plans for its ongoing test taking place on the Isle of Man. The operator has developed separate pricing plans aimed at businesses, enterprises and consumers. Corporate users will pay $119 for a monthly subscription and 100Mb of data. Pricing for the small business user is about $74 per month for 50Mb of data. Consumers will pay $37 for 20Mb of data. Each plan charges users a small fee for data downloaded beyond the plan's allotment.

According to a new consultation paper from the Radiocommunications Agency, entitled "Implementing Spectrum Trading", the UK government is proposing to allow the 3G license holders to trade their unused radio spectrum, but not until around 2005. The paper also noted that spectrum trading cannot be introduced in the UK until the European Commission Framework Directive has been implemented. The types of trading being proposed include an option to change the use of the radio spectrum. Currently, the UK's license holders are required to use WCDMA but an option to change the use of the spectrum could lead to the introduction of cdma2000 1x EV-DO into the UK as a secondary system, mainly to support roaming users from non-WCDMA countries. The paper can be downloaded from www.radio.gov.uk/topics/spectrum-strat/consult/implementingspectrumtrading.pdf

Telefónica has decided to freeze the activities of its mobile telephone affiliated companies in Germany, Austria, Italy and Switzerland, and at the same time to make write down the value of its 3G licenses and investments by $4.81billion. The company's operation in Germany, trading as Quam, is now planning to scale back its GSM based virtual network and will retain a small core team to keep its 3G preparations ready for when the company restarts its 3G roll-out.

Telia Mobile has signed a framework agreement with Hi3G in Sweden for co-locating 3G operator masts. Telia Mobile had previously reached framework agreements with Orange and Tele2 about co-locating UMTS antennas on Telia Mobile's masts.

Switzerland's telecoms regulator has offered a delay to the 3G license holders enabling them to slow down the rollout of their networks. The regulator has cited the lack of handsets and specific services as the reasons for this delay. The original license conditions had required that the 3G networks covered 20% of the population by the end of this year. In Sweden, Orange has asked the local telecoms regulator for a delay in its 3G network launch by three years and a half. Currently the deadline is set for the end of 2003.

Smartcom of Chile has commercially launched 3G services, based on CDMA2000 1X, in Santiago, Chile. Smartcom has deployed a national wireless network, which includes the 13 areas that make up Chile. Telecom, New Zealand's largest wireless service provider has also launched a CDMA2000 1X network.

Nokia and AT&T Wireless have signed an agreement for the delivery of GSM/GPRS/EDGE radio network systems to enable multimedia applications and high-speed packet-based access to the Mobile Internet. Under the agreement, Nokia will provide its EDGE-capable UltraSite base station solution, its Network Deployment and Care packages, project management and optimisation. This expansion includes markets from the recently acquired AT&T affiliate, TeleCorp, serving Alabama, Iowa, Kentucky, Louisiana, Mississippi, Tennessee, Wisconsin, Puerto Rico and US Virgin Islands, further enhancing AT&T's nationwide footprint.

NTT DoCoMo and its eight regional subsidiaries have announced that they will roll out a dual network service under which FOMA 3G service subscribers will be able to assign the same phone number both to FOMA and PDC (800MHz) phones beginning July 2002. DoCoMo expects the service to encourage conventional PDC users to migrate to FOMA, especially since they can continue to use their PDC phones with the dual network service. DoCoMo's 3G network only added in May just 6.800 new subscribers, giving it a total of 112.300 3G customers. On the other hand KDDI reported 361.600 new 3G customers, giving it a total of 695.700 3G subscribers.

The CDMA Development Group (CDG) and eight wireless vendors signed a Memorandum of Understanding (MoU) for the delivery of CDMA2000 infrastructure and terminal equipment to be used for 2.1 GHz spectrum. Under the MoU, Ericsson, LG Electronics, Lucent Technologies, Motorola, Nortel Networks, Qualcomm, Samsung and ZTE have committed to provide wireless operators with CDMA2000 infrastructure, terminal equipment, or related technology to offer commercial service at 2.1 GHz frequency. Under the terms of the MoU, 2.1 GHz equipment will be

available for customer trial and testing purposes as early as September 2002 and commercially available as early as February 2003. The initial trial equipment will be developed to potentially support the 3G trial efforts of China's Ministry of Information Industries (MII).

The CDG has also announced that there are more than 10 million CDMA2000 subscribers worldwide, accounting for more than 98 percent of the total number of 3G users. CDMA2000 continues to grow, now adding nearly 1.5 million subscribers per month. There are 15 operators in the Americas, Asia and Europe offering 3G services with CDMA2000. CDG has also reported that there were more than 127 million CDMA subscribers at the end of the second quarter of 2002. Over the past year, CDMA subscribers grew by 32 percent, while the CDMA2000 base increased nearly 21 times. The 3G CDMA2000 base has nearly doubled in the past four months and is now growing at a rate of 1.8 million per month. The adoption rate of the technology is especially impressive in Asia: In Korea, 38 percent of subscribers use CDMA2000 technology and in Japan, KDDI has signed on 1.67 million CDMA2000 customers in only five months. KDDI adds on average 10,000 new CDMA2000 subscribers a day, and expects to have seven million, or 40 percent of their base, using 3G services by March 2003. A recent independent equity research report on wireless technologies from Morgan Stanley placed CDMA2000 in the leading position for delivering 3G services. Research conducted for this report was based on real-world operator experiences in Asia, the only region to have commercially available, co-existing 2.5G and 3G technologies including GPRS, W-CDMA, CDMA2000 1X and CDMA2000 1xEV-DO. An executive summary of the report titled "Wireless Technology: Who is ahead?" can be viewed on the CDG's Web site at www.cdg.org

The UMTS Forum has published a new report that predicts global Wireless LAN (WLANs) solutions will add $2.8 billion to the 3G mobile data market by 2005. 'Impact & Opportunity: Public Wireless LANs and 3G Business Revenues', which explores the perceived impact the technology will have on projected UMTS/3G business revenues, finds 3G and WLAN to be complementary rather than competitive technologies that will together strengthen a total mobile data services portfolio. It shows that whilst the direct impact on forecast 3G mobile intranet revenues is likely to be less than 1% of total 3G revenues in 2005, WLAN will stimulate the overall mobile data services market and demand for 3G services - benefiting all industry players.

Another report from The UMTS Forum provides mobile operators and regulators in Central and South America with valuable information relating to the implementation of UMTS/IMT-2000 in the region. Titled "A harmonised frequency solution for early implementation of UMTS/IMT-2000 in Central and South American countries", the new Report (No. 23) includes detailed information on current usage of the frequency bands in the region for public mobile networks below 3 GHz. The Forum encourages operators to benefit from global harmonisation of frequency arrangements for UMTS/IMT-2000 as resolved at the WARC-92 conference as a key element in reducing cost and complexity of IMT-2000 implementation, as well as to facilitate global roaming. The report is available at the web site http://www.umts-forum.org/reports.html.

3G Americas has recommended a set of common preferred elements for terminals and devices supporting the GSM-based evolution to UMTS. An informational document, entitled "3G Americas Terminal Recommendations" and published on its website (www.3gamericas.org), identifies and prioritizes its members' preferences for terminals supporting GSM/GPRS/EDGE and UMTS capabilities. 3G Americas Terminal Recommendations addresses various questions raised by vendors and manufacturers regarding terminal devices in the Americas. Specifically, the terminal document highlights Technology Mode and Frequency, Regulatory Mandates, Adaptive Multi-rate Vocoder (AMR) Support, Modulation, Coding Schemes, Network Selection, Security, Terminal Management, Memory, and other elements.

According to a Mobinet study, while 61% of mobile phone users in 15 countries are aware of the service capabilities associated with 3G, only 29% said they plan to upgrade. The research indicates education campaign about 3G are creating awareness, but 36% of the people that participated in the study cited cost as the most important factor preventing from upgrading to 3G.

Mobile Satellite Communications

Globalstar said it demonstrated a wireless phone that can use the same radio spectrum to connect to both satellite and terrestrial communications networks. The company used Ancillary Terrestrial Component (ATC) technology, a method that allows existing satellite phone spectrum to also be used over dedicated terrestrial networks, with call capacity managed and reallocated, in real-time, between satellite and terrestrial networks via a common control center. Calls can be made over either network using the same phone.

NTT DoCoMo has announced that its third communications satellite, N-STAR c, has been successfully launched by Arianespace, the European transportation company. DoCoMo has been operating two satellites providing WideStar satellite mobile communications services. The third satellite will serve to ensure the continuation of the company's high-quality satellite mobile communications service.

Mobile Phones and Health Concerns

A study published in the August edition of the European Journal of Cancer Prevention found that users of analog mobile phones (NMT 450MHz and 900MHz) showed a 30% increased risk of developing brain tumors. The risk increases to 80% for people using these phones for 10 years or more. The study, conducted by Swedish researchers, did not find a statistically significant increase in brain tumors for users of digital technology or cordless phones within a five-year latency period.

A study conducted by the Institute of Medical and Veterinary Medicine of Adelaide University in Australia found no increase in the cancer rate in genetically engineered cancer prone mice from digital mobile phone emissions. No increase in tumours was also found in normal mice. The mice were exposed to various levels of mobile phone radiation (0.25, 1.0, 2.0 and 4.0 W/Kg) over a two-year period for an hour each day.

Another study by researchers at Washington University School of Medicine in St. Louis also found no significant increase in any tumor type in rats exposed to radiation from cell phones for four hours a day, five days a week for two years. The research also found no differences in weight or life span between exposed and control animals.

US Mobile Market

The Federal Communications Commission (FCC) has adopted its Seventh Annual Report on the state of competition in the Commercial Mobile Radio Service (CMRS) marketplace. The Seventh Report concludes that in the year 2001, the CMRS industry continued to experience increased

competition, subscribership, and innovation as well as lower prices for consumers, and increased diversity of service offerings. During 2001, wireless operators continued to fill in gaps in their national coverage through mergers, acquisitions, license swaps, and joint ventures. In parallel with this process of footprint building, mobile telephone operators continued to deploy their networks in an increasing number of markets, expand their digital networks, and develop innovative pricing plans. The mobile telephony sector experienced continued strong growth and competitive development. In the twelve months ending December 2001, this sector generated over $65 billion in revenues, increased subscribership from 109.5 million to 128.5 million, and produced a nationwide penetration rate of roughly 45%. Broadband PCS carriers and digital SMR providers continued to deploy their networks. To date, 268 million people, or 94 percent of the total U.S. population, live in counties with access to three or more different operators (cellular, broadband PCS, and/or digital SMR providers) offering mobile telephone service. Over 229 million people, or 80 percent of the U.S. population, live in counties with five or more mobile telephone operators. And 151 million people, or 53 percent of the population, live in counties in which six different mobile telephone operators are providing service. Digital technology is now dominant in the mobile telephone sector. At the end of 2001, digital customers made up almost 80 percent of the industry total, up from 72 percent at the end of 2000. During the past year, the mobile data industry continued to grow and to evolve. Estimates of the number of mobile Internet users at the end of 2001 range from approximately 8 to 10 million, up from 2 to 2.5 million at the end of 2000. Since release of the Sixth Report, several mobile telephone carriers have begun upgrading their networks with advanced wireless network technologies, such as cdma 2000 1xRTT and GPRS. As of March 2002, these technologies were available in some portion of U.S. counties covering approximately 181 million people.

The FCC has made significant modifications to Part 22 of its rules that cover the Cellular Radiotelephone and other services. Among the rule changes adopted by the Commission is the amendment of sections 22.901 and 22.933 of FCC rules to modify the requirement that cellular carriers provide analog service compatible with Advanced Mobile Phone Service (AMPS) specifications by establishing a five-year transition period after which the analog standard will not be required, but may still be provided.

The U.S. Department of Commerce has released a plan known as the "3G Viability Assessment" concluding that 90 MHz of radio spectrum can be made available in the future for advanced wireless (third generation or "3G") telecommunications services to meet the anticipated demand for new wireless services. One of the challenges in developing the plan was allocating some of the spectrum currently used by the U.S. Department of Defense without jeopardizing its critical mission of national security. The Viability Assessment is the result of research and analysis conducted by NTIA, the FCC, the Defense Department, and other Executive Branch agencies, which focused on whether the 1710-1770 MHz and 2110-2170 MHz bands could be reallocated for third generation (3G) services. NTIA said the 90 MHz available for 3G services would be made up of 45 MHz from the 1710-1755 MHz band now used exclusively by federal government agencies, including the Department of Defense, and 45 MHz from the 2110-2170 MHz band occupied by non-government users. The 1755-1770 MHz band, also part of the assessment, was concluded not to be a viable home for 3G due to difficulties in sharing with or relocating the incumbent defense systems. Availability of the identified spectrum bands will be accomplished after the bands are substantially cleared of existing users. The Defense Department will relocate certain parts of its systems to other bands no later than December 2008. The cost of relocation by the federal government users will be paid by the private sector entities receiving the reallocated spectrum. The plan is available at www.ntia.doc.gov/ntiahome/threeg/va7222002/3Gva072202web.htm

At the opening of the final day of four public workshops the FCC Spectrum Policy Task Force has convened to seek broad industry, government and public input on spectrum policy issues, FCC Chairman Michael Powell outlined four critical elements for future spectrum policy initiatives: more efficient use of spectrum, shift from a "command and control" model of regulation to market based mechanisms, reconciling critical governmental uses of spectrum with commercial uses and fostering innovation. The workshop topics were: experimental licenses and unlicensed spectrum, interference protection, spectrum efficiency, and spectrum rights and responsibilities. The complete transcript of the four workshops can be accessed from the Spectrum Policy Task Force web site www.fcc.gov/sptf/

The FCC has initiated a proceeding to examine methods to promote the commercial development and growth of spectrum in the 71-76 GHz, 81-86 GHz and 92-95 GHz bands. These bands have never before been occupied by non-government users. Specifically, the FCC seeks comment on its proposed rules to allow use of these spectrum bands for a broad range of new fixed wireless services. Potential uses of this spectrum include high-speed wireless local area networks, broadband access systems for the Internet, point-to-point communications, and point-to-multipoint communications. Additionally, the FCC anticipates that its proposals will encourage the use of technologies developed in military and scientific applications in a broad range of new products and services, such as high-speed wireless local area networks and broadband access systems for the Internet.

The FCC's Office of Engineering and Technology (OET) adopted an Order today establishing a waiver procedure that will permit the continued operation of Ground Penetrating Radar (GPR) devices and wall-imaging devices. Under the new procedure, eligible users may operate under a blanket waiver to Part 15 regulations provided that they register their devices with the Commission. Additionally, the Order clarifies Part 15 of the Commission's rules with regard to the parties that are eligible to operate ultra-wideband systems. GPRs and wall imaging systems may be used only by law enforcement, fire and emergency rescue organizations, by scientific research institutes, by commercial mining companies, and by construction companies. The Order clarifies that GPRs and wall imaging systems may be operated for one of the purposes described in the regulations, but need not be operated directly by one of the described parties.

The FCC has adopted a Fifth Report and Order that sets forth a uniform migration path for General Use and State License public safety channels that will promote the deployment of spectrally efficient equipment in the 764-776 MHz and 794-806 MHz band (700 MHz band).

The FCC has extended the wireless local number portability deadline by one year to November 24, 2003. It will also reduce the burdens otherwise associated with the simultaneous implementation of number portability and thousands-block number porting. The extension also will allow

wireless carriers to guard against any potential network disruptions that might result from simultaneous implementation of thousands-block number pooling and porting.

According to a new report from Technology Business Research (TBR), Cingular Wireless and Sprint PCS are ranked No. 1 and No. 2 in its mobile operator competitive benchmark by profitability and growth, respectively. Leveraging its size advantage, Cingular Wireless is among the most profitable mobile operators in the United States. TBR says that Cingular Wireless's and Verizon Wireless's business models and financial results are evidence that mobile operators can be profitable in an industry constrained by massive debt levels. However, beyond profitability, Cingular is faced with a challenging and complex 3G network upgrade path. TBR believes consolidation for survival will occur in the U.S. mobile operator market during the next 12 months, with at least one major acquisition/merger among the "big-six" U.S. wireless carriers.

Northrop Grumman Information Technology sector and Flarion Technologies have announced that the two companies are working together to promote a homeland security network communications system to government customers. The network will connect local, state and federal emergency agencies using push-to-talk technology. The network would use spectrum already assigned to the US government and could take two years to build. According to Northrop Grumman, it chose OFDM technology from Flarion because it offers higher speeds than other wireless technologies and can more easily be adapted to work with satellite backup systems.

The US Department of Defense is said to introduce rules that will limit the use of wireless devices inside military buildings due to security concerns. The rules will concern cellphones, pagers and hand-held computers by civilian and military personnel.

The Army has awarded Boeing Co's Space & Communications group a $856million contract to produce a radio system that will be part of a wireless communications network allowing soldiers, ground vehicles and aircraft to communicate on a common frequency by linking all of the military's old radio networks.

A new survey from ComScore Media Metrix estimates there are about 10million active wireless Internet users in the US (11% of US wireless users). The study reports that 5.8million of the 67.2million mobile users and 5million of the 19.1million users of handheld computing devices or PDAs utilize wireless Internet.

The Yankee Group estimates that about 3% of US phone users have wireless phones as their only phones. The firm also predicts that 5 to 10% of the US population will use wireless phones only in the next five years, and that more than half of all personal calls will be made on wireless phones by then (from about a third nowadays).

According to a study from Park Associates about 20% of all US households will have a home computer networking solution by 2006, with many of these network being wireless. The firm expects the number of home-based WLANs to grow from 2million at the end of 2002 to nearly 20million by the end of 2006.

In a new report, entitled "U.S. Mobile Worker Forecast and Analysis, 2002-2006", IDC predicts the number of mobile workers in the US will increase by 12.7million between 2001 and 2006, from 92million to 105million.

According to Hop-On, the FCC has approved the company's disposable and recyclable CDMA cellphone. The device is a single-mode digital device that operates in the 800MHz frequency band. It is fully recyclable and will offer a rechargeable battery.

AT&T Wireless has sold wireless licenses in parts of Virginia to Triton PCS Holdings for $65million.

Wireless LAN and Bluetooth

The European Commission is pressing regulators in France, Greece, Italy, Luxembourg and Spain to lift restrictions on the use of WLAN, particularly Wi-Fi networks. Some governments consider the technology as a threat to the success of 3G.

The US Navy will test a WLAN aboard the USS Howard, an Arleigh Burke-class destroyer. The network includes wireless gateways supporting both infrared and 802.11b wireless connectivity. With this network personnel will be allowed to access critical information and instantly communicate with other throughout PDAs, laptops or other hand-held wireless devices.

A new report from Alexander Resources predicts the total market for WLAN services is expected to reach $15billion. The company expects public WLAN hot spots will generate $9.5billion by 2007 with the majority of the revenues coming from business users in airports, hotels and exhibition centers. The research firm In-Stat/MDR has reported that offering WLAN services today will enable mobile operators to experiment with broadband services, to combine them with GPRS and CDMA 1X RTT offerings, and migrate users to WCDMA when it becomes available. According to the firm, in 2006, of the total public WLAN users worldwide, approximately 52% will be paying their service bills to cellular network operators. The Yankee Group's 2001 Corporate Wireless Survey shows that WLAN installations have doubled over the past year, while wide-area wireless data initiatives have stagnated. According to the report, approximately 1million WLAN access points are used by over 700,000 US businesses. The firm In-Stat has reported a 175% increase of WLAN hardware shipments in 2001. The company expects enterprise WLAN shipments to grow 60% in 2002 with end-user revenues growing 7%.

According to a study from IDC, the Bluetooth semiconductor market is expected to reach $2.6billion in revenue by 2006, up from $76.6million in 2001. The study predicts a widespread adoption beginning in 2003. The firm expects cell phones will be the largest segment with 51% of Bluetooth revenues in 2006, followed by headsets, desktop PCs, notebook PCs and accessories. Another study from ABI, 'Bluetooth – The Global Outlook for Bluetooth Component and Equipment Markets', projects Bluetooth chipset shipments to increase to 33.8million in 2002, up from 11.2million in 2001. The company also expects the market will grow to 1.1billion chipsets by 2007 with associated revenues of $2.54billion.

Wireless, PMR and Public Safety

Ericsson and the International Federation of Red Cross and Red Crescent Societies have signed a unique Active Partnership Agreement. Both sides will share equipment, knowledge and volunteer personnel in the field to ensure the speed and effectiveness of disaster response operations. A mutual training and development program is also part of the agreement.

IBM and a group of Government agencies in the Washington D.C. area are building a secure public safety wireless data communications network, the Capital Wireless Integrated Network (CapWIN), that will allow 40 police, fire and safety agencies to communicate in real-time via instant

messaging and access one another's databases. The project, valued at $20million and funded by the federal government, involves building a network that will handle 10.000 users and, according to IBM, will surpass security standards set by the FBI.

More than 70 public safety agencies in 27 US states have reported interference with their communications from Nextel wireless call transmissions. The operator has proposed to segment the 800MHz spectrum band for distinct purposes in order to solve the interference problems. Under the proposal, discrete blocks of spectrum in the band would be allocated to public safety and industrial purposes. The company, that offered $500million towards relocating public safety communications, said the plan would result in more capacity for the agencies. However, this plan has been criticised as it is said it would give the company an additional 16MHz at no cost.

Motorola has announced the introduction of the Fireground Communications System, a new mobile communications product specifically designed for firefighters. The product is designed for deployment at an incident scene and will provide on-scene and in-building radio coverage, and enhanced personnel accountability and monitoring. The system should also include rescue/location tracking capability and a self-contained breathing apparatus. In addition, an integrated evacuation feature allows a commander to wirelessly transmit a signal to all radios on the scene alerting the presence of immediate danger. Motorola will roll-out the system in phases starting in 2003. Motorola has also introduced its AirMobile 3.5 wireless solution designed for allowing users in the law enforcement and public safety communities to quickly and easily manage and transfer large amounts of data to mobile users in the field while preserving the use of their wireless wide area networks. The solution provides users with the ability to encrypt all transmitted data using 256-bit data encryption. The city of Jackson has announced the acceptance of a Motorola wireless mobile data solution, Motorola Premier MDC, for law enforcement officials that incorporates in-vehicle mapping and easy access to the federal National Crime Information Center and local crime information databases using their mobile computers.

Nokia will deliver to Berliner Verkehrsbetriebe (BVG) in Germany what it claims is the first TETRA system with IP backbone. The network will be used, initially, by the Berlin subway. Nokia is using standardized components, which have been implemented many times in GPRS projects. The Finnish manufacturer has also announced that Taiwan's Coast Guard (CGA) has chosen its TETRA solution as the platform for evaluating its future professional mobile radio communication needs, becoming then the first deployment of a TETRA solution in Taiwan. Nokia will provide easy-to-use automatic vehicle location and data enquiry solutions for the CGA's evaluation.

Technology and Research News

BAE SYSTEMS and Roke Manor Research are teaming to develop in depth the concept of CELLphone raDAR - CELLDAR - to provide a revolutionary, totally covert and innovative approach to the detection of moving air, land and sea-based objects, maturing a technology which will significantly enhance military capabilities such as air warfare, littoral operations and Homeland Defense. The two companies have signed an agreement to fund the development of the technology, already developed by Roke Manor Research, exploiting the latter's in-depth knowledge of cellphone technology. The BAE SYSTEMS Future Systems, C4ISR and other business units will be contributing their defense domain knowledge and systems integration expertise. CELLDAR uses extended multi-static radar detection and data processing for the tracking, identification and cueing of objects moving in cellphone fields. The massive world-wide investment in cellphone technology and the ability to exploit the extensive electromagnetic transmission fields created to support them presents the opportunity for CELLDAR to offer high-performance, long-range, low-cost detection of objects moving in space in real time to user communities. CELLDAR utilises the radar frequencies associated with the current mobile telephone transmissions (GSM 900, 1800 and 1900) and future transmissions (3G).

A new security algorithm, known as A5/3, will provide users of GSM mobile phones with an even higher level of protection against eavesdropping than they have already. It will ensure that, even if a prospective attacker manages to pull a GSM phone call out of the radio waves, he will be completely unable to make sense of it, even if he throws massive computing resources at the task. A5/3 has been developed by a joint working party between the GSM Association Security Group and the 3rd Generation Partnership Project (3GPP), for use in GSM systems. It will also be useable for the General Packet Radio Service (GPRS) where it will be known as GEA3, and other GSM modes such as High Speed Circuit Switched Data (HSCSD) and Enhanced Data Rates for GSM Evolution (EDGE). The new algorithm was designed by the Security Algorithms Group of Experts (SAGE) of the European Telecommunications Standards Institute (ETSI), based on a requirements specification produced by 3GPP's Working Group SA3. The development was carried out with the support of the GSM Association, 3GPP and the United States' T1 Standards Committee, sponsored by the Alliance for Telecommunications Industry Solutions (ATIS). A5/3 is based on the Kasumi algorithm, specified by 3GPP for use in 3rd Generation mobile systems as the core of confidentiality and integrity algorithms. Kasumi in turn was derived from the MISTY algorithm, created by Mitsubishi. The defining specifications are publicly available on the 3GPP web site. GSM systems use several security elements, designed to safeguard the interests of the user, network operators and service providers. The A5/3 encryption algorithm specifically supplies signalling protection, so that sensitive information such as telephone numbers is protected over the radio path, and user data protection, to protect voice calls and other user generated data passing over the radio path.

SkyTower/AeroVironment, in collaboration with the Japanese Ministry of Post and Telecommunications (CRL/TAO) and NASA, has successfully completed several telecom tests in Kauai—the world's first commercial applications transmitted from over 60,000 feet in the stratosphere. The two applications tested, HDTV and 3G mobile, further validate the viability of the SkyTower's unmanned High Altitude Platform Station (HAPS) for use by wireless service providers for a broad range of telecommunications applications. The tests were conducted from Pathfinder-Plus, an unmanned solar-electric aircraft developed by AeroVironment, Inc., the parent company of SkyTower. The 3G mobile test demonstrated video telephony using an off-the-shelf NTT DoCoMo handset sold in Japan, and Internet surfing from a wireless modem-equipped laptop at data speeds of up to 384 kbps. The SkyTower platform connects users within its footprint of 30 to 600 miles in diameter to one or two gateway stations on the ground that can be

tied directly into a central switch/fiber optic backbone. According to a company's representative, "small, low-cost, stationary user antennas can be used due to the unique tight turning radius of the aircraft, which makes it appear geostationary from the ground. The platform's closer proximity to earth enables much higher frequency reuse than satellites, resulting in more than 1,000 times the local access capacity compared to a geostationary satellite. Multiple stratospheric platforms can serve the same area, further reusing the same frequency spectrum and multiplying system capacity".

ArrayComm claims that its patented IntelliCell smart-antenna technology improved performance in a GSM base station during a demonstration as it multiplied network capacity by up to 6 times. In addition, the company claims its technology allows to offer clearer calls, fewer dropped calls and higher data rates for cellular users. Through its licensing agreement with AirNet Communications, ArrayComm has integrated its technology into AirNet's AdaptaCell base station. During some AirNet field tests, the adaptive-antenna solution, using a multi-antenna array, demonstrated up to 30dB of improvement in uplink interference rejection, a 5dB gain in delivered power to the user of interest, and 17dB less interference to a co-channel user.

Users of 3rd Generation (3G) mobile systems can expect to benefit from superior interoperability of mobile terminals and other user equipment, thanks to a newly-released set of test suites. These test suites will provide a means of proving the interoperability necessary for global roaming that is one of the key strengths of the next generation mobile networks. Designed by the Technical Specification Group for Terminals (TSG-T) of the 3rd Generation Partnership Project (3GPP), the test suites provide a common platform against which terminal implementations may be tested to ensure that mobiles from different manufacturers behave consistently. The test suites have been developed in a two-stage process by the Terminals Testing working group of TSG-T. The first stage involved a prose specification giving a general description of the purpose and method of each test. The second stage produced a formal description of each test, written in the test language TTCN (Testing and Test Control Notation), which itself is the subject of an international standard, ISO-IEC-9646-3. The TTCN release consists of a number of abstract test suites (ATS), each focussed on testing a different layer or area of the 3GPP communication protocols, together with modules containing common procedures and generic functions. All the suites are designed to run on commercially available test equipment. The latest release of the test suites (Version 1.4.0) is available from the 3GPP web site at www.3gpp.org/ftp/tsg_t/WG1_Test/TSGT1SIG/TTCN_delivery/

The University of Florida has developed a wearable computer system that provides blind users with directions for navigating unfamiliar locations. The prototype system uses global positioning technology, a special database, a Xybernaut wearable computer, voice activation software and either a Motorola iDEN phone or an 802.11b wireless LAN.

3G Americas has published a white paper, entitled "Voice Capacity Enhancements for GSM Evolution to UTMS" and written by independent expert Peter Rysavy of Rysavy Research, concluding that wireless carriers that transform their TDMA networks to the world standard GSM wireless technology can double their voice capacity and even quadruple it with the new Adaptive Multi-rate Codec (AMR). According to the study GSM maximizes capacity to sixteen times that of AMPS using AMR. The paper also indicates

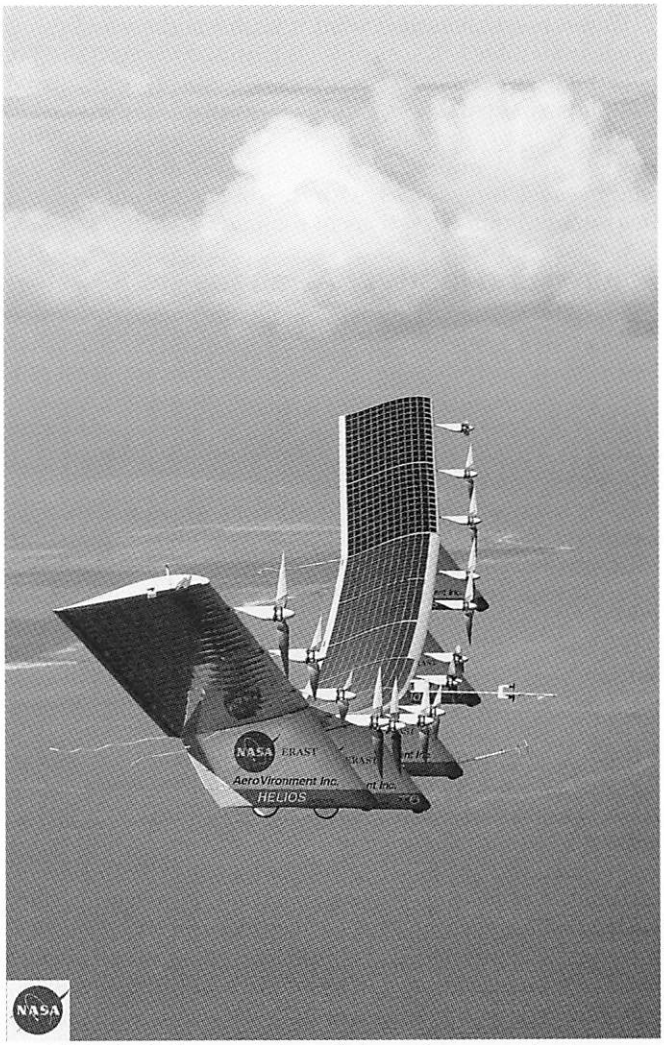


PHOTO BY NASA

NASA's Helios prototype flying wing used for the Skytower tests

that Single Antenna Interference Cancellation (SAIC), still in development, will provide an additional increase of 60-100% in voice capacity.

Siemens has deployed Europe's first commercial GSM Railway (GSM-R) communications network, using a complete radio and infrastructure solution from Nortel Networks, to serve Deutsche Bahn's new InterCity Express high-speed train route between Frankfurt and Cologne. The network includes 56 base stations along the 177km route. The network provides integrated voice and data communications between conductors and crew, dispatchers, operation managers, and train stations.

Scotland-based Applied Generics has announced it will a system in the UK and Sweden that uses cellphones signals to base stations to plot the location of traffic jams by monitoring hundreds of cellphones signals to base stations.

The Israeli firm, ControlID, has launched a cellphone operated security gate system that uses a cellphone to open and close gates. The user has to simply dial a normal phone number to open the gate. Since the system uses Caller ID to verify the caller's identity, only authorised users are able to open the gate. The system uses GSM technology and it has been designed to work on the 900, 1800 and 1900MHz frequency bands. The system also offers the option of SMS messaging to generate a log to record all activities.

Wavecom has launched what it claims is the world's first quadband GSM/GPRS module, WISMO, covering the 850, 900, 1800 and 1900MHz frequency bands. The quadband module is expected to be commercially available in early 2003.

According to a set of tests recently run by NASA and the British Civil Aviation Authority, ultrawideband systems are said to cause interference with the collision-avoidance and instrument-landing systems in commercial airliners.

Forums and Industry Alliances

Nearly 200 of the world's leading mobile operators, device and network suppliers, information technology companies and content providers have announced the formation of a new, global organization called the Open Mobile Alliance (OMA). Members of the alliance include Nokia, Qualcomm, Motorola, Vodafone, NTT DoCoMo, Microsoft and Intel. The OMA will deliver open standards for the mobile industry, helping to create interoperable services which work across countries, operators and mobile terminals and are driven by user's needs. The OMA includes all key elements of the wireless value chain. Examples of key applications on which OMA focuses include browsing, messaging and content download. The Open Mobile Architecture initiative and WAP Forum have joined to form the foundation for this new organization while the Location Interoperability Forum (LIF), MMS Interoperability Group (MMS-IOP), SyncML Initiative and Wireless Village Initiative, through MoUs, have announced their intent to consolidate the OMA. More information on this initiative can be found at www.openmobilealliance.org

The CDMA Development Group has signed joint membership agreements with Cellular Telecommunications and Internet Association (CTIA), Latin American Wireless Industry Association (Alacel), and an MoU with Association of Telecommunications Enterprises of the Andean Community (ASETA). CDG is a non profit trade association formed to foster the worldwide development, implementation and use of cdmaOne and CDMA2000.

AT&T Wireless and Microsoft have formed a strategic alliance in which the US carrier will offer a series of devices based on Microsoft's Pocket PC platform and mobile data services via Microsoft's Net platform to consumers and enterprise subscribers. The deal also includes using Microsoft's Net technology for the carrier's location-based services.

Nine companies, including Motorola, Samsung, Philips, Eastman Kodak and Hewlett-Packard, have formed an alliance to develop a certificate program dedicated to the widespread adoption of wireless imaging and multimedia devices and applications. The WiMedia Alliance will initially focus on the IEEE 802.15.3 draft standard being developed for the 2.4GHz spectrum.

IBM and Nokia have announced an agreement on digital content delivery for mobile applications and services. The two companies will provide wireless operators and service providers with a complete solution for content management and delivery. They have also agreed to collaborate on secure content delivery solutions, including digital rights management, according to industry-wide open standards and specifications.

Nokia and the Korean Game Development & Promotion Institute (KGDI) have announced the signing of an agreement of mutual support for the development and deployment of Korean digital content for mobile communications. As part of the cooperation, Nokia will gain access to the mobile game technologies and content being created through the support of KGDI.

Wireless Data

NTT DoCoMo, Telefónica Móviles and Telefónica Móviles España have announced an agreement under which i-mode will be launched in Spain in the first half of 2003. DoCoMo will provide patents, know-how and technologies needed by the Spanish operator to offer the i-mode on its GPRS network in Spain. The pact will remain valid for five years. KPN Mobile, which has already launched i-mode in Germany and The Netherlands, has announced that it has passed the milestone of 100.000 i-mode customers, with 77.000 of them corresponding to Germany.

China Unicom and Qualcomm have announced that they have signed a definitive agreement under which China Unicom will commercially launch over its CDMA network a new wireless application service based on Qualcomm's Binary Runtime Environment for Wireless (BREW) solution by the end of 2002. China Unicom's wireless customers will be able to personalize their BREW-enabled mobile phones by downloading the applications they want and need using the BREW platform. Separately, China Unicom and Qualcomm have also made plans to establish a joint venture in China to foster a domestic BREW developer community and manage the BREW applications produced by this development community. Qualcomm's BREW platform is a thin application execution environment that provides an open, standard platform for wireless devices. The BREW platform is part of a complete, end-to-end solution for wireless applications development, device configuration, application distribution, and billing and payment. Qualcomm has also announced that more than one million end users around the world have purchased and activated BREW-enabled handsets since November 2001. Three carriers are currently offering wireless applications for Qualcomm's BREW platform. South Korean operator KTF was the first to launch BREW-enabled services in mid-November 2001. KDDI in Japan and Verizon Wireless in the United States followed, launching wireless data applications via the BREW platform in March 2002.

The progress of mobile commerce is being accelerated with the establishment of a new Specialist Task Force (STF) by the European Telecommunications Standards Institute (ETSI). The STF will support the work of ETSI Project M-Commerce in the development of mobile-signatures, which will be used to authenticate the identity of a person doing business on a mobile telephone. The main aim of this STF is to define a precise architecture, protocols between service providers and signature gateway, and general security requirements to achieve interoperability between entities involved in the mobile signature architecture.

Other News

Auburn University in Alabama has become the first school in the US to offer a four-year bachelor's degree in the study of wireless technology. Wireless companies Verizon, Nortel, Ericsson, Nokia, Motorola and Vodafone all sit on the program's advisory board.

According to a report from O´Melveny Consulting and the San Diego Regional Technology Alliance, California has emerged as the center of the US wireless communications industry with almost twice as many workers in the sector as Texas, its nearest rival. The state hosts more than 2.000 wireless companies and has more than 60.000 wireless-sector workers.

3G Americas has announced that global TDMA and GSM subscribers reached 763.2million as of March 31, 2002 and the milestone 100million global TDMA subscribers was attained in May 2002 according to EMC. GSM is currently

growing at an annual rate of 42.37%. The organisation also claims GSM is the fastest growing wireless technology in Latin America from July 2001 to June 2002 with a 59% year-over-year growth rate. During the same time TDMA saw a 36% annual growth in the region.

NTT DoCoMo and eight regional subsidiaries have announced that they will established a not-for-profit Mobile Communications Fund. The purpose of the philanthropic fund is to contribute to the world community by: encouraging research and human resource development in the fields of Internet and mobile communications; and by improving human welfare in all countries. DoCoMo has also unveiled its Digital Library containing collections of digital materials about the development and spread of mobile communications technology. Unfortunately the library is only available in Japanese at the web site www.digital-lib.nttdocomo.co.jp/

The governments of North and South Korea are to co-operate on developing a mobile phone network in North Korea. The current plan involves building a CDMA network.

The UK's telecom regulator, Oftel, has said that for the first time mobile usage among UK adults showed no growth over the past quarter.

VTC2003-Spring Date Change

To avoid any travel difficulties over Easter, the dates of VTC2003-Spring in Jeju, Korea have been changed to the 22-25 April 2003. Further details can be found on the conference web site, www.vtc2003spring.org, and a Call for Participation appears on Page 43.

VTS Board of Governors Election Results

This year's ballot for IEEE VTS Board of Governors election saw nine candidates run for the five positions which fall vacant this year. This year's successful candidates were:

Mark Ehsani
James Irvine
Roger D. Madden
Thomas N. Rubinstein
James Worsham

Thomas N. Rubinstein, currently webmaster and responsible for conference site selection, and James Worsham, responsible for conference finance, are existing members of the Board.

Roger Madden, while not currently a Board member, is nonetheless an old hand within the Society and has served on the Board a number of times before. He is a past president of the VTS, a role he held in 1979 and 1980.

Mark Ehsani and James Irvine are new to the Board. Mehrdad (Mark) Ehsani has been a professor of Electrical Engineering at Texas A&M University since 1981 and Director of its Texas Applied Power Electronics Center since 1992. He is active within the VTS on the Vehicle Power and Propulsion Committee, which under his chairmanship has been reactivated and is running session of vehicular power and electronics at one of the VTCs each year. James Irvine has been editor of the VTS News for the past three years, and has overseen the development of the newsletter to include more feature articles and color.

The new members replace J. R. Cruz, Anil Kripalani and John Gilsenan as elected Board members. However, J. R. Cruz, as retiring President of the Society, will remain on of the Board of Governors as Junior Past President.

VTS Executive Committee Elections

Elections were also undertaken at the Board of Governors meeting at VTC in Vancouver for the Executive Committee for 2003. There were two nominations for the position of president: Dennis Bodson, currently Executive Vice President and Charles Backof, currently treasurer. Dennis Bodson, who was invited to speak first, spoke for Charles Backof's election and then withdrew his own candidature. Charles Backof was then elected unanimously. The other elections were less dramatic, with Dennis Bodson, Eric Schimmell and Robert Mazolla retaining their positions as Executive Vice President, Vice President Mobile Radio and Vice President Motor Vehicles respectively. Harvey Glickenstein, currently VTS News Senior Editor for Land Transportation, was elected to the position of Vice President Land Transportation.

Vehicle Power and Propulsion Committee

A meeting of the Vehicle Power and Propulsion Committee (VPPC) was held during VTC in Vancouver. The committee has been active recently under Chairman Mark Ehsani and organised four sessions of vehicle power related matters at VTC. The meeting was very successful, attracting 14 members, which rather swamped the committee room. During the meeting, Dr. Abdul Masrur was appointed as Secretary for the VPPC.

Given the success of the Vancouver sessions, and the two sessions organised in Atlantic City last year, it was agreed to target six technical sessions for VTC2003-Fall. Rather than attempting to have its sessions in each semi-annual VTC, the VPPC is targeting 2 days in every Fall VTC to have a vehicle power track.

It was also agreed to pursue the idea of a panel session at VTC2003-Fall, where industry experts could discuss their views. It was felt that this would attract academics working in the area to VPPC. Dr. Juan Balda agreed to organise the panel, around a theme of 'What will the advanced vehicle of the future be?'.

The possibility of a special issue of the Transactions on Vehicular Technology on VPP matters was raised. Mark explained that the editor of the Transactions, Greg Bottomley, was keen on the idea, and in fact had suggested it for this year. However, that was probably too early. It would be better to build up exposure within VTC first. It was agreed to focus on VTC2003-Fall for now, and then work on a special issue.

A number of initiatives were proposed to get new members in the area. The simplest is for the VPPC members to tell their colleagues, and to ask their colleagues tell their colleagues, and so on. It was also proposed to do an exchange of articles between newsletters with the Power Electronics Society, where each promotes the other's membership, as was done with the Antennas and Propagation Society. Other possible targets are the Industry Applications Society, Industrial Electronics Society and the Aerospace Electronics Society. Country representatives in VPPC will spread VTC-VPPC call for papers within their countries. The countries identified were the UK, Sweden, France, Germany and Italy Australia and the US.

IEEE VTS Board of Governor's Meeting, 8 May 2002

The second VTS Board meeting of 2002 was held during VTC2002-Spring in Birmingham. Attendees included Eric Wang, Gordon Stuber, John Gilsenan, Roger Madden, George McClure, James Irvine, J. R. Cruz, Sam McConoughey, Dennis Bodson, Ray Trott, Bob Mazzola, Bob French, Charles Backof, Mohsen Guizani, Tom Rubinstein, Annamalai Annamalai, Yong Soo Cho, Fuchun Zheng, Jae Hong Lee, and Vijay Bhargava

The minutes of the last meeting were approved. The Avant-Garde awardees have not yet been listed in the VTS News, as a complete list has is still being compiled.

Secretary's Report: An information pack for newly elected and appointed board members, as well as chairs and members of VTS committees is being prepared.

Treasurer's Report: Charles Backof explained that he expected some interest income this year. There was a large charge for administration. This is the money which goes to the IEEE centrally in order to cover the IEEE's deficit. Conference income is lower than had been expected, so we are about $44,000 down on the break even budget for this year, but with some belt tightening it should still be possible to break even over the year as a whole. Charles noted the membership fee has remained the same since 1996. The IEEE centrally is pressing for the cost of society membership is to be at least the cost of society administration and the newsletter, i.e., the services all members receive. The VTS had operated for several years on the basis that the surplus from the transactions paid for the newsletter, so that publications as a whole break even. Higher grade membership has been fairly constant in the mid 4000's for a number of years. The member's rate for the transactions is $22 per year. The marginal cost of producing each set of transactions is in fact $25 (for paper and printing). This does not include the setup costs for typesetting, etc., which are fixed. A proposal has come from the Technical Activities Board (TAB) by which members which were not full members (for example students) would not get printed publications, but only receive them in electronic form. Gordon Stuber suggested that we could do this for the VTS News, with only full members receiving a printed version, but James Irvine noted that the since the IEEE charges societies for the use of electronic versions, this charge may be more than the savings which would be generated by reducing the print run, since the society has relatively few student members. However, postage costs also need to be taken into account. A group consisting of Charles Backof, Bob Mazzola and James Irvine will investigate the cost implications of any proposed changes.

President's Report: JR Cruz reported that TAB have had agreed to move from the so-called "blended method" of taxing societies to recover money to cover the deficit generated by IEEE centrally to the "principles method". In the blended method, the charge to the society depends on the society's reserves and the services they receive from the IEEE centrally, whereas under the principles method, only the services, and not the reserves, are charged for. Since the services charge is based on the number of members of society has, this is in effect a charge per member of the society. The move from the blended method to the principles method will be phased in over the next two years. TAB has also agreed that publications material from conferences must be produced in IEEE Xplore compliant format from 2003 onwards. US laws means that the services that the IEEE can provide to members in certain countries which are embargoed by the US must be restricted. The position is explained in the Region 8 newsletter.

Awards: Ray Trott reported on the awards which will be presented this year. It was agreed to change the award for the Chapter of the Year from a certificate to a plague. The Convergence Fellowship will be awarded at VTC in Vancouver, rather than at Convergence.

Board of Governors election slate. After some discussion, a slate of nine names was agreed, subject to confirmation of the willingness of those named to allow their names to go forward.

Tom Rubenstein reported on the **VTS digital library**. With both transactions and proceedings, the cost of producing this was quoted as $83,340 for scanning, and $41,000 for producing CDs and DVDs. Charles Backof asked if there was any way that the cost could be spread by implementing the project in stages, for example scanning from 1988 backwards (the more recent issues are available on Xplore), and doing the conference proceedings as separate project. The scanning charges were quoted as 50 cents per page. James Irvine noted that it may be cheaper to do this elsewhere. It was agreed to look at the options for taking a staged approach and at other scanning options, and revisit the issue at the September meeting, with a view to budgeting this from 2003 onwards.

Conference Management Services: Three proposals had been solicited, and all were quite different in terms of what was included and the costs involved. Given the detail of the proposals, a working group of George, Bob, Tom, and Charles will go through the proposals in detail to make a recommendation for the fall 2005 conference. Gordon Stuber had experience of using IEEE Conference Services for all conference requirements, which therefore forms a fourth option.

Publications Committee: The new web based process was now producing output, and there was a good number of submitted papers. Two new associate editors have been appointed for the transactions. It is currently taking about 18

months from submission to publication. James Irvine, newsletter editor, reported that the remaining authors had been lined up for a complete the series of articles on 3G technologies.

Conference Reports: **VTC2002-Fall**: Vijay reported that 1123 papers had been submitted, with 400 being accepted for oral presentation and 120 accepted for poster presentation. All papers must have one full registration. The tutorials had been interleaved with the sessions rather than being held on a single day to allow participants to take part in more than one. Postcards will be going out for the next couple of weeks to advertise a conference.

VTC2003-Spring: Jae H. Lee reported that the Call for Papers was out and a bank account had been opened. They are budgeting for 600 attendees, 300 of whom being students. Professor Lee went through the budget in some detail. A system called "e-conference" will be used for the conference proceedings. JR Cruz noted that this must be compatible with IEEE Xplore or the society will be charged for amending the papers. Rooms have been set aside at a number of local hotels with different rates, and web site was opened at the end of February.

Preston Jackson reported on **VTC2002-Spring**. There had been 438 pre-registrations with another 20 on-site registrations. 216 had been full registrations and more than half – 238 – had been students. The tutorials had been well attended (138 participants) and the conference is expected to break even.

Jim Worsham reported on **past conferences** by speaker phone. Regarding VTC2001-Spring, the conference organising company has requested additional funds for the expenses of moving the conference from Israel to Rhodes, but had not provided supporting evidence requested by the IEEE. For VTC2001-Fall, closeout was proceeding well, and auditors should be available after the income tax season. They are expecting about a $35,000 surplus.

VTC2003-Fall: Conference chair Moshen Guizani reported that a contract had been signed with the hotel, for which they have got a very good deal, and the hotel was near (2 miles) the Disney attractions. The room rate has been negotiated down to $125. While a domain name had been obtained, the web site was not active yet. Dr Robert Lucky had been secured as a keynote speaker. The Technical Programme Committee Chair and Co-chairs have been appointed, and the new standard VTC logo will be used for the conference in line with policy.

Fuchun Zheng, Associate Professor, Victoria University of Technology, Melbourne, Australia, gave a detailed presentation on the proposal to hold VTC2006 in Melbourne, Australia. The details of this proposal will be considered and the board will revisit the issue and vote on it at the September meeting.

VTC2004-Fall: Tom Rubinstein reported that the Los Angeles chapter is currently preparing a proposal to host this conference.

Convergence Fellowship: Bob Mazzola reported that the winner has been selected and the award will be presented at VTC in Vancouver.

Dan Noble Fellowship: Charles Backof reported that the person in Motorola responsible for university liaison is taking over responsibility for chairing this process. The selection should be made in August.

Fellows Committee: Gordon Stuber reported that nine applications for fellow were being considered, and that the reviews were due in June.

John Gilsenan reported that IEEE USA has established a transportation committee. Anyone interested should get in touch with him.

Membership Development: George McClure proposed that the VTS should prepare a brochure and poster advertising the society. This was agreed. It was also agreed to prepare standard half, full and two page adverts which would be available for publications, such as the VTC programme, to advertise the society.

George also reported that the L31 form which reports on chapter meetings can be submitted electronically. John Gilsenan will assist George in developing a chapter handbook tailored to the needs of the VTS. It was also agreed to develop a media contact list.

Some time was spent updating the VTS organisational chart, which in some places has become quite dated.

Bob French reported that the **ITS Council** president is promoting the formation of chapters as a step in the direction of moving towards becoming a society, although currently this is an individual initiative and not something the Council was pursuing. There are potential conflicts with the societies forming the Council and their chapters.

The next meeting will be held during VTC2003-Fall in Vancouver on 27 September 2002. Those attending were reminded that travel to Vancouver may be cheaper via Seattle, taking advantage of the Amtrak train through the Cascades.

Calls for Papers

2003 IEEE/ASME Joint Rail Conference

Chicago, IL April 22-24, 2003

The increased use of Amtrak in the wake of the September 11th terrorist attacks highlights the demand for a national system of high-speed passenger rail services as an alternative to flying in the United States. However, a rail system is no more immune to sabotage than the air system. Security concerns will, no doubt, heavily influence all transportation systems in the future around the world. One year after the event, have we gained more insight into new challenges and opportunities for the rail industry?New applications of technology in the railroad and rail transit industries are presented periodically at conferences and trade shows. The annual IEEE/ASME Joint Rail Conference, sponsored by the Land Transportation Division of the IEEE Vehicular Technology Society and the ASME Rail Transportation Division, offers a unique and comprehensive technical forum. Join your peers to share information, learn about technological progress, and share operating experience at the **2003 Joint Rail Conference, in Chicago, Illinois on April 22 - 24, 2003.**

You are invited to submit papers for presentation and discussion at the Conference. Prizes will be awarded to the top three IEEE papers presented. Papers are

solicited from members of the supply industry, rail transportation corporations and rail transit agencies, governmental agencies, consulting/engineering firms, academia, technical organizations, and others. Papers should cover topics of current interest in system design, hardware/software development, transportation technology, service experience, or related issues. **This year's conference will feature a special theme - *Has the Rail Industry Changed Since 9/11? A Look at the Industry Today.*** Papers in this area are especially appreciated, and may be presented together in a special forum. Other papers of interest are also welcome. Topics may include:

- ✦AC and DC traction propulsion and control systems.
- ✦Electrical power distribution and energy efficiency.
- ✦Communication Based Train Control, and EMI/EMC issues.
- ✦Computer modeling and simulation of transportation systems.
- ✦Monitoring and fault detection, safety and quality assurance programs.
- ✦Rail transportation, high speed passenger rail, rail transit, light rail systems.
- ✦Automated train dispatching, data management systems and control centers.
- ✦Signal and communication systems, automation and microprocessor control.
- ✦Other applications of electrical or electronic technologies in rail transportation.

Authors are requested to submit 200-300 word abstracts by November 15, 2002 to:

Denise Burleson, Papers Chair
3340 Peachtree Road, NE
Suite 2400, Tower Place 100
Atlanta, GA 30326-1087
Phone : (404) 364-2418
Fax : (404) 262-3126
E-Mail:burleson@pbworld.com

- ✦Electronic mail submissions are preferred. If submitting by mail or fax, please forward a diskette copy of your abstract, if possible, using Wordperfect or Microsoft Word format.
- ✦Notification of paper acceptance will be made by November 30, 2002. Selected papers must be submitted in an acceptable electronic format, as instructed, by January 15, 2003 for publication in the Conference Proceedings (CD format).
- ✦Lead author Advanced Registration for the Conference will be required.

VTC2002-Fall in Orlando, Florida

Hyatt Orlando Hotel, 4-9 October 2002

The VTC-2003 Fall Conference, to be held in Orlando, Florida, aims to capture and present the current state of the innovative and highly active mobile wireless industry. We seek to present the changing face of wireless technology and a glimpse in the future of this exciting field. We expect a large number of highly qualified technical papers and posters to be presented, along with tutorials, business application/panel sessions and exhibits. Authors are invited to submit extended abstracts describing original research results, innovative applications, and experimental or field trial/test results in the following, but not limited to:

- ✦**Antennas and Propagation (01)**: Space-time processing, Smart antennas, Channel modeling, Prediction tools, Indoor propagation
- ✦**Wireless Access (02)**: Spread-spectrum technology, OFDM, Multi-carrier modulation, Medium access control protocols, Channel assignment/reservation schemes
- ✦**Transmission Technology (03)**: Modulation, Source/Channel coding, Interference rejection techniques, Equalization, Synchronization, Multi-user detection, Software radio, Transceiver Design, Turbo coding, Transmit diversity, MIMO systems
- ✦**Multimedia, Networks and Systems (04)**: Mobile multimedia technology, Quality of service assurance, Ad-hoc networks, Mobile data/computing/navigation networks, Wireless ATM, Enhanced mobility IP, Bluetooth, IEEE 802.11, Wireless e-commerce
- ✦**Wireless Personal Communication Systems (05)**: 3.5G and 4G Technologies, Broadband mobile communication systems, LMDS, Cellular technology, Bluetooth technology, Location techniques, Systems integration issues
- ✦**Mobile Satellite (06)**: Mobile satellite communications, GPS, LEO/MEO/GEO systems, Navigation
- ✦**Transportation (07)**: Intelligent transportation/vehicle systems, Vehicular electronics

There will also be special sessions on Vehicle Power and propulsion (see page 44).

Technical Paper Submission Guidelines

Authors submit an extended abstract (up to 2 pages) and a short abstract submission (approx. 150 words) for our review. The submission must be made online at www.vtc2003.org and will ask for the name, complete mailing address, telephone and fax numbers, the Technical Subject Area of the paper and the email address of the primary author.

Proposals for Tutorials and Panel sessions are also accepted in the VTC-2003/Fall.

Panel Sessions & Tutorials

Tutorials (half-day or full-day sessions) that are intended to provide in-depth learning on a specific topic of interest to the participants. Panel sessions are 90 minutes long. They present leaders in a particular area discussing a topic of interest to the attendees of VTC-2003/Fall. There is usually significant audience participation in Panel sessions. Proposals for Tutorials and Panel sessions should consist of a 250 word summary, and a 100 word abstract. Summaries should be submitted online by February 15, 2003.

Important Dates

Feb 15, 2003	Last date for submission of abstracts
Apr 15, 2003	Notification of acceptance
July 15, 2003	Last date for submission of camera-ready version of accepted papers

General Chair

Mohsen Guizani,
University of West Florida
mguizani@cs.uwf.edu

Tutorial, Symposia or Panels Chairs

Mohamed Slim Alouini,
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alouini@ece.umn.edu

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Call for Participation

CALL FOR PARTICIPATION

VTC 2003-Spring
JEJU, KOREA
Technology Innovations for a Tetherless Planet
IEEE

The 57th IEEE Semiannual Vehicular Technology Conference

APRIL 22-25, 2003
International Convention Center, Jeju, Korea
http://www.vtc2003spring.org
secretariat@vtc2003spring.org

The VTC 2003-Spring Conference, to be held in Jeju Island, Korea, aims to capture and present the current and innovative ideas to highly active mobile wireless society. Our objective is to provide the state-of-the-art wireless technology and a glimpse for the future of this exciting field both in academia and industries. Over 600 full technical papers and posters are to be presented, along with tutorials and business application/panel sessions. They will show original research results, innovative applications and developments, as well as experimental or field trial/test results in, but are not limited to, fields of wireless communication.

VENUE

Jeju Island is located in the Pacific Ocean just off the south-western tip of the Korean peninsula. Known as a most beautiful island in Korea, Jeju Island is a volcanic island with a mountainous terrain, a dramatic rugged coastline, and spectacular watershed courses. International Convention Center Jeju is located at a most beautiful spot over the coast. Jeju Island has a mild oceanic climate. Average temperature in Jeju Island is 15 degrees and various flowers will be in full bloom in April. Jeju Island is only a one hour flight south of Incheon International Airport and Seoul Airport. There are also direct flights to Jeju from several foreign cities. In Jeju Island an entry wisa is usually not needed for short-term conference attendees and tourists from most countries. Visit our homepage www.vtc2003spring.org for further information.

TECHNICAL AND OTHER TOURS

Korea has launched and is going to launch new wireless services such as cdma2000 1xEV-DO/EV-DV, W-CDMA, and picture services using handsets with a built-in camera which have been demonstrated during the 2002 FIFA World Cup Korea/Japan. Technical tours will be arranged related to these services. Also various excursion programs will be prepared for accompanying persons to visit nearby natural attractions and cultural assets.

Conferences of Interest

The following table shows VT-06 sponsored and co-sponsored conferences as well as related conferences not sponsored by the Society. While every attempt was made to ensure accuracy, you should contact the respective conference committee to confirm date and location.

DATE	CONFERENCE	LOCATION	WEB PAGE	
17-21 November 2002	Globecom 2002	Taipei, Taiwan	http://www.globecom2002.com	
24-26 March 2003	Int. Symp. On Wireless Systems and Networks (ISWSN'03)	Dhahran, Saudi Arabia	http://www.kfupm.edu.sa/ee/ISWNWeb/first_call.htm	
22-24 April 2003	JRC 2003	Chicago, IL	See Page 41	✓
22-25 April 2003	VTC 2003-Spring	Jeju, Korea	http://www.vtc2003spring.org/	
22-25 April 2003	EPMCC2003	Glasgow, Scotland	http://www.epmcc.com	
11-15 May 2003	ICC2003	Anchorage, AK	http://www.icc2003.com	
1-3 June 2003	MobiHoc 2003	Annapolis, MD	http://www.sigmobile.org/mobihoc/2003/	✓
15-18 June 2003	SPAWC2003	Rome, Italy	http:// www.spawc2003.it	✓
15-18 June 2003	IST Summit	Aveiro, Portugal	http://www.mobilesummit2003.org/	✓
23-27 June 2003	APS International Symposium/ URSI Radio Science Meeting	Columbus, OH	http://aps2003.eng.ohio-state.edu/	✓
17-19 September 2003	MC-SS 2003	Oberpfaffenhofen, Germany	http://www.dlr.de/kn/kn-s/mcss2003	✓
Fall 2003	VTC 2003-Fall	Lake Buena Vista, FL	http://www.vtc2003.org	✓
1-5 December 2003	Globecom 2003	San Francisco, CA	mailto:GLO2003C@comsoc.org	
Spring 2004	VTC 2004-Spring	Genoa, Italy	mailto:vatalaro@ing.uniroma2.it	
Fall 2004	VTC 2004-Fall	Los Angeles, CA	mailto:Sumner.S.Matsunaga@aero.org	
29 May - 1 June 2005	VTC 2005-Spring	Stockholm, Sweden	mailto:Jens.Zander@radio.kth.se	

Conferences marked '✓' have open calls for papers as of 1 November 2002. This list is based upon the conference calendar at our web site, which is updated more frequently than this list can be. To access it go to the following URL: http://www.vtsociety.org/, then click on "Conference List" in the left frame.

Corrections and additions to this list are most welcome. We are particularly interested in adding listings for Automotive and Transportation conferences. Please send corrections and additions to Tom Rubinstein at t.rubinstein@ieee.org.

Vehicle Power and Propulsion @ VTC2002-Fall

Hyatt Orlando Hotel, 4-9 October 2002

Papers on all aspects of vehicle power and propulsion area are solicited for this conference. Vehicular Technology Conference organizes specialized sessions for this important and growing technical area. The conference is an opportunity for these researchers and authors to meet each other and share new developments and opportunities. Topics of interest include (but are not limited to) those listed below. Proposals for tutorials, in any of these or relate areas are also accepted in VTC-Fall 2003.

- ✦Vehicle power system architectures
- ✦42V vehicle power systems
- ✦Higher voltage vehicle power systems
- ✦Vehicle power electronics
- ✦Vehicle motor drives
- ✦Advanced vehicle electrical loads
- ✦Drive by wire; Brake by wire
- ✦X –by wire
- ✦Electrical power steering
- ✦Vehicle power system dynamics and controls
- ✦Military vehicle power systems and loads
- ✦Electric vehicles
- ✦Hybrid electric vehicles
- ✦Mild hybrid vehicles
- ✦Fuel cell or fuel cell hybrid vehicles
- ✦Engine electrical controls
- ✦Hybrid electric power trains
- ✦Advanced electrical drive trains for rail vehicles
- ✦Rail vehicles
- ✦Multi-wheeled vehicles
- ✦Heavy vehicles
- ✦Starter/generators
- ✦Power management and distribution
- ✦Off-road vehicles
- ✦Automatic Cruise Controls
- ✦Active suspension

Authors MUST submit an extended abstract (up to 2 pages) AND a short abstract (approx. 150 words). Forms for submission are soft copy in MS Word, PDF or PS file formats. The submission must include the name, complete mailing address, telephone and fax numbers, the designation number of the Technical Subject Area of the paper (08 in this case) and the email address of the author(s). Summaries should be submitted electronically (MS Word, PDF or PS) by February 15, 2003 to the VTC2003-Fall web site (see page 42). Submissions for the special sessions should also be submitted to the VPPC committee chair, Professor Mark Ehsani, at ehsani@ee.tamu.edu.