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FEATURES

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An emergency worker uses a TETRA handset. Find out about the Project MESA international standardization effort for PPDR on page 4. (Photo Nokia)

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Foreword

James Irvine, Editor

We live in interesting times. Now that 3G systems are rolling out, and cellular company executives are gaining a few more grey hairs as they watch take up rates, there is an increasing clamour to address the question of what happens next. The timing is right. The fundamental work for 3G systems was started over ten years ago, when 2G systems were at a similar stage to 3G systems are today. However, the intervening period has seen the bursting of the telecoms bubble, and with the increasingly short term view taken in some money markets, there has been a marked reluctance to talk about replacements for 3G, at least until 3G has had a chance to prove itself. Europe has been particularly prone to this concern, much preferring to talk of 'systems beyond 3G' or 'B3G' to keep to message even more obscure, rather than speak of '4G'.

Other countries have not been so reluctant. The Asian market in particular has been looking to 4G to provide new air interfaces with speeds of up to 100Mb/s. However, even here there has been concern at press reports of 4G proposals and test beds with 3G at such an early stage, with journalists being assured that '4G' is the best part of ten years away.

The American view is somewhat different. With 3G deployment at a less advanced stage, there is a need to differentiate

'4G' from what is still a relatively unknown '3G', and this has shifted talk of 4G to short range, high data rate Wi-Fi WLAN networks. With the marketing of wireless laptops based around Intel's Centrino processors driving a large take up of hotpots, a combination of WLAN for high data rates, and 2.5G cellular for ubiquitous connectivity would allow the US to steal a march on the competition and move straight to '4G'.

It is in this context that the IEEE has been widely reported in the press as being in a position to 'standardise' 4G by the end of next year, something which is bound to set the cat amongst the pigeons. The report referred to work on 802.20 (<http://www.ieee802.org/20/>), a new group formed last December to standardise packet-based IP networks with high data rates (1Mb/s and over) in cells of up to 15 kilometers or more, even to mobile users travelling at speeds up to 250 kilometers per hour. The prospect has a much more cellular feel than the short-range 802.11 derivatives or the 802.16e broadband wireless access work targeting low mobility users.

Whether such a short time scale is realistic is open to question. However, even the discussion of a 4G option on the table so quickly could give those cellular company executives more grey hairs.

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For inquiries and orders, see telephone numbers above.

Overview of Project MESA

Roger Day

Earthquakes. Train crashes. Terrorist attacks. Never a day goes by without emergency service and civil defence personnel having to race into action, somewhere in the world. In a special article for VTS News, business technology writer Roger Day met Claire d'Esclercs of European standards agency ETSI to find out what potential 'The MESA Project' has for improving communications at the scene of a disaster.

High-bandwidth, self-healing radio networks

Claire d'Esclercs is a Technical Officer for ETSI, the European Telecommunications Standards Institute. In this position she has responsibility for ETSI's EMTEL initiative (the Emergency Telecommunications coordination group, of which MESA is a member), and also is Technical Officer for Project MESA, which is a joint initiative between ETSI and America's TIA (Telecommunications Industry Association).

So what does MESA stand for?

"MESA is the name of the town in Arizona where our Partnership agreement with the USA was ratified in January 2001. As a group we have the task of defining the next generation of mobile networks for scene-of-incident communications. In what is a truly user-driven environment, national authorities and emergency service bodies from North America and Europe are sitting down to define the type of *ad hoc* radio network which would be instant, robust and scalable enough to deal with anything from a rural motoring accident up to a metropolitan event of the extent of September 11th.

In practical terms – now that all the member organisations have contributed their wishlist for an emergency network – what we are arriving at is a self-establishing, self-healing broadband network operating at specific hot-spots in excess of 2Mbps. This intelligent platform would be shared by police, fire, ambulance, coastguard, civil defence and other bodies so that all participants in a disaster relief project could share information and facilities. Unlike, say, when the ferry Herald of Free Enterprise capsized between mainland Europe and the UK, giving the various emergency services intercommunication issues, Project MESA would deliver a shared local or even wide area radio network."

Scalable rural, local or wide area links

How does that interconnectivity and scalability work in practice?

"The Statement of Requirements we're formulating calls for a 2Mbps network which includes a mobile physical layer based on either IPv6, IPv4 or ATM access. Within that scenario a police car, for example, could instantly establish itself as the communications node for a localised incident.

Other resources entering the area would then automatically form an IP network, with the localised network re-configuring itself as nodes arrived at or left the area.

To complement the MESA terrestrial cellular broadband system and extend that same network from a local to a wide area, the MESA plan also includes broadband satellite systems like INMARSAT, or High Altitude Platform Systems, HAPS – which are suitably equipped airborne platforms – to extend the reach of the network. Thus in the case of an emergency like September 11th – where the impact on the emergency services rippled out to, say, a 100 mile radius within half an hour – all the communicating resources involved would have created an homogenous MESA network merely by being in place and switched on."

You mentioned September 11th a couple of times. What lessons were learned from that disaster?

"I think it's well documented that the public fixed and mobile networks quickly reach saturation when there's an event of that nature. On that day all public network operators in the New York/Washington area (and beyond) reported enormous increases in traffic. This is clear evidence that emergency networks with their specific requirements and need for availability should be distinct from public networks.

In addition, from countless emergencies worldwide, MESA members have also reported that a lack of interconnectivity between land mobile radio (LMR), the PSTN and the Internet have reduced the efficiency of their operations."

From smart ambulances to robotics

What applications do you envisage for MESA?

"Amongst a wide range of technical publications which are freely available from the ETSI and MESA websites (see below), we have published a white paper which runs through a handful of application scenarios. I've already mentioned a police car becoming the first-on-scene node of a rapidly developing ad-hoc network, with a satellite or HAPS extending the reach of the network as required. But sharing that network you could have ambulances equipped with high-bandwidth patient diagnostics applications, transmitting data and even video en route to the hospital.

Similarly, we've envisaged a complete firefighter smart uniform which monitors the wearer's vital signs and also enables control centre staff to receive video and IR-camera feedback from personnel within the building. The MESA network could also deliver a 3D location profile of firefighters working within, say, a high rise building or wide area conflagration.

Thanks to its inherent bandwidth and fault tolerance, the homogenous MESA network could also be used to control robotic assets, for example bomb disposal or mine clearing equipment. The end result is that all the resources employed within an event have interconnectivity, no matter which service or which country they come from."

MESA as a developing global standard

You mentioned a global standard. But isn't MESA confined to North American and European partners?

"Not at all. With representatives such as the FBI, the UK Home Office, America's National Telecommunications and Information Administration and the Royal Canadian Mounted Police, it's certainly true that the significant majority of MESA members are currently from those two continents. But both TIA and ETSI want MESA to become a global standard. It's against the philosophy of the initiative if, for example, MESA networks suddenly stopped at the boundary between the USA and Mexico, or wouldn't enable co-operative emergency relief between Finland and Russia.

That's why we welcome participation from other countries and regions. And the MESA standard is by no means set in stone, so public authorities and manufacturers from around the world are more than welcome to make their voices heard as MESA develops. Although the 'E' in ETSI stands for 'European', that's something of a misnomer as the work we do on a huge range of telecommunications standards has global impact and global participation. For instance, ETSI's TETRA project is a well known worldwide initiative. All in all, ETSI members come from 57

countries ... so the answer to your question is a resounding 'no'. MESA is definitely not aimed at selected markets, nor is it a 'done deal' which new members cannot hope to influence." In fact, now that the current members have finished with the initial phase of imagining the features required in an emergency network, the technical development phase is only just beginning.

Find out more

For technical information on MESA, visit www.projectmesa.org or www.portal.etsi.org/mesa. Email MESAsupport@etsi.org.

For more information about the ETSI Emergency Communications co-ordination group, visit www.emtel.etsi.org.

ETSI - the European Telecommunications Standards Institute - is officially responsible for standardization in telecommunications, broadcasting and certain aspects of information technology within Europe. A non-profit making organization based in Sophia Antipolis, France, ETSI unites nearly 800 members from 57 countries inside and outside Europe, and brings together manufacturers, network operators, administrations, service providers, research bodies and users. For more information: <http://www.etsi.org/>

TIA - the Telecommunications Industry Association - represents the communications sector of the Electronic Industries Alliance. Based in the USA, it is a market-focused forum for 1,000 member companies that manufacture or supply products and services used in global communications. More information at www.tiaonline.org.

Project MESA

Project MESA (Mobility for Emergency and Safety Applications) is an international standardization partnership on mobile broadband technologies for the growing area of PPDR (Public Protection and Disaster Relief). PPDR will form a focus for VTC2004-Fall in Los Angeles. A Final Partnership Agreement for Project MESA was ratified in January, 2001 in the City of Mesa, AZ. The project provides a forum in which key players and users can contribute actively to the elaboration of user requirements (Statements of Requirements, or SoR) and corresponding technical specifications focussed on the advanced needs of the Public Protection (Safety) & Disaster Relief/Response sector (PPDR), such as:

- ◆ Police/Law Enforcement/Anti-terrorism, National and International
- ◆ Advanced Surveillance and Security (Airports, Nuclear Power Plants etc)
- ◆ Emergency and Medical Services (Telemedicine)
- ◆ Advanced Firefighting
- ◆ Civil Defense and Disaster Response, etc.

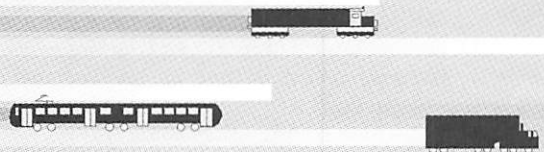
The goal of MESA is the implementation of advanced digital services based on a very high bit-rate mobile platform (over 2 Mb/s). Requirements and services will be defined in the MESA Statement of Requirements (SoR). These requirements include:

- ◆ Ad-hoc mobile and fixed networks/components

- ◆ Mobile and remote communications/sensor/other applications
- ◆ Interoperability/Interworking capabilities
- ◆ Highly secure and robust

A coordinated list of specifications, for Broadband Terrestrial Mobility and SatCom applications and services are being defined, driven by common scenarios, requirements and spectrum allocations. The MESA SoR is the first such document to specifically involve direct user input within an international standardization partnership. It is intended to describe functional and technical specifications and a standards platform. The MESA system could be installed as either a private system owned by the government or a governmental/commercial partnership that provides priority service to public safety agencies and possibly secondary service to other commercial clients. This includes criminal justice services, emergency management, emergency medical services (EMS), fire, land management, natural resource management, military, transportation (i.e., ITS), wildlife management, and other similar governmental functions that have a need for aeronautical and terrestrial, high-speed, broadband, digital, mobile wireless communications.

Documentation from the project is publicly available at www.projectmesa.org



European Perspective on Telematics: Facing New Challenges and Opportunities

Walter Maisel, Siemens VDO Automotive Corporation

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The telematics industry in Europe continues to be shaped and defined by the availability and advancement of numerous technologies, combined with the move toward compatible, open architectures and communications protocols. New issues relative to the human machine interface play an increasing role in forging new telematics products requiring the proper mix of safety and ease of use for cockpit controls. A revolution is now underway in the European telematics market that promises to achieve effective telematics cockpit controls that take into account the special requirements of driving a vehicle. The manner in which telematics information is presented to the driver is as critical to the successful implementation and deployment of telematics products as the telematics services themselves. Also enabling this revolution and shaping the European telematics service provider business model will be the ongoing movement of vehicle data processing to powerful off-board servers that expand the menu of services available to the telematics subscriber.

Introduction

Telematics offers the European consumer entirely new capabilities that enhance and expand safety, security and travel services. Differences in language and culture are now bridged by new technology. With the steady march toward open computing platforms and flexible communications standards, consumer acceptance of telematics will progress steadily. And new cockpit technologies are sure to contribute to a safer and easier driving experience.

The EU Perspective

Because telematics operates in a global industry, it may be helpful to begin our examination of European trends by citing similarities to the other major markets, North America and Japan.

The promise of enhanced safety and security via telematics services is one of the common denominators. Here telematics has introduced unique offerings such as automatic collision notification, actual traffic information and roadside assistance. These features will only expand as vehicle communication systems become more capable and local governments and agencies such as emergency medical services deepen their appreciation of the technology. Tech-

nologies developed for increased safety and security will expand as the entire electrical architecture of cars and trucks becomes much more powerful. As we move toward drive-by-wire systems — and the power generation system moves gradually and in intermediate steps toward a 42-volt future — the ability to add sophisticated telematics technologies will be greatly enhanced. These new electrical architectures may give us the raw power to launch adaptive telematics systems that handle inputs from steering, suspension and drive train systems. By hewing closely to the theme of optimized vehicle safety, but not exclusively of course, the auto industry stays on safe ground with the early stage development of a telematics market. The consumer may, in fact, be much more receptive to telematics services and technology if these are perceived in much the same way as other safety-enhancing vehicle innovations such as night vision, ABS and stability control systems, head-up displays — even run flat tires.

The similarities between Europe and other markets extend to other areas that should be familiar. The build up of intelligent vehicle/intelligent transportation systems will drive more features and capabilities, such as route guidance linked to traffic conditions. The continuing advance in telecommunications technology — although not without its occasional fits and starts — will include the vehicle as an important node on the network linking it to office and home. Will telematics show a growth rate similar to the early stages of the PC or cell phone industry? Probably not, despite the hyper-ventilation of market researchers and stock analysts. But clearly telematics has enormous potential in ways that other new automotive technologies have not had in the past.

What about infotainment, ranging from in-vehicle movies to e-mail downloads to satellite radio? The consumer is in the driver's seat. Will the consumer pay for telematics services at a level that recoups the industry's tremendous development costs and offers a return on investment that makes it all worthwhile? Perhaps a better question might be: Can we as an industry create a compelling enough product and service mix so that the consumer will without question adopt telematics as enthusiastically as other technologies such as the video recorder, Walkman or DVD? That is our challenge.

We know that consumers will tell focus groups and market researchers that they would love to have new technology and all manner of electronics. But we also know from hard experience that getting the consumer to pay for these new marvels is an entirely different matter. The European consumer, in fact, may be more reluctant than a North American or Japanese consumer to take on a monthly obligation from a telematics service provider (TSP). Acceptance of any-

thing beyond basic travel information has, to date, been disappointing. European consumers want telematics made available very cheaply or, picking up a lesson from the Internet, get it for free. If we as an industry priced telematics attractively enough to drive acceptable option or take rates, could we make money at these price points? This is a good question still in search of an answer.

What Makes Europe Different

The similarities are obvious. What makes Europe unique or even a little different from other markets? Obviously, in comparison to the United States and Japan, the European market is much more fragmented by language, nationality and cultural preferences. Creating a one-size-fits-all telematics service, for example, is much more problematic because of the extent of cross-border travel. Thus, drivers of cars and trucks are primarily looking for information that not only makes their commute more manageable, but also their long-distance travels to neighboring countries. Real-time traffic information, enabled by a more extensive ITS network, and simple travel or navigation information services are at the top of the European's telematics menu. This is especially true in major cities with ancient road grids.

In Europe, there is also the advantage of a homogenous digital network in contrast to the United States, with its hodgepodge of digital and analog systems and several competing technologies. Yet, next-generation wireless technologies do not seem to be rolling out in Europe with any more speed or coherence than they are elsewhere. Without a higher-capacity network that can deliver a variety of telematics services over broadband at affordable rates, things will continue to progress very slowly. And there are signs that new investment in early stage wireless companies is falling, no doubt a result of the conflicting technical standards and ongoing uncertainty in the telecom industry.

If we look at the leading TSPs in Europe, both OEM-labeled and independently branded, the emphasis on travel information and navigation is clear. Tegaron, backed by DaimlerChrysler and Deutsche Telekom, is a major provider of traffic, safety and concierge services for owners of Mercedes-Benz, Audi and Renault. Tegaron provides Renault's Odysline navigation information and breakdown service as well as Mercedes' Tele Aid service.

Targa Services, a unit of the Fiat Group, for example offers navigation and concierge services in several languages to owners of Fiat, Alfa Romeo, Lancia and Peugeot. The TargaConnect call center, the company says, will download the requested information to the customer in the vehicle receiver. A menu of concierge services is also available anywhere in Europe.

It should be pointed out that both of these TSPs are also aggressively testing and marketing services that can be received on cell phones and PDAs, the so-called thin client option. This, of course, plays to the strength of many European markets that have high rates of cell phone usage and a culture of personalized, digital communications.

Tegaron is aggressively marketing its navigation service, known as Scout, for use on smart phones and PDAs such as the Compaq iPAQ and Trium Mondo. The PDA sits in a dashboard cradle and can work in any car. You don't need an onboard CD-rom and the service promises dynamic traffic information updated frequently. This is an excellent example of the thin client approach. The service offerings and technology behind them can only get better as the telematics market matures. When Ford Motor Co., PSA

Peugeot Citroen and Renault-Nissan announced earlier this year that they were teaming up to develop new telematics solutions in Europe, it was touted as a partnership that will reduce telematics costs to the end-user and accelerate product introductions. That is good news for the industry.

Despite differences in language and culture, the European telematics market shares many of the same challenges that are ahead for North America and Japan. The value proposition for consumers, weighed heavily with safety and security advantages, needs to be communicated effectively to the market. The convergence of telecommunication and information technology that enabled the initial stages of telematics needs to accelerate through the adoption of compatible, open architectures and common communications protocols. And developing a safe, easy to use Human Machine Interface will be of crucial concern in the near term.

Open Standards: Market Accelerator

Telematics, an industry created by the convergence of telecommunications and information technology, will find widespread market acceptance to the degree that various industry players remove proprietary barriers and enhance information processing capabilities. The development of common communication standards and plug-and-play technology are really non-negotiable requirements for taking telematics to a true mass market driven by consumer demand. Likewise, the onboard processing of data and communications will increasingly move to land based systems, reducing the cost of vehicle hardware and providing a richer menu of service offerings. The thin client solution cited earlier is just one example of how to sync telematics solutions with consumer lifestyles.

Linchpin: The Human-Machine Interface

In Europe, there is also a great deal of interest in ensuring that telematics, which promises the user safety and security, are not provided in an unsafe manner. For several years now, European governments have been studying safety and the Human-Machine Interface (HMI) question. Government involvement in this area is active and growing.

To cite just one example, some 90 members of parliament in the United Kingdom earlier this year called for a ban on handheld mobile phones in vehicles. This followed the release of a report that purported to show that mobile phone use while driving was as dangerous as operating a vehicle while over the legal alcohol limit. Using handheld cell phones while driving a vehicle is already illegal in nine European countries and Turkey. Of course, the same type of ban has been put in place in New York and is under review in dozens of state legislatures in America.

Solving the HMI issue is key to the success of telematics. At Siemens VDO, for example, we've introduced a next-generation head-up display that projects vehicle instrumentation and driver information onto the windshield. This will greatly assist drivers who are coping with greater information loads – partly contributed by telematics – and the growing frequency of distractions while on the road. The average driver requires approximately one second to read information from the instrument cluster – the time it takes to cover 14 meters at a speed of 50 km/h. The HUD cuts this read time in half, while presenting display information in the driver's line of site, on the road ahead.

Our driver information system for the new Mercedes-Benz E Class, following the successful introduction of a similar system for the S Class, was also aimed at

providing the driver enhanced capabilities for handling telematics and other vehicle data. The central information display combines the characteristics of dot matrix and segment display through two display cells. The front cell has 64 light segments that are arranged in a circular manner and allows a graphically perfect arc of a circle for the display of information, such as adaptive cruise control, located within the speedometer dial. Positioned behind this cell is a second layer featuring a customary dot matrix with 120 x 126 pixels that can display in excess of 240 warnings, messages and additional information. The central information display is capable of presenting driver information in seven languages including German, French, English (US/British), Italian, Spanish and Japanese.

At the heart of the instrument cluster is a 32-bit microcontroller to control the bus systems (CAN) gauges and displays. The E Class combines the variable dialog window with steering wheel remote control of all functions of the radio, telematics services, communication and naviga-

tion. Using common icons, it provides the driver with a wide variety of important information, such as navigation, tire pressure warnings, and the pneumatic state of the vehicle's shock absorbers. The interactive on board diagnostic display allows for improved service shop maintenance.

Conclusion

Despite differences in language and culture, the European telematics market shares many of the same challenges that are ahead for North America and Japan. The value proposition for consumers, weighed heavily with safety and security advantages, needs to be communicated effectively to the market. The convergence of telecommunications and information technology that enabled the initial stages of telematics needs to accelerate through the adoption of compatible, open architectures and common communications protocols. And developing a safe, easy to use Human Machine Interface will be of crucial concern in the near term.



Emerging Technologies Survey

According to a recent J.D. Power and Associates survey on U.S. Automotive Emerging Technologies, when selecting from 25 features, eight of the ten most desired features were related to vehicle or occupant safety. Desired safety-related features were, in order of preference [1]:

1. Electronic sensing system to monitor vehicle tire pressures and to alert drivers when tire pressure(s) are low and potentially unsafe (the most popular feature).
2. Anti-whiplash, active headrest, seats
3. Night vision systems to help drivers see objects at night or in poor visibility conditions.
4. Object-detection, external-surround sensing, of vehicles (blind spot, plus backup assist, etc).
5. Vehicle yaw-rate stability braking-control systems.
6. Radar-aided adaptive cruise control.
7. Headlight systems that adapt to current driving conditions.

Unlike air bags and seat belts that help protect occupants as a crash takes place, most of the above desired safety-related features actively assist the driver in avoiding the crash in the first place.

Automotive Electronics

Bill Fleming, Senior Editor

US Study on Factors Contributing to Vehicle Crashes

In an update to the landmark Tri-Level study done by Indiana University in the 1970s, the U.S. GAO (General Accounting Office) recently began an extensive analysis of the NHTSA's (National Highway Traffic Safety Administration's) principal databases on traffic crashes (the Fatality Analysis Reporting System, the Crashworthiness Data System, and the General Estimates System) [2]. Several factors may combine to produce circumstances that may lead to a motor vehicle crash; i.e., there is rarely a single cause. The three main factors that contribute to crashes are as follows:

1. **Human Factors** which involve actions taken by, or the condition of, the motor vehicle driver; including speeding, violating traffic laws, alcohol or drug impairment, distraction, decision errors, and age.
2. **Roadway Environment Factors** that contribute to, or are associated with, crashes; including design (medians, narrow lanes, lack of shoulders, curves or inter-sections); hazards (poles, trees, or embankments); and conditions (rain, ice, snow, or fog).
3. **Vehicle Factors** that include vehicle-related failures or design problems.

The GAO report provides up-to-date information based on data, experts, and studies about factors contributing to motor vehicle crashes, along with information about major ongoing and planned Department of Transportation research into factors that contribute to crashes. A copy of the 55-page report can be downloaded using the link, <http://www.gao.gov>, and then selecting "GAO Reports," then "Find GAO Reports," and then searching for report number, "GAO-03-436."

Older Drivers More Likely to Crash, But Do Less Harm

As drivers get older they become increasingly likely to be at fault in collisions, but they're less likely (than teenagers, for example) to hurt other people [3]. Although highway death rates for drivers 70 and older were higher than average, older drivers were less likely to be involved in collisions that were fatal to other people on the road. In other words, drivers under 30 are responsible for more injuries and lives lost than senior drivers. When people do die in crashes in which older drivers are involved, it's usually the older people themselves and their passengers (also usually older) who suffer [3].

Latest Cell Phone Distraction Survey

A new survey, conducted by the University of North Carolina Highway Safety Research Center, found that drivers who talk on cell phones are nearly twice as likely as other drivers involved in crashes to have rear-end collisions [4]. It was also found that crashes involving cell phone use were less likely to result in fatalities or serious injuries than crashes not involving cell phones. The study determined that:

- ◆ Almost 60 percent of licensed drivers have used a cell phone while driving
- ◆ Drivers who most often talked on cell phones were between 25 and 39 years old
- ◆ A higher proportion of cell phone users drove sport-utility vehicles
- ◆ Approximately 25 percent of users had a hands-free phone
- ◆ Most cell phone users were at least partially responsible for their crashes

Automotive Electronics Reliability Survey

A survey performed by Consumers Union found that the reliability of electrical and electronic components and systems in Japanese-made vehicles was better than that of North American vehicles, and far superior to that of European luxury cars [5]. The most troublesome systems were among the newest — e.g., on-board navigators, rear-seat entertainment modules, and dashboard touchscreens. The study placed Honda, Acura, and Toyota vehicles at the head of the electrical / electronics reliability list, while Audi,

Table 1 HEV (Hybrid gasoline-Electric Vehicle) Summary

Honda Civic and Honda Insight HEVs: current production [12], no performance details available in the present references
Toyota Prius HEV: current production [12], no performance details available in the present references
2004 Chevrolet Malibu Maxx [13]: no performance details available in the present references
2006 Chevrolet Equinox, and 2007 Chevrolet Malibu [14]: <ul style="list-style-type: none"> • Value-focused configurations that mate electric-motor assist and GM's VTi variable transmission to an Ecotec four-cylinder engine for a fuel economy increase of nearly 15 %
2004 Ford Escape Hybrid [12], [13]: no performance details available in the present references
2005 Ford Futura Hybrid [13]: derived from the Mazda6 platform, no performance details available in the present references
2004 GMC Sierra and Chevrolet Silverado full-sized pickup trucks [14], [15]: <ul style="list-style-type: none"> • Stores electrical energy during deceleration to provide a 12 % improvement in economy • Integrated starter/generator allows shut down of engine when vehicle stops, and re-start when vehicle re-initiates movement
2007 GMC Sierra and Chevrolet Silverado full-sized pickup trucks [14], [15]: <ul style="list-style-type: none"> • Includes engine displacement-on-demand that operates between 4 and 8 cylinders, depending on the need for power for fuel economy improvement
2005 Saturn VUE sport wagon [12], [14]: <ul style="list-style-type: none"> • Advanced dual electric-motor systems and control electronics boosts the composite city/highway efficiency up to 50 % to nearly 40 mpg • The vehicle operates at speeds up to 15 mph solely on electric power • The air conditioning compressor takes power directly from the transaxle, allowing it to run from either the engine or from the electric motors
2004 Toyota Prius [12], [13]: <ul style="list-style-type: none"> • Uses the Synergy Drive powertrain with 50% more electric power than the last-generation Prius and improved low-end torque • Uses a V-6 engine, but obtains V-8 performance with 4-cylinder compact car fuel efficiency • Dual front and rear electric motors are used, operating at double the voltage of the current Prius hybrid vehicle • Larger and more aerodynamic than the previous model

Mercedes-Benz, and Volkswagen models brought up the rear. The Consumers Union study was based both on tests performed at their automotive facility, and a survey sent to the magazine's 4 million subscribers.

The majority of the reliability problems were traced to faulty wire connections between sensors, control units, and harnesses. For example, when wiring was minimized, by using multiplexing in doors (to control power windows, locks, and mirrors) — everything worked better and reliability was very good. It was concluded that reliability was basically a matter of attention to detail. Simple, well-laid-out, electrical systems were generally the most reliable [5].

High-Intensity-Discharge Headlamps Criticized

The April 2003 issue of *Consumers Reports* included a feature article, "Blinded By the Light," which concluded that HIDs (High-Intensity-Discharge headlamps) were respon-

sible for much of the glare that troubles drivers [6]. Even though just 1 % of new vehicles sold in the U.S. have HIDs, NHTSA has received complaints from roughly 4,000 drivers about HID lights. HID headlamps dazzle oncoming drivers. *Consumers Reports* recommended that NHTSA should:

- ◆ Require better low-beam lighting straight ahead of the vehicle
- ◆ Require HID lights to be self-leveling (to compensate for vehicle cargo / passenger loading)
- ◆ Require more gradual beam-cutoff patterns
- ◆ Chemically alter, or filter, HID's so they emit more yellow light (more like halogen headlamps) instead of the (dazzling) blue light
- ◆ Reduce the maximum mounting height of low-beam headlights on SUVs and pickup trucks

As of May 2003, NHTSA was continuing to work on a NPRM (Notice of Proposed Rule Making) for Standard 108, Headlight Glare. Release of a NPRM on headlight glare is targeted for this coming winter [7]. In addition to the glare issue, NHTSA is also writing lighting standards for vehicle adaptive headlights, daylight running lamps, and LED signaling lamps.

Automotive Electronics Trends

Recession-weary semiconductor chip makers are turning to automotive applications [8]. Not all the promises of automotive electronics come to pass — for example, telematics (the incorporation of wireless communications and multimedia into automobiles) stagnated because consumers found the add-on feature too pricey and lacking in appealing applications. Today, chip makers are boosting the performance of high-end 32-bit microcomputers for powertrain and for engine control applications such as variable valve timing/lift. Another new opportunity involves bus networks ranging from FlexRay and TTP to the more established CAN standard. Indeed, in the electronics industry it's said that, "the automobile can be thought of as nothing more than a mobile electronics network." In the past, electronic devices in vehicles were usually not connected. Now, devices and technologies are being integrated; so speech, navigation, radios, and CD players are being all connected to one another [9].

Notwithstanding the earlier disappointments with automotive telematics, *Microsoft* has rolled out a new automotive software package with integrated technology. It incorporates *Bluetooth*, and speech recognition, capabilities together. The software, called *Automotive 4.2*, is based on *Windows CE.NET 4.2*, the latest version of *Microsoft's* embedded real-time operating system [10].

Hybrid Gasoline-Electric Vehicle Update

This spring, under pressure from automakers, the California Air Resources Board dropped its requirement that manufacturers sell zero-emission battery-electric cars in the state. Pure electric vehicles were found to be too expensive and have too little range [11]. Instead of battery cars,

Table 2 Fuel Cell Vehicle Summary

<p>DaimlerChrysler NECAR 5 minivan [16]:</p> <ul style="list-style-type: none"> • Sixty vehicles will be field evaluated • Uses a Ballard fuel cell stack, with compressed gaseous hydrogen stored in a 5,000 psi tank • Seats four, 90 mile cruising range
<p>Ford Focus FCV [16]:</p> <ul style="list-style-type: none"> • Includes 300-V Sanyo battery pack and a regenerative brake-by-wire system • Uses a Ballard Mark 902 fuel cell stack, with compressed gaseous hydrogen stored in a 5,000 psi tank • Seats five, 160-to-200 mile cruising range
<p>GM HydroGen 3 minivan [16], [19]:</p> <ul style="list-style-type: none"> • Delivery vans will be field evaluated by FedEx Japan in Tokyo • Uses a 80-kW Ballard fuel cell stack, with either compressed gaseous or liquid hydrogen (there are two different versions of this vehicle) stored in a 5,000-psi carbon-composite-cylinder tank (a 10,000 psi tank is also certified) • Seats five, 250 mile cruising range (for liquid hydrogen version of vehicle)
<p>GM Hy-wire [19]:</p> <ul style="list-style-type: none"> • Fuel cell-powered and SKF by-wire controlled, with re-configurable "skateboard" chassis • Note. <i>GM has now rejected the use of onboard reformers for methanol or gasoline because of costs, weight, and packaging problems. Instead, GM believes that the reformers could be positioned at gasoline stations for on-premise creation of hydrogen fuel from gasoline, naphtha or natural gas.</i>
<p>Honda FCX [16], [18]:</p> <ul style="list-style-type: none"> • Certified for commercial use by the EPA in the U.S. • Five vehicles became part of the city of Los Angeles motor pool this year (lease rate = \$500/month for L.A., and \$10,000/month elsewhere [18]) • Uses a 78-kW type-902 Ballard fuel cell stack, with compressed gaseous hydrogen stored in a 5,000 psi tank • Front wheels are driven by ac-synchronous, 93%-efficient, motors • Electricity is stored in Honda "capacitor assist" ultracapacitors (which are 10 % more energy efficient than metal hydride batteries) • Seats four, 170 mile cruising range
<p>Hyundai Santa Fe FCEV sport wagon [16]:</p> <ul style="list-style-type: none"> • Uses a 75-kW UTCFC pressure fuel cell, with compressed gaseous hydrogen stored in a 5,000 psi tank • 100 mile cruising range
<p>Nissan Xterra FCV small SUV [16]:</p> <ul style="list-style-type: none"> • Uses a 75-kW Mark 901 Ballard fuel cell stack, with compressed gaseous hydrogen stored in a 5,000 psi tank • Rear wheels are driven by neodymium-magnet synchronous motors • 125 mile cruising range
<p>2003 Nissan X-Trail FCV SUV (limited production) [18]:</p> <ul style="list-style-type: none"> • Uses a UTC fuel cells, with compressed gaseous hydrogen stored in a 5,000 psi tank • Includes a lithium-ion battery pack
<p>Toyota FCHV sport wagon [16], [18]:</p> <ul style="list-style-type: none"> • Joint venture with Daihatsu (compact cars) and Hino (buses) • First vehicle certified by Japan's Ministry of Land, Infrastructure, and Transport • Uses a 90-kW Toyota fuel cell (platinum-rich proton exchange membrane) stack, with compressed gaseous hydrogen stored in four 5,000 psi tanks • Toyota makes its own electric motors • Seats five, 186 mile cruising range • In May 2003, Toyota issued a worldwide recall of these vehicles — all six of the vehicles — to fix a leak near the high-pressure tank filler nozzle [17]
<p>Volkswagen Bora HY.POWER [16]:</p> <ul style="list-style-type: none"> • Uses a 74-kW Paul Scherrer Institute (Switzerland) fuel cell, with compressed gaseous hydrogen stored in a 5,000 psi tank • Electricity is stored in Supercaps, in place of batteries

automakers can now sell HEVs (Hybrid gasoline-Electric Vehicles), and hydrogen fuel cell autos, starting with 2005 models. Current and future HEV vehicles are summarized in Table 1.

Some, as yet unresolved, HEV issues are the following [12]:

- ◆ Battery packs, electronics software, and electric motors currently add \$4,000 to \$5,000 to the cost of a typical HEV. In the future, the 100+ lb (50+ kg) battery packs will potentially pose disposal problems.
- ◆ According to real-world driving experiences, HEVs don't come close to delivering their rated fuel economy.
- ◆ When a Honda Civic HEV was driven by *Ward's* editors [12] last fall for two weeks; they only obtained 39 mpg (6.0L/100 km), whereas the car was rated at 51 mpg (4.6L/100 km). The editors noted that a similar Civic LX, a conventional IC (Internal Combustion) engine-powered sedan, produced within a few miles per gallon nearly the same gas mileage, and it was \$4,600 less expensive!
- ◆ *Ward's* editors likewise found that the Toyota Prius and Honda Insight HEVs were also disappointments, with substantially lower fuel economy than expected [12].
- ◆ Emissions scores for HEVs were also not very impressive. "The 2003 EPA Green Vehicle Guide ranked sixty vehicles ahead of the emissions performance of the Civic HEV ... and all (including a Volvo XC90 CUV and a BMW 325i Sport Wagon) relied solely on gasoline-fueled IC engine powerplants" [12].

Fuel Cell Vehicle Update

To satisfy California requirements that manufacturers sell zero-emission cars in the state, each of six automakers (GM, Ford, Chrysler, Toyota, Honda, and Nissan) must sell at least 250 zero-emission vehicles by 2008 — most of these vehicles are now expected to be pow-

ered by fuel cells [11]. A summary of current fuel cell vehicles is given in Table 2.

Some unresolved fuel cell vehicle issues include:

- ◆ Fuel cell companies today are still manufacturing in very small volumes and virtually by hand. To get costs down to be competitive with today's IC engines, high-volume fuel cell manufacturing must yet be realized [16].
- ◆ The loading of precious metal platinum in the fuel cell membranes needs further reduction in order to reduce cost [16].
- ◆ Processing hydrogen from a gaseous form into a pressurized or liquid form, available to refuel millions of cars, remains a problem [16].
- ◆ The best available fuel cell vehicle cold startup time today is 30 s at -20°C (-40°C startup is apparently still unobtainable) [19]. This remains a customer non-acceptance point.

Advanced IC Engine Developments

Many believe that the continually improving IC engine will prevail over HEV and fuel cell power sources for as long as 30 years to come [20]. Indeed, European manufacturers contend that HEVs carry too much weight by virtue of their dual electric and IC engine powerplants. BMW, Volkswagen, Mercedes-Benz, and GM's Adam Opel — all contend that new common-rail direct-injection versions of diesel powertrains, which make up 40 % of the European new car market, are the real solution to emissions and fuel efficiency challenges [12]. For this reason, European manufacturers are not actively pursuing the development of HEV powerplant vehicles. And, to date, only DaimlerChrysler and Volkswagen are developing fuel cell-powered vehicles.

Table 3 Recent IC Engine Improvements

<p>BMW Valvetronic Engine [21]:</p> <ul style="list-style-type: none"> • Electric motor-actuated stepless variation of valve lift from 0.2 mm at idle to 9.9 mm at full load, eliminates most of the engine throttle functions (i.e., breathing is controlled entirely via valve lift) • By-wire throttle is only used to assist engine start, maintain vacuum, and provide emergency back-up • Servo motor-actuated steplessly variable intake manifold, varies air intake path length between 215 and 607 mm
<p>Mitsubishi GDI Engine [21]:</p> <ul style="list-style-type: none"> • GDI (Gasoline Direct Injection) provides lean air-fuel operation which improves fuel economy
<p>GM Displacement on Demand Engine [21]:</p> <ul style="list-style-type: none"> • Engine displacement-on-demand operates between 4 and 8 cylinders, depending on the need for power, which improves fuel economy
<p>Honda i-VTEC Engine [21]:</p> <ul style="list-style-type: none"> • Continuously variable intake valve timing, and variable "lift and duration electronic control" reduce emissions and improve fuel economy
<p>FEV Electro-Mechanical Valve Train Engine [21]:</p> <ul style="list-style-type: none"> • Electromagnetically individually actuated valves can be opened or closed at any time, at any speed, to any amount of lift for any duration to reduce emissions and improve fuel economy
<p>GM New Generation V-6 Engine [22]:</p> <ul style="list-style-type: none"> • Includes electrohydraulic phasor-actuated four-cam continuously variable valve timing on both intake camshaft and exhaust camshaft (both with 50 crankshaft degree timing-adjust authority) • Variable valve timing eliminates the need for the exhaust gas recirculation system • Plenum valve-actuated dual-stage variable air intake manifold • 32-bit torque-based engine control microcomputer

A summary of some recent IC engine improvements is given in Table 3.

References

1. K. Jost, "Industry Must Listen to, Educate Consumers on Safety," *AEI (SAE Auto. Engr. Intl.)*, p.6; May 2003
2. "GAO Updates Data on Factors Contributing to Vehicle Crashes," *Highway & Vehicle / Safety Report*, p.3; May 12, 2003
3. "IIHS: Older Drivers Involved More in Crashes, Less Likely to Harm," *Highway & Vehicle / Safety Report*, p.5; May 12, 2003
4. "Cell Phone Use Leads to More Rear-End Crashes, HSRC Finds," *Highway & Vehicle / Safety Report*, p.3; April 14, 2003
5. C. Murray, "Japan's Cars Lead in Electrical Reliability," *Electronic Engr. Times*, pp. 1 and 18; April 14, 2003.
6. "Consumer Reports Critical of HIDs," *The Hansen Report On Automotive Electronics*, p. 8; April 2003
7. S. Kratzke, "NHTSA Rulemaking Status Meeting," Romulus, MI, April 3, 2003.
8. A. Cataldo, "Recession-Wearied Semiconductor Chip Makers Turn to Auto Applications," *Electronic Engr. Times*, pp. 35 and 38; May 19, 2003.
9. C. Murray, "Developers Hit the Road for Embedded Conference," *Electronic Engr. Times*, pp. 4 and 98; April 21, 2003
10. "The Week in Review: Embedded — Auto Focus," *Electronic Engr. Times*, p. 8; May 5, 2003
11. "California Focuses on Hybrids, Fuel Cells," *Automotive News*, p. 3; April 28, 2003.
12. D. Winter et al., "Hybrid Heartburn," *WARD'S AutoWorld*, pp. 44-51; March 2003.
13. K. Zachary et al., "Charge It! New York Show Abuzz with Hybrids," *WARD'S AutoWorld*, p. 21; May 2003.
14. K. Jost, "North American International Auto Show Production Vehicles — GM Hybrids," *AEI (SAE Auto. Engr. Intl.)*, pp.10-12; March 2003
15. "Hybrids Begin To Take Centre Stage," *Auto. Engr. (G.B.)*, p. 6; Feb. 2003.
16. J. Peter, "Fuel Cells — Out of the Blocks," *Automotive Industries*, pp. 28-31; May 2003.
17. J. Treece, "Toyota Recalls Global Fleet of 6 Fuel Cell Vehicles," *Automotive News*, p. 48; May 26, 2003.
18. J. Yamaguchi, "Leading the Way — Fuel Cell Vehicles from Toyota and Honda Are Hitting the Streets," *AEI (SAE Auto. Engr. Intl.)*, pp.54-58; March 2003
19. S. Birch, "Driving the Hy-wire," *AEI (SAE Auto. Engr. Intl.)*, pp.105-108; April 2003
20. "Fuel-Cell Vehicles in High Volumes Said to be 30 Years Away," *Machine Design*, p. 32; April 17, 2003
21. G. Witzenburg, "Internal Combustion Engines — It's All About Flow," *Automotive Industries*, pp. 34-37; May 2003.
22. J. McCormick, "In a Family Way — GM Gives Birth to a New Generation V-6," *Automotive Industries*, pp. 42-45; May 2003.



Mobile Radio

Javier Gozalvez, Senior Editor

CTIA Wireless 2003

CTIA Wireless 2003 took place in New Orleans, LA (March 17-19). During the event, Motorola, announced that its new CDMA Cellular Remote Monitoring Systems (CRMS), that enables operators to monitor network performance remotely, is currently available to network operators. The US manufacturer also announced the expansion of its CDMA2000 1X portfolio with the introduction of a standards-based CDMA 1xEV-DO solution. Motorola's 1xEV-DO solution is highly integrated into its CDMA2000 1X systems and leverages existing Base Transceiver Subsystem (BTS) product offerings through a new 1xEV-DO Multi-channel CDMA card. Motorola also showcased during the event its product VIAMOTO, a suite of location software that turns data capable cell phones into navigation systems and local information guides.

Qualcomm demonstrated during the event a suite of new enhancements for CDMA2000 1xEV-DO that include: a Quality of Service (QoS) feature that enables the system to treat various users and applications with different levels of

priority; Instant Multi-Media (IMM) that can be used to implement conferencing with the additional capability to send video images to the entire group; Location Based Services; equalizer with advanced signal processing in user devices that allows to significantly increase user data rates and capacity in a given CDMA2000 1xEV-DO network; receive diversity; 2X Multicarrier that shows the possibility in the future of having devices with the ability to access two CDMA2000 1xEV-DO RF carriers simultaneously, thereby doubling the available data rates. The US manufacturer also announced plans for Samsung to offer the world's first feature-rich multimode GSM1x handsets, enabled by the MSM6300 chipset solution and GSM1x technology solution. The MSM6300 is the first product to integrate GSM and CDMA modems into a single chip solution.

Nokia demonstrated its Global WCDMA (G-WCDMA) solution, that enhances the benefits of WCDMA technology by introducing High Speed Downlink Packet Access (HSDPA) technology. The Nokia HSDPA solution doubles base station capacity at the air interface and offers, what the company

claims is the highest performance at the lowest cost, enabling real mass-market mobile IP. Anritsu Company introduced during the event a measurement software for its MS8608A/MS8609A Digital Mobile Radio Transmitter Testers creating what it claims is the industry's first solution for accurate analysis of signals. Both transmitter testers can accommodate up to three software packages, so that the HSDPA software can be loaded in the MS8608A/MS8609A along with W-CDMA and GSM/EDGE testing capability. The company also introduced high-end analysis software that allows 5 GHz OFDM signals to be accurately measured in accordance with IEEE 802.11a with a single instrument.

Ericsson demonstrated cross-technology push-to-talk over CDMA2000 and GSM/GPRS. Ericsson Instant Talk is based on the IP Multimedia System (IMS) core network open interfaces and is developed to work across GSM/GPRS, EDGE, CDMA2000, WCDMA and WLAN networks. The Ericsson Instant Talk solution, compliant to the IMS based push-to-talk standard, will offer push-to-talk functionality combined with presence services.

Allgon Telecom Ltd announced it has been selected to provide a comprehensive wireless telecommunications coverage solution for the Chicago Transit Authority rapid subway tunnels, underground stations and station passageways. Once completed, the project will be the first state-of-the-art multi-provider, multi-technology wireless coverage solution deployed in a U.S. mass transit system. Allgon's fiber-based distributed antenna network will transmit mobile radio signals from strategically positioned radio base station hotels outside of the Chicago Subway tunnel system. The system will be connected to a common fiber-optic backbone.

Spirent Communications announced its SR5500 Wireless Channel Emulator, with what it claims is the world's highest channel modelling performance. This new instrument enables accurate performance qualification of different air interface technologies, including CDMA2000, 1xEV-DV, WCDMA, and WLAN. SR5500 can evaluate next-generation receiver architectures by providing more complex channel models that include up to 48 independent paths. In addition, the SR5500 provides low-level control over time-varying power delay profiles for the thorough evaluation of the adaptive modulation schemes found in emerging high-throughput wireless access technologies.

Marconi and SnapTrack™ announced an agreement to cooperate in the development of an enhancement to Marconi's Planet EV tool, the next-generation version of its network planning and optimization product family. The two companies are working together to empower Planet EV with its newest module, the BSA Planner (Base Station Almanac Planner). The module will improve the accuracy and efficiency of deployment and maintenance processes for Qualcomm's gpsOne hybrid A-GPS location systems.

Openwave Systems introduced Openwave Voice MMS, which is built on proven IP based multi-media messaging platform and utilizes MMS transport for delivering voice-messages. In addition to enhanced call answering capabilities, Openwave Voice MMS delivers voicemail to the handset over MMS.

3G Roll-Out News

Hutchison, under the brand name "3", has announced the launch of UMTS services in Sweden. 3's launch in Sweden initially covers Stockholm, Gothenburg and Malmo as well as other smaller cities. Network coverage reaches approximately half of the Swedish population, and Hutchison is targeting population coverage of 70 per cent by this year end.

Previously, the Telecoms authority denied permission to the operators to delay the rollout of their 3G networks. Hutchison Telecom has also launched its Australian 3G network. For the time being, the network is covering Sydney and Melbourne. Vodafone Ireland has launched its UMTS network on a limited basis. The operator has over one-third 3G population coverage in all of the main urban centres and beyond. Austria's Mobilkom has announced the start of its consumer sales of 3G handsets. The operator has increased the network coverage to 42%, including the 54 largest cities in the country. E-Plus has confirmed it is buying some 3723 UMTS base stations, with 931 of these sites already been equipped, from Mobilcom in Germany for just \$23million. NEC and Siemens ICM have completed the first phase of Hutchison 3G radio network. NEC and Siemens mobile are supplying half of the 3G radio infrastructure required by 3 UK, implementing the Radio Access Network (RAN) and Radio Network Controller (RNC) equipment across London and southern England. According to the companies, the pace of the rollout is without precedent in the industry since they have been installing up to 140 base stations per week.

The European Commission has decided to allow limited 3G infrastructure sharing in the UK. Although roaming will be allowed in small cities and rural areas it will not be permitted in the top ten cities in the country. Previously, mmO2 and T-Mobile entered into agreements to share 3G site infrastructure and to roam on their 3G networks in the UK and Germany.

The UK's Radiocommunications Agency has commissioned a report that has concluded that future ultra wideband (UWB) devices could have a serious detrimental impact on UMTS mobile phones. The study found that handsets would be subjected to the highest level of interference from UWB transmitters. The report concludes that changes in dropped call rate are generally very small.

NTT DoCoMo, who said it has reached 320000 customers in its 3G network, has announced the launch of WORLD WING, an international roaming service for DoCoMo 3G FOMA handset users, on June 1, 2003. To use the service, customers simply insert the UMI chip that comes with their FOMA handsets into any GSM handset having international roaming service capabilities. WORLD WING will be available in 53 countries and regions at the time of launch, and will be expanded at a later date to encompass 72 countries and regions. The Japanese operator also announced an agreement with Singapore Telecom Mobile Pte Ltd to collaborate through technical exchange and joint studies, regarding WCDMA technology. The two companies will also jointly study highly advanced WLAN service offerings, for example, IP connection and convergence with 3G mobile services. The Japanese operator has also launched in its 3G network a one-to-many video streaming service that enables users to download or stream live and archived content via 64 Kbps circuit-switched wireless transmission. As part of its strategy to promote the rapid development of 3G technology, DoCoMo said it will invest in the development of FOMA 3G mobile phones being manufactured by Sharp.

KDDI has said it has reached seven million mobile subscriber in its CDMA2000 1X network. The network was launched on April 1, 2002. Services are already offered in all 47 of Japan's prefectures and administrative divisions, and are accessible to 90 percent of the country's population.

Qualcomm has announced the launch of China Unicom's nationwide CDMA2000 1X network. Centennial Dominicana has also launched 3G CDMA2000 1X services in the Dominican Republic. Reliance Infocomm has also an-

nounced the launch of its 3G CDMA2000 1X network, bringing advanced wireless data and voice services to 92 cities in India. Multi-Links Telecommunications Ltd. and Nortel Networks have announced the commercial launch of Africa's first CDMA2000 1X Wireless Data Network in Lagos. The network will enable data access at speeds up to 153 kilobits per second. Motorola will provide a CDMA2000 1X to PT Telkom in Indonesia. The network, which will run on the 800MHz band, will cover the ten provinces of Sumatra, one of the largest islands in the country.

The CDMA Development Group (CDG) has announced that network and terminal vendors are now preparing to offer commercial-grade CDMA2000 equipment at 2.1 GHz, one of the IMT-2000-designated 3G spectrum bands. One country that will potentially benefit from the availability of CDMA2000 equipment at 2.1 GHz is China. In fact, Lucent Technologies has announced it has successfully completed a series of tests of its CDMA2000 equipment at 2.1 GHz spectrum in China, including the successful completion of CDMA2000 voice and high-speed data calls. The testing was conducted in adherence with the CDMA2000 system testing specifications of the China Wireless Telecommunication Standard group. Nortel Networks has also completed 3G wireless voice and data calls using CDMA2000 1xEV-DO and CDMA2000 1X wireless standards over 2.1 GHz radio spectrum in the Nortel Networks Global Technology Center in Ottawa. Ericsson also announced it has conducted 2.1GHz CDMA2000 voice and data calls on its CDMA2000 1xEV-DV ready infrastructure equipment. Moreover, Ericsson has announced that it has deployed a multi-access network based on its CDMA2000 network and WLAN solutions for China Unicom in the Sichuan province. Ericsson's CDMA2000 multi-access solution will enable China Unicom to complement their CDMA2000 network, optimised for mobility and coverage in the wide area, with WLAN, which is optimised for high-speed data in local area coverage and will support services in "hot spots".

Verizon Wireless and Lucent Technologies have announced plans to launch a 3G CDMA2000 1xEV-DO mobile data network in Washington D.C. that will provide businesses and consumers with data services at speeds of up to 2.4 Mbps. Verizon Wireless customers will be able to access the high-speed network by equipping their laptop PCs and PDAs with 1xEV-DO wireless modem cards.

The Malaysian mobile operator DiGi Telecommunications has commissioned Siemens to equip its network with GSM, GPRS, and EDGE technology, becoming, according to the companies, the first commercial EDGE project in Asia. According to Ericsson, it has been chosen by América Móvil as main supplier for the Core Infrastructure and one of the principal suppliers for the Radio Infrastructure for a GSM and EDGE Network to complement the existing TDMA network of its Brazilian subsidiary Telecom Americas. According to the Swedish manufacturer, this marks the world's first announced commercial rollout of EDGE in the 1800 MHz spectrum. Total Access Communication (DTAC) and Nokia have announced the successful completion of the first EDGE call in Thailand. Nokia has also announced successful completion of the first EDGE call, together with Smart Communications, in the Philippines. Pannon GSM Telecommunications has also conducted Hungary's first public EDGE call by a mobile operator using Nokia's solution for EDGE technology. In addition to cooperating on the EDGE call, Nokia and Pannon have signed an agreement for Nokia to provide EDGE infrastructure for a trial launch in Budapest in the third quarter 2003.

Location-based Services

Siemens has developed the "m.traction Senior Care Service", a person locating system based on GSM. The goal of this service is to enable people with slight orientation problems to move out of their immediate residential area without the fear of not finding their way back. The people being tracked wear a hidden, ergonomically formed fabric ribbon on their arm or leg. This ribbon contains a TC35 GSM module from Siemens that controls the transmission and receipt of the radio signals. The ribbon also contains an antenna, a module for processing the localization information, and a battery.

According to TruePosition, the location technology U-TDOA has been formally standardized by the 3GPP, becoming one of three location technologies supported by this organisation. The technology locates wireless phones by comparing the time it takes a radio signal to reach several Location Measurement Units installed at base stations. On the other hand, T-Mobile USA has said it will abandon E-OTD location technology. A factor taken into account by the operator was whether there would be continued commitment by the manufacturers to support this technology, specially after AT&T Wireless and Cingular Wireless also dropped the technology.

Taiwan Cellular Corporation (TCC) will use Agilent and Applied Generics to support push based advertising within its network. Using their technology, TCC will be able to establish which users are in a particular area without having to poll for their location, which reduces the additional required load on the network.

According to research conducted by Frost & Sullivan, North American Location-based Services Markets has generated \$13million in revenues in 2002 and is likely to generate more than \$850million in 2006, with the market growth being fuelled by the E911 mandate of the FCC.

Technology and Research News

NTT DoCoMo has announced plans for a field trial of a fourth-generation (4G) mobile communications system in Yokosuka. In indoor experiments announced last October, DoCoMo's 4G system demonstrated maximum information bit rates of 100 Mbps for the downlink and 20 Mbps for the uplink. The field trial will employ Variable Spreading Factor Orthogonal Frequency and Code Division Multiplexing (VSF-OFCDM) and Variable Spreading Factor Code Division Multiple Access (VSF-CDMA) technologies. VSF-OFCDM enables downlink connections of extremely high speeds, both indoors and outdoors, while VSF-CDMA realizes high-speed, high-efficiency packet transmissions for the uplink. DoCoMo will evaluate the following high-speed transmissions technologies during the field trial: effective packet transmission methods, adaptive modulation and channel coding scheme, adaptive retransmission control and adaptive beam forming based on predicted direction of arrival. UbiNetics has also said it is supplying DoCoMo with mobile simulators for the testing and evaluation of its experimental High-Speed Downlink Packet Access (HSDPA) system. The Japanese operator has also announced that WRISTOMO, the world's first commercial wristwatch-style Personal Handyphone System (PHS) mobile phone, has gone sale. The wrist phone transfers data at up to 64 kbps. The WRISTOMO is also equipped for DoCoMo's "Location based Web Sites," which provide information about restaurants, weather, transportation and other concerning the user's current location.

picoChip Designs claims to have made the first 3G call using a software-defined basestation. The basestation, which is fully 3GPP compliant, has been implemented using the company's technology platform of picoArray devices. The system, that can be upgraded entirely in software to new releases of the standard, can support voice, data and video services. The company says the next revision of the software will include multi-standard/multi-mode functionality.

Nokia has announced that its proposal for standardizing a CDMA2000 wideband speech codec was selected by the 3GPP2 from a field of five competing proposals. According to the manufacturer, the new Variable-Rate Multi-Mode Wideband speech codec (VMR-WB) offers superior wideband speech quality at data rates comparable to current narrowband speech codecs, resulting in highly intelligible and natural speech that represents a quantum leap over the quality of both today's wireless and wireline networks. The VMR-WB standard is also interoperable with the AMR-WB standard selected by the 3GPP for use in GSM/WCDMA networks. Nokia has also introduced IP Multimedia products for GPRS, EDGE, WCDMA and CDMA2000 networks. Interactive services are made possible by IP Multimedia Subsystem (IMS) technology, which enables person-to-person IP connections between terminals. The new IMS-capable network products, expected to be available during 2003, employ the 3GPP/3GPP2-adopted Session Initiation Protocol (SIP) in setting up the IP session. The Finnish manufacturer also launched its MMSC Interconnection Service to help ensure smooth interworking between the MMS systems of different operators.

Qualcomm has announced the MSM6275 radioOne Mobile Station Modem chipset and system software, a high-performance solution delivering HSDPA as well as roaming on GSM and GPRS systems. The MSM6275 solution will enable high-quality, multimedia-rich WCDMA handsets with extended time for MP3 file playback, streaming video and video telephony. The manufacturer has also announced the CSM6700 Cell Site Modem solution and the MSM6700 Mobile Station Modem chipset and system software supporting integrated voice and simultaneous high-speed packet data. The CSM6700 solution will support 1xEV-DV including the latest CDMA2000 Revisions C and D. The MSM6700 solution supports CDMA2000 Revision D and CDMA2000 1xEV-DO. CDMA2000 Revision D enables wireless carriers to provide voice and bi-directional high-speed packet data services simultaneously on a single Radio Frequency (RF) carrier. As specified by 3GPP2, the CDMA2000 Revision D standard is backward compatible with IS-95 and the CDMA2000 Release 0, A, B and C standards. CDMA2000 Revision D supports not only similar peak forward rates to 1xEV-DO but also high data rate reverse links to better support high-resolution cameras, video streaming, video telephony and other multimedia services. Qualcomm also announced that the Company has successfully demonstrated push-to-talk (PTT) initial call set-up performance of less than two seconds over CDMA2000 infrastructure and handsets between dormant mobiles, with its QChat technology. Qualcomm's QChat solution uses voice over Internet protocol (VoIP) technologies to enable ubiquitous, efficient and virtually instantaneous PTT functionality on wireless devices based on CDMA2000 and other CDMA 3G networks. The QChat client is deployed as an application on Qualcomm's Binary Runtime Environment for Wireless (BREW) platform.

TriQuint Semiconductor has introduced, what it claims is, the world's smallest GSM front-end antenna switch mod-

ule. The module integrates antenna switching and low pass filtering functions with increased electro-static discharge protection.

According to RTX Telecom, the company has signed an agreement concerning the development of a GSM/TD-SCDMA chipset for the Chinese TD-SCDMA standard. The company, which says the chipset will be available for mass-production by the first half of 2004, claims the chipset will be the first one available for the development of commercial TD-SCDMA handsets.

A new research center at the Lawrence Livermore National Laboratory in the US is developing a mobile phone that can also detect dirty bombs by means of detectors that unload their information in a central database. The device, called RadNet, would be deployed as part of a wide network that would report and transmit data about the possible location of nuclear materials.

Sony Ericsson has announced that they have started the development of a new Rugged Cellular Communication Module, the GM46, intended for embedded applications where operation in harsh environments is a requirement, such as Automotive and Industrial applications. The GM46 will be a tri-mode module capable of operating in GSM, AMPS, and TDMA, and will also support class 8 GPRS packet data communications.

AirWalk Communications has launched its integrated base station and base station controller to answer the service providers' demands for hotspots, blindspots and in-building voice and data wireless coverage. The industry's first integrated IP-BTS and BSC, AirWalk is delivering a compact, carrier-class, cost effective solution.

Radiation from Mobile Phones

Research conducted by the UK's Civil Aviation Authority (CAA) claims to have proven that mobile calls made by airline passengers can interfere with aircraft equipment. The study found that these calls can produce significant errors on instrument displays and background noise on audio outputs. The full report can be download from http://www.caa.co.uk/docs/33/CAPAP2003_03.pdf

Researchers from the Center for the Study of Wireless Electromagnetic Compatibility at the University of Oklahoma claim that the use of mobile phones do not cause petrol station fires. The researchers claim there has never been a confirmed incident implication with a mobile phone at a gas station.

Vodafone Malta is making available to the public the emission rates from some of its mobile towers. The operator has allocated ten electro-magnetic radiation probes to monitor the RF radiation levels. The readings from each probe will be downloaded to the following web server, located at the University of Malta, where also more information on this project can be found: <http://gardjola.eng.um.edu.mt/emr/>

US Mobile Market

The Federal Communications Commission's Office of Strategic Planning and Policy Analysis (OSP) and Office of Engineering and Technology (OET) have released OSP Working Paper No. 39, "Unlicensed and Unshackled: A Joint OSP-OET White Paper on Unlicensed Devices and Their Regulatory Issues". The paper considers all aspects of wireless devices which do not require a license from the FCC. The OSP-OET paper presents a survey of unlicensed wireless devices, their governing regulation, the current technological state of the art, an overview of the market with infor-

mation from publicly available sources, and an analysis of the potential regulatory issues. The authors conclude that much of the benefit and promise of future generations of these devices will depend upon a continued forward-looking approach to policy reform for unlicensed devices. The authors state that effective policy reform includes enabling more unlicensed spectrum, and continuing to promulgate rules to encourage technological and market-based solutions that optimize sharing, and thus, efficient use of available spectrum. The full text of the paper is available at www.fcc.gov/osp

The FCC has proposed to make available for unlicensed use an additional 255 megahertz of spectrum in the 5.470-5.725 GHz band. The Commission proposed that this spectrum is made available for use by unlicensed National Information Infrastructure (U-NII) devices, including Radio Local Area Networks (RLANs), operating under Part 15 of the FCC's rules. This would increase the spectrum available for use by unlicensed devices in the 5 GHz region of the spectrum by nearly 80%. The Commission also proposed additional technical requirements for U-NII devices, including transition periods for implementation of these requirements.

The FCC has adopted a Report and Order and a Further Notice of Proposed Rulemaking that (1) authorizes spectrum leasing in a broad array of wireless radio services, (2) adopts streamlined processing for certain categories of license transfer and assignment applications, and (3) seeks comment on additional steps to improve the functioning of secondary markets. In the Report and Order, the Commission authorizes most wireless radio licensees with "exclusive" rights to their assigned spectrum to enter into spectrum leasing arrangements. These policies and rules affect both mobile and fixed services, including Cellular, Personal Communications Services (PCS), Specialized Mobile Radio (SMR), Local Multipoint Distribution Service (LMDS), fixed microwave, 24 GHz, and 39 GHz, among others.

The FCC has adopted an item establishing licensing and service rules for the 50 megahertz of spectrum in the 4940-4990 MHz band (4.9 GHz band). This action promotes effective public safety communications and innovation in wireless broadband services in support of public safety and homeland security. This action also promotes interoperability by providing a regulatory framework in which traditional public safety entities can pursue strategic partnerships with both traditional public safety entities.

The FCC has adopted a new licensing process to speed delivery of satellite services to consumers. This reform will increase regulatory certainty, advance the digital migration, facilitate spectrum efficiency and continue U.S. leadership in the global satellite industry. The central revision is to create a queue for satellite applications whereby each application will be considered under the Commission's public interest standard in the order in which it is filed. The Commission also adopted other revisions to its satellite licensing system to allow market mechanisms to play a greater role in determining spectrum use by satellite systems.

Nextel Communications has launched the first phase of its nationwide Direct Connect service allowing customers to contact each other with the carrier's push-to-talk service. The company expects to have the service nationwide by the end of August.

According to a report by the US General Accounting Office (GAO), 83% of US cellphone users are satisfied with their service. A different study conducted by the Yankee Group has found that wireless telephone subscribers in the

USA spend, on average, more minutes talking on their wireless phones than on their landline ones.

IDC is forecasting that US wireless SMS and Instant Messaging (IM) markets will grow to 75million and 63million subscribers respectively in 2007. IDC expects annual subscriber revenue to grow to approximately \$1.9billion for each service.

Verizon Wireless has completed the acquisition of 50 PCS licenses and its related network assets from Northcoast Communications. The licenses provide the company with additional growth over portions of the East Coast and Midwest. The operator is also putting an end to its CDPD network, towards the end of 2005. The CDPD customers will be migrated to 1xRTT. On another hand, AT&T Wireless and T-Mobile USA have announced a joint roaming agreement.

According to interWAVE Communications, Cell-Tel Government Systems has secured a contract with the US Army's CECOM for the company's complete GSM solution for its locations of Fort Monmouth, Fort Huachuca and Fort Bragg. The company's solution is Type 1 secure.

Spectrum Licenses

Bahrain's Telecommunications Regulatory Authority (TRA) has awarded the country's second GSM license to MTC Vodafone. The Estonian National Communications Board has invited the country's 3 GSM operators to submit an application for a UMTS license. The Estonian authority plans to award four UMTS licenses by an open tender. Deteccon International is advising the National Telecommunications regulation authorities in Namibia on the award of a second mobile network license. The government plans to award a GSM900 license, through a bidding process, in order to improve the development of rural and remote areas. Anatel, the Brazilian regulator, has reaffirmed its decision to maintain 1.9GHz frequency band for 3G use, therefore refusing the request by Vesper, to deploy a mobile network in 1.9GHz frequency.

Industry Forecasts and Surveys

Allied Business Intelligence (ABI) estimates total global shipments for UWB-enabled electronics and chipsets could reach 45.1million units by 2007, with revenues of \$1.39billion for the same year. In a different study, ABI has reported that nearly 20% of all new vehicles worldwide will contain embedded Bluetooth hardware by 2007.

According to Dell'Oro Group, mobility infrastructure revenues have declined, in the first quarter of this year, by 14% to \$6.4billion compared to the fourth quarter in 2002. While GSM and CDMA revenue declined, TDMA and WCDMA experienced respective growth of 24% and 25%, with in the case of TDMA due to network expansions in the Americas. On the other hand, and according to IDC's Worldwide Handset Qview, the worldwide market for handsets grew in the first quarter of 2003 by 16.6% year-over-year. While Nokia still maintains the top position, LG Electronics has taken the fifth position to Sony Ericsson. Motorola, Samsung and Siemens remain the other manufacturers in the top 5. In the same quarter, the market for worldwide converged handheld devices grew 438.3% year-over-year.

According to Analysys, global revenues from mobile messaging are set to double to \$70billion by 2007 with \$25billion coming from Western Europe. The firm expects the total messaging volume will increase from 670billion in 2002 to 2600billion in 2007. The firm has also said that Average Revenue Per User (ARPU) in Western Europe in 2002 averaged \$33.19 per user per month. The report has con-

cluded that France, Germany, Spain and the UK have experienced growth in ARPU for their active subscriber bases during 2002. The company also estimated that Western European mobile operators have generated an average of 12% of their revenue from non-voice services in 2002, with mmO2 reaching nearly 20% in Germany. The firm also expects that person-to-person messaging in Western Europe will grow from \$13.9billion in 2003 to \$21.4billion in 2008. Mobile entertainment service revenues are expected to grow from less than \$3.2billion in 2003 to nearly \$11.7billion in 2008.

According to new figures from the Global Mobile Subscriber Database, the number of mobile subscribers in the Middle East and Africa grew by 35% during 2002, reaching nearly 84million at the end of December which represents 7% of the world's total. Africa has the lowest penetration in the world with only 4.39% compared to 16.59% for the Middle East.

Wireless LAN and Wireless PAN

Ericsson has successfully demonstrated what it claims is the first standards based solution that allows users a single sign-on for both GSM and Public WLAN. At the WLAN Event in London, a WLAN-enabled laptop was authenticated (identified) by a GSM network, using the same simple procedure that is used when a regular GSM mobile call is made. The SIM-card is the standard identification module used in all GSM-handsets. Until now, only proprietary solutions for WLAN logon have been available, effectively curtailing market take off.

Siemens ICM has fitted out the Paris congress center to make it the largest WLAN hotspot in France. The Siemens WLAN network, which can reach data transmission rates of up to 11 megabits per second, covers with its 63 access points the entire 20,000 square meter area of the congress center.

Motorola has said it is now delivering hardware and software samples to several development partners in support of the draft IEEE 802.15.4 Standard being driven by the ZigBee Alliance — an association of companies working together to enable reliable, cost-effective, low-power, wirelessly networked, monitoring and control products based on an open global standard. Engineering samples of the comprehensive, Standard-compliant Motorola solution are expected to be available in November. The IEEE 802.15.4 Standard fills a void in the wireless networking spectrum by empowering designers to create products with low cost, very low power and highly flexible wireless networking capabilities. The IEEE 802.15.4 Standard details the Physical Layer (PHY) and Medium Access Control (MAC) specifications, and offers the building blocks for different types of networking known as “star, mesh, and cluster tree.” Network routing schemes are designed to ensure power conservation, and low latency through guaranteed time slots. Motorola's comprehensive MAC/PHY 802.15.4 solution is designed to support the global 2.4 GHz band at data rates of up to 250 kbps over air.

The Wi-Fi Alliance has announced that the first round of products has successfully completed Wi-Fi Protected Access (WPA) interoperability testing. The WPA specification replaced the existing WLAN security specification, WEP.

The Italian government has introduced legislation which will enable operators to offer commercial WLAN services in both the 2.4GHz and 5GHz bands. Until now, operators were restricted to providing indoor WLAN services or installing small trial hotspot networks.

Korea Telecom, China Netcom, Maxis, StarHub and Telstra have reached an agreement to form the world's largest Wireless Broadband Alliance. The companies will roll-out initially a pilot project to establish inter-operator roaming.

Lufthansa and Boeing have reached an agreement to install WiFi connectivity on all eighty of the carrier's long-haul jets by the end of this year. Satellites provide the connections to earthbound networks.

According to a report from Dell'Oro Group, 802.11g wireless products have accounted for 16% of the wireless networking sector and 17% of the shipment. The firm predicts the revenue for wireless networking to be \$1.9billion this year and that unit shipments will rise 60%. In a different report, Jupiter Research said that 57% of US companies already support 802.11 networks, with an important lead from small businesses compared to large ones.

Wireless Data

Visa International, Nippon Shinpan, OMC Card and AEON Credit have announced the start of a pilot program, together with NTT DoCoMo, to test a service for making credit card payments at bricks and mortar merchants via DoCoMo 504i and 504iS series mobile phones, which are equipped with infrared transmission (IrDA) ports. NTT DoCoMo together with its eight regional subsidiaries have also announced the launch of an on-line payments service, named “DoCommerce”, enabling both 2G and 3G SSL-compatible i-mode handset users to enjoy mobile shopping and pay online with their VISA, MasterCard or JCB credit cards. On the other hand, DoCoMo and Samsung Electronics said that the two companies have reached an agreement to jointly develop i-mode handsets that are compatible with 2G GSM/GPRS wireless networks.

Telecom Italia Lab (TILAB) and Motorola Labs have announced the launch of the JADE Governing Board, a not-for-profit organization chartered to promote the evolution and the adoption of JADE, the platform developed by Telecom Italia Lab that runs on top of Java, by the mobile telecommunications industries as a java-based de-facto standard middleware for agent-based applications in the mobile personal communication sector.

The joint venture between cellular operators Telefónica Móviles and Portugal Telecom have announced the launch of the first commercial BREW-enabled services in Latin America. Qualcomm and BellSouth International also announced the signing of an agreement to launch downloadable wireless application services, based on BREW, in nine BellSouth operating companies in Latin America, with Colombia and Ecuador being the first ones. The other BellSouth International operations that are currently planning to roll out service based on the BREW solution are Argentina, Chile, Guatemala, Nicaragua, Panama, Uruguay and Venezuela. Qualcomm has also released several milestones that, according to the manufacturer, demonstrate the success of the BREW solution: 28 million individual BREW-based application downloads, 8 million BREW-enabled handsets in the market, 50 BREW-enabled handset models in the market, 7 network operators on 4 continents with commercial BREW-based service.

Siemens ICM has created what it claims is the world's first quality assurance scheme for mobile phone applications (www.siemens-mobile.com/developer). The ‘Siemens mobile Optimized Test’ and assurance logo will let developers prove the outstanding quality of their product. The test-

ing scheme is open to any developer of Java applications for Siemens handsets.

Alcatel has announced it will open its 3G Reality Centre in China to application developers in the Asia Pacific region, to jointly work on multimedia mobile medical applications to contribute to the current anti-SARS fight. Such applications can include mobile "tele-medicine" and remote temperature follow-up with discharged patients, which will be of great help in the anti-SARS campaign.

Forums and Industry Alliances

Telefónica Móviles, T-Mobile International and TIM (Telecom Italia Mobile) have announced a cooperation to set up an alliance to provide their customers with a unified and superior offering of products and services in all the countries where the three operators are present. The alliance's first outcome will be that, via roaming agreements, the partners will be able to develop new joint offers in voice, data and mobile internet.

After the merge between the Parlay Group and the PAM Forum, PayCircle and Parlay Group have announced the creation of an application programming interface to promote interoperable payment services over 3G networks, and have released a co-branded specification called Parlay X Web Services APIs.

A group of fixed wireless providers, including among others Intel, Nokia, Alvarion, Proxim, Fujitsu, Wi-LAN and the OFDM Forum technology special interest group, have created the WIMAX venture in order to promote certification of equipment interoperability in this market.

The Global mobile Suppliers Association (GSA) has announced the creation of the GSA APAC Chapter to support the growth of GSM/EDGE/WCDMA to ensure full communication, information sharing and industry support for the Asia Pacific market. The GSA APAC Chapter has started its activities focusing on supporting business development in Thailand, Indonesia and The Philippines, with Alcatel, Ericsson, Nokia and Siemens as the initial contributors.

Wireless, PMR and Public Safety

Project MESA has adopted a work plan that foresees the completion of the necessary technical specifications as early as the end of 2004. Project MESA is an international partnership project between the European Telecommunications Standards Institute (ETSI) and the Telecommunications Industry Association (TIA) of the USA. During a meeting in Ottawa, it was decided that some of the key technologies to drive these requirements should be based on fully wireless system infrastructures, which have never been realized before. Within MESA, the Service Specification Group (SSG) was given responsibility for capturing the requirements of the future "MESA Market" from a variety of user bodies and for producing the Statement of Requirements (SoR). This document is now being used by MESA's Technical Specification Group (TSG) as a basis for the development of the MESA Technical Specifications.

Motorola has announced it has been commissioned by the Hong Kong Police to deliver its third generation Command and Control Communications system (CC3). The agreement calls for Motorola to deliver a completely integrated command and control communications system consisting of four components: a digital trunked radio communications system based on the TETRA standard, with voice and data capabilities; 999 emergency telephone system with automatic emergency caller number and location identification capability; a mobile computing system; and automatic vehicle lo-

cation system (AVLS). China's Tianjin Light Rail has also announced that it adopted Motorola's TETRA system to ensure the overall coordination, security and communications efficiency for the transportation system. Dubbed as the "Golden Commercial Bridge," Tianjin Light Rail spans 45.4 kilometers at speeds as high as 100 kilometers per hour. The US manufacturer has also been awarded a contract to provide a Train Dispatch Radio System (TDRS), using TETRA, for Taiwan Railway Administration (TRA). The system, expected to be fully operational by end 2005, will be the largest TETRA railway network in Asia-Pacific. Motorola CGISS will supply a 380-400 MHz TETRA digital radio communication system to cover 1100km of track and 201 train stations. Other contracts awarded to Motorola include a 800 MHz ASTRO SmartZone trunked radio system for the State of Colorado and a ASTRO digital two-way mobile communication solution, compliant with the APCO 25 standard, for the City Police of St. Petersburg and the Leningrad Region. The system for the State of Colorado, designed to provide approximately 95 percent mobile coverage along major highways throughout the state, will include 120, four-channel sites and five upgraded dispatch centers with Motorola CENTRACOM Gold Elite dispatch consoles to manage communications around the state. The St. Petersburg network, provided for the celebration of the city's 300th anniversary, has an extended coverage including three zones, 18 channels, 300 digital two-way radios and a control center to manage talk groups in real time.

Nokia and Beijing Just Top Network Communications Company Limited have signed a contract to build the first phase of the Beijing municipal government's shared Digital Professional Mobile Radio (PMR) communications network, using Nokia's TETRA system with IP backbone. According to the companies, the TETRA network in Beijing will become China's largest and most advanced digital trunking communication network with the richest functionality. The first construction phase of the entire network, supporting 50,000 subscribers and completely covering Beijing metropolitan area, nearby key counties and major parts of the main highways, will be completed in the first half of 2004. The second phase will be finished by 2006, when the network will support 150,000-200,000 subscribers.

Other News

Nokia, the International Youth Foundation (IYF), Pearson and the United Nations Development Programme (UNDP) have launched BridgeIT, an innovative program that uses mobile technology to bring interactive, multimedia learning materials to local classrooms around the world. The program will be tested in the Philippines in an initial country-wide pilot, beginning in June, with a view to expanding its geographic reach and range of educational content. Ericsson and the International Federation of Red Cross and Red Crescent Societies (IFRC) have launched the Ericsson Response humanitarian assistance program for Central America and the Caribbean. The pilot project will operate from the Pan-American Disasters Response Unit (PADRU) based in the former Howard Base near the Panama Canal. PADRU will maintain two containers of Ericsson mobile network equipment that can be deployed quickly to a disaster area. Each container includes hardware and software to allow the simultaneous operation of 12 phone lines. Additionally, Ericsson has provided PADRU 1,200 mobile terminals. The Wireless Foundation has announced a partnership with the American Red Cross to develop a program to communicate with blood donors via wireless text messages.

China Mobile is putting a GSM base station on Mount Everest in order to support a team that will send news of their ascent via SMS and MMS. Although wireless operating equipment generally should work below a height of 4000 meters, the Chinese operator will be the first carrier to bring wireless connectivity to a height above 5100 meters.

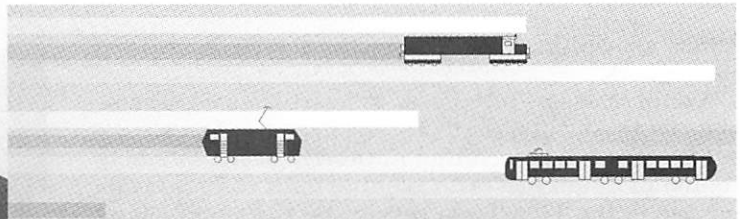
NTT DoCoMo has announced it is the first Japanese mobile operator to incorporate recycled ABS resin in mobile phone accessories. The first resin-based accessory is an optional desk-top charging stand for the new mova D505i. ABS resin is an engineering plastic compound that is lightweight, highly shock resistant and easy to recycle, making it an ideal material for production of mobile phones and accessories. The Japanese operator has also announced that it has sold more than 10 million camera phones since launching the first model, the mova SH251i, on June 1, 2002.

The CDMA Development Group (CDG) reported that a record-breaking 12 million users signed up for CDMA services in the fourth quarter of 2002, bringing the total number of CDMA subscribers to nearly 147 million, including 33 million 3G CDMA2000 users. According to CDG, CDMA was the fastest growing wireless technology in 2002, with a 32% increase in the subscriber base, compared to 24% for the overall industry. With 89 million users, the Americas are

the biggest market for CDMA. It continues to dominate North America with 62 million subscribers representing 44% of all users in the U.S. and Canada. The expansion of CDMA in China contributed to significant gains in the Asia-Pacific region; more than 13 million CDMA subscribers were added in 2002. Asia has the highest proportion of 3G subscribers, driven mainly by the success of CDMA2000 services in Korea and Japan. CDG also reported there are 130 CDMA networks in commercial operation on five continents. On the other hand, and according to 3G Americas, GSM increased its digital cellular subscriber base in the Americas by 54% in 2002, the largest percentage gain of any wireless technology in the region. In Latin America, GSM increased its subscriber base by 90% in 2002. Globally, GSM added over 165 million new customers in 2002.

April 3rd marked the 30th anniversary of the first public telephone call placed on a portable cellular phone. The call was made between Motorola and AT&T's Bell Labs.

Alcatel has announced the signature of a contract with Telecom Namibia to deliver its high-performance Local Multipoint Distribution Service (LMDS) solution and high-capacity urban microwave radio systems, making it the first LMDS network deployment in Southern Africa.



Transportation Systems

Harvey Glickenstein, Senior Editor

Phoenix is proposing an extension of the light rail system, which is presently under design. The existing design is for a 20-mile starter line. It will operate from the Phoenix Spectrum Mall through Tempe to Mesa.

The four-mile extension north from the end of the starter line at Bethany Home Road to Metrocenter would be intended to enter revenue service in 2010—four years after completion of the first 20 miles of line.

The Phoenix, Arizona light rail project was funded to the tune of \$12 million in the Transportation Department budget that was approved by Congress. This project, together with Seattle's Sound Transit Central Link light rail line were the only two projects that had received the "highly recommended" rating from the Federal Transit Administration.

The Department of Rapid Transit Systems (DORTS) of Taipei has awarded a design-build contract for a nine-mile extension of the rubber-tired Mucha Line. The extension, called the Neihu Line, will be mostly elevated and will have twelve stations.

Bombardier will provide 202 new vehicles, install a new automatic train control system, and retrofit the 102 existing Mucha Line cars with the new train control system.

The line is to open in three stages. The first six miles, which will need 60 vehicles, is scheduled to open in the sum-

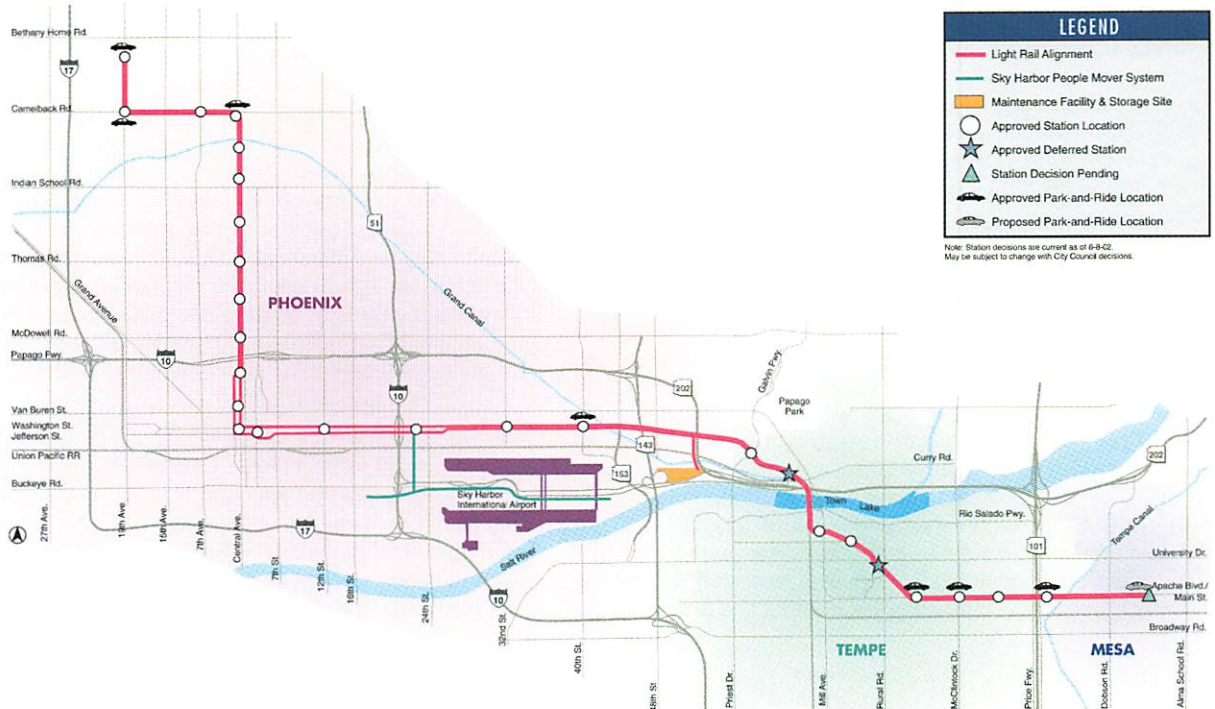
mer of 2007. The second stage is scheduled to open in late fall of 2007, with the last stage scheduled to open in the spring of 2008.

In April the consortium Metronet signed the formal contracts to take over responsibility for upgrading, replacing, and maintaining about two-thirds of the London Underground infrastructure. The consortium is made up of five companies—Atkins, Balfour Beatty, Bombardier Transportation, SEEBOARD, and Thames Water. The 30-year contract with the consortium is a Public Private Partnership (PPP) arrangement that is part of the privatization scheme for the London Underground. Separate PPP contracts were let for the Bakerloo, Central, Victoria, and Waterloo & City Lines and for the Metropolitan, District, Circle, Hammersmith & City, and East London Lines.

Bombardier will provide new rolling stock and signaling and maintenance. At the start of the contract Bombardier will start resignaling the Victoria and Sub-Surface Lines, refurbish the rolling stock on the District Line, and build two pre-production trains for the Victoria Line.

Balfour Beatty will perform the bulk of the track work, and a joint venture of Balfour Beatty, Thames Water,

LIGHT RAIL TRANSIT STARTER SEGMENT



Atkins, and SEEBOARD will be responsible for the civil and station work.

A third company, Tube Lines, will have similar responsibility for the Jubilee, Northern, and Piccadilly Lines.

FGV, the transportation authority of the Valencia region of Spain has ordered nine light rail trainsets for use in the Tren-Tram service on the 30-mile long line between Alicante and Altea.

The trainsets, consisting of three articulated cars each, will have a capacity of 99 seated and 204 standing. The meter-gauge vehicles will have a top speed of 43.5 mph in street running and 62 mph on private right-of-way. The trainsets will have ac traction motors. Power will be received from an overhead catenary at 750 volts dc. They will have an acceleration of rate of 2.7 mph per second and a braking rate of 3.36 mph per second. The vehicles will have floor heights of 15¾ inches and 34½ inches.



BOMBARDIER
TRANSPORTATION

New vehicles for London's District Line



BOMBARDIER
TRANSPORTATION

Extension for the Mucha Line



Artists conception of the Alstom Tren-Tram vehicle.

COURTESY ALSTOM



Alstom is scheduled to deliver the vehicles starting in May 2005, with the last vehicles being delivered in October 2005. The total value of the vehicle contract is 46 million.

The new Metro Line 9 in Barcelona, Spain will use spread spectrum radio as part of its Communications Based Train Control (CBTC) system. Siemens; Dimetronic (a Spanish subsidiary of Invensys—the parent company of the American company Safetran); and EMTE sistemas, a Spanish manufacturer of telecommunications equipment, will furnish the train control system, the interlocking equipment, and the operations control center.

Construction of the new line started last year. It is almost 26 miles long and will have 43 stations. Starting in the northern suburbs it will connect all five existing metro lines and six surface rail lines and will end at the airport south of the city. It will also serve the Sagrera Station of the high speed rail line between Madrid, Barcelona, and the French border.

The line will be fully automated, similar to the Paris Meteor Line. It is scheduled to open in stages starting in 2005 and to be completed in 2008.

The Florida High Speed Rail Authority (HSRA) is the process of reviewing the four proposals they re-

ceived for the proposed high-speed line from Tampa to Orlando. Exotic proposals, such as the one proposing an evacuated tube within which passenger modules would be shot from station to station, are not anticipated to make the cut. The HSRA is expected to approve one of the conventional rail solutions using technology that has been demonstrated within the U.S. or overseas.

Supporters of the system beat back an effort by Governor Jeb Bush to have the state legislature put an amendment on the ballot rescinding the constitutional amendment requiring the construction of a high-speed line between Tampa And Orlando. The project supporters were not able to get the previous \$70 million funding for high-speed rail restored, but \$7 million for the HSRA was included in the budget. This allows the HSRA to continue reviewing the proposals, but does not allow for award for construction.

Another unknown is the route that the line will take between Disney World and the Orlando Airport. Orange County would like the line to go through downtown Orlando and serve the Orange County Convention Center. Disney is opposing that route, preferring a more direct non-stop route between the airport and Disney World. Disney has threatened to retain the shuttle bus service it now provides if the new line serves the convention center. A decision as to the route is expected to be made this summer.

The TRAX light rail extension to the University of Utah medical complex east of downtown Salt Lake City will open in September. This is over a year ahead of the previous schedule.

The Charlotte Area Transit System (CATS) received a Record of Decision from the Federal Transit Administration for the South Corridor Light Rail Project. The South Corridor is a ten-mile long line running south from Uptown Charlotte to Interstate 485. It will have 15 stations and will operate on its own tracks within an existing rail right-of-way.

Final design has begun with the construction planned to start this Fall. Revenue service is planned to begin in 2006.

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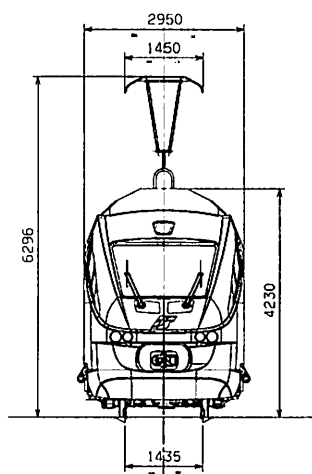
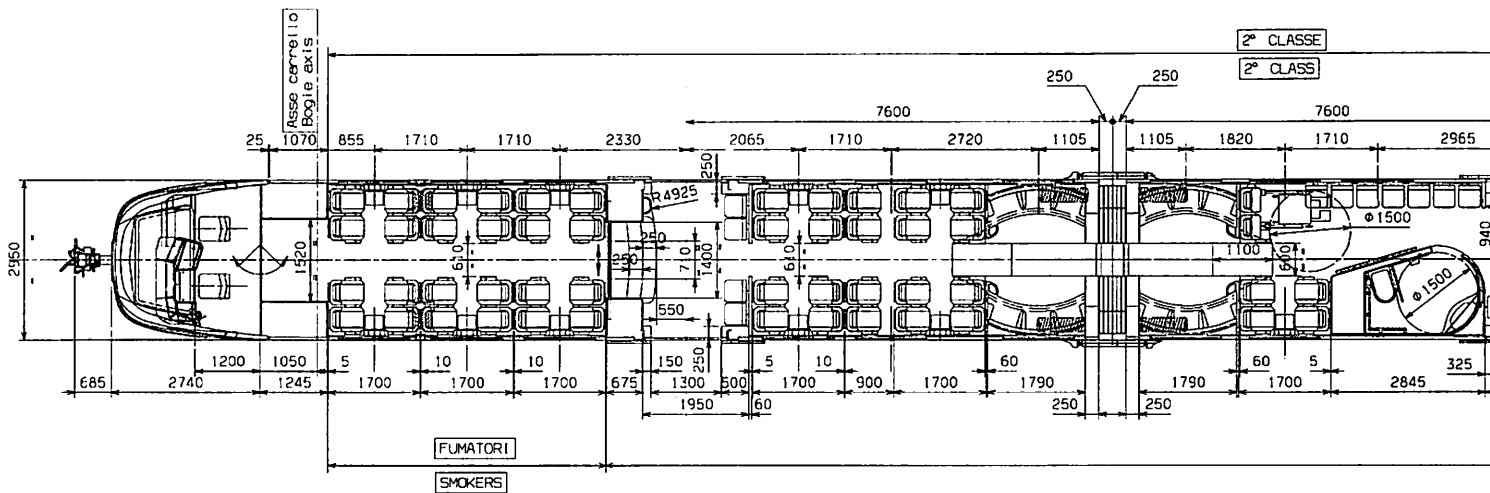
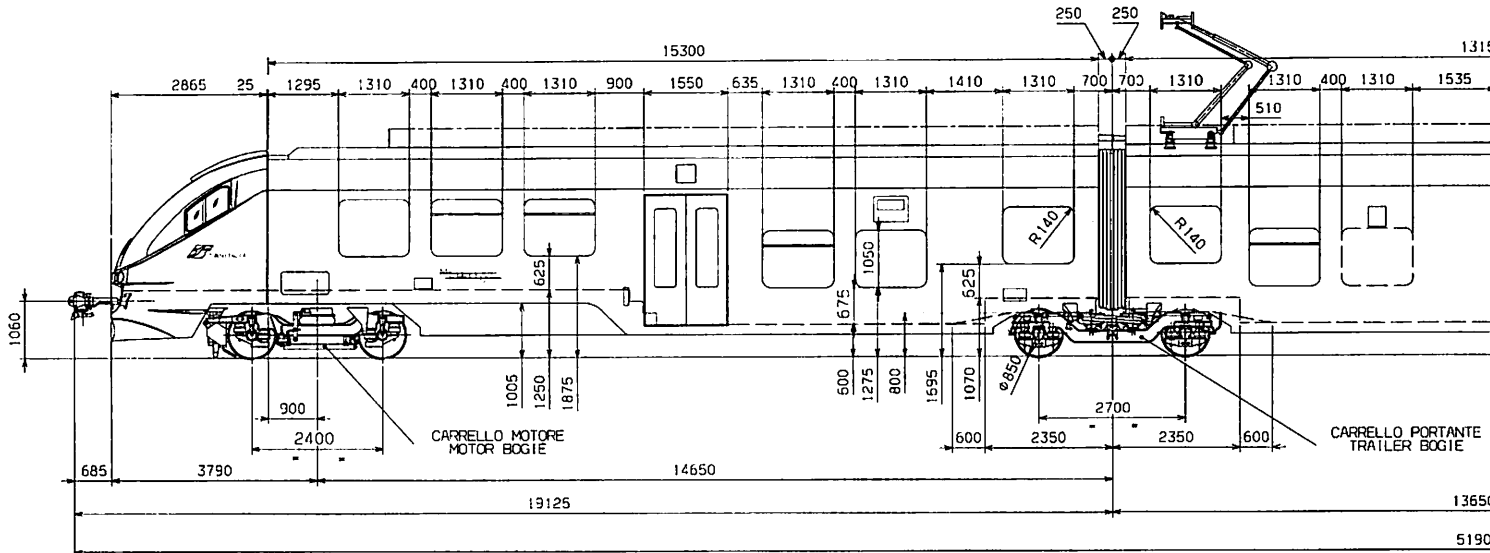
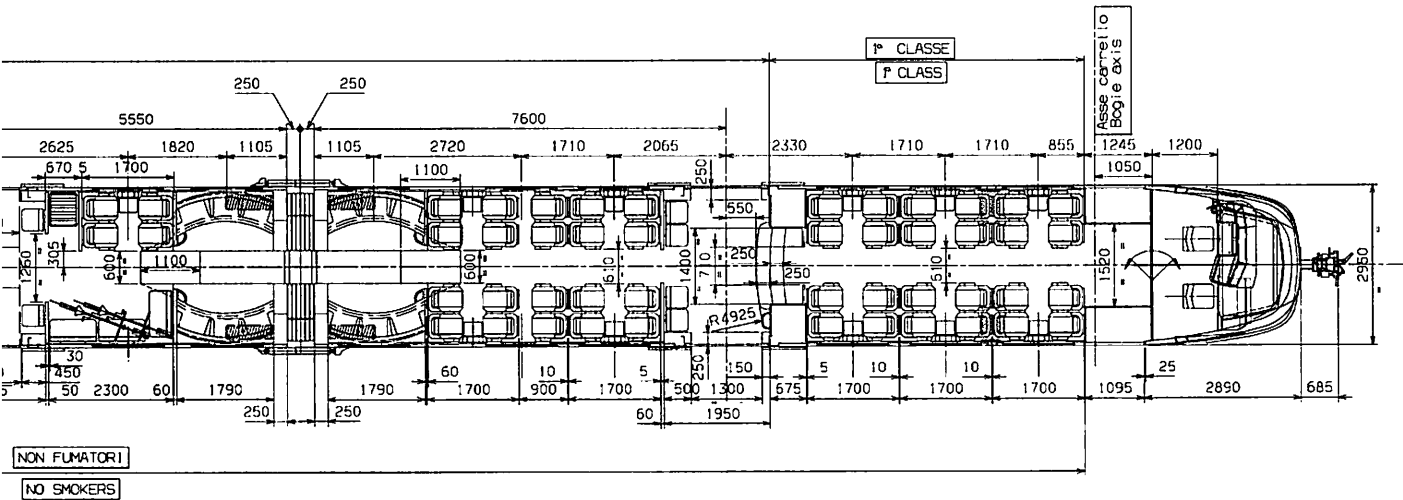
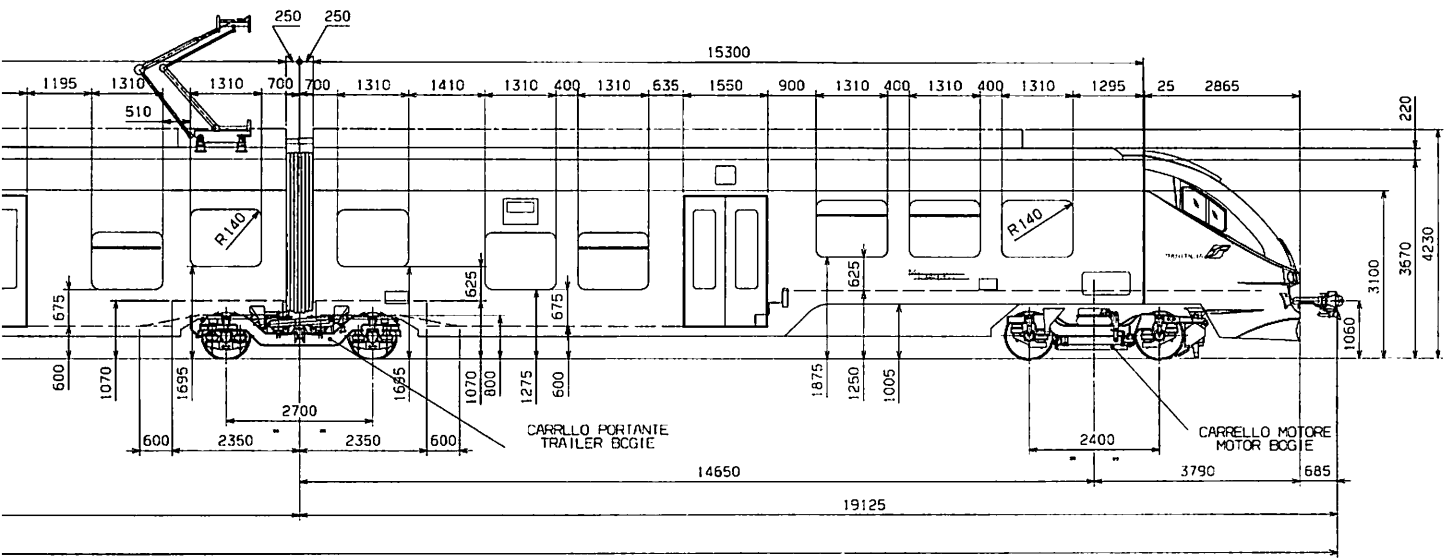
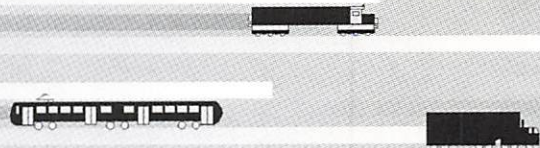


TABELLA RIASSUNTIVA POSTI A SEDERE
SUMMARIZING LIST OF SEATS

TIPO TYPE	ELEMENTO DI TESTA A COACH ELEMENT A		ELEMENTO INTERM. M INTERM. ELEMENT M		ELEMENTO DI TESTA B COACH ELEMENT B		TOTALE CONVOGLIO
	72691 - A		72692 - M		72693 - B		
	MOTRICE TRACTOR		RIMORCHIATA TRAILER		MOTRICE TRACTOR		
	1° CLASSE CLASS	2° CLASSE CLASS	1° CLASSE CLASS	2° CLASSE CLASS	1° CLASSE CLASS	2° CLASSE CLASS	
POSTO BICICLETTE BICYCLES PLACE				2			2
POSTO DISABILI AREA FOR WHEELCHAIRS				1 HK			1 HK
POSTI STRAPUNTINO FOLDING SEATS		4		15		4	23
POSTI FUMATORI SMOKING PASSENGERS						24	24
POSTI NON FUMATORI NO SMOKING PASSENGERS	24	26		22		26	98
POSTI TOTALI SENZA HK TOTAL SEATS WITHOUT HK	50 + 4		22 + 15		50 + 4		145 (122+23)
POSTI TOTALI CON HK TOTAL SEATS WITH HK	50 + 4		20 + 15 + 1 HK		50 + 4		144 (120+23+1 HK)



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	MODELLO: TGV	MODELLO: TGV
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Advances in Mobile and Wireless Communications Highlighted in Korea at Spring VTC

George F. McClure

Over 650 attendees heard of the progress on all fronts in mobile communications and wireless networks at the April conference held in the just-completed beautiful conference center on Jeju Island off the south coast of Korea.

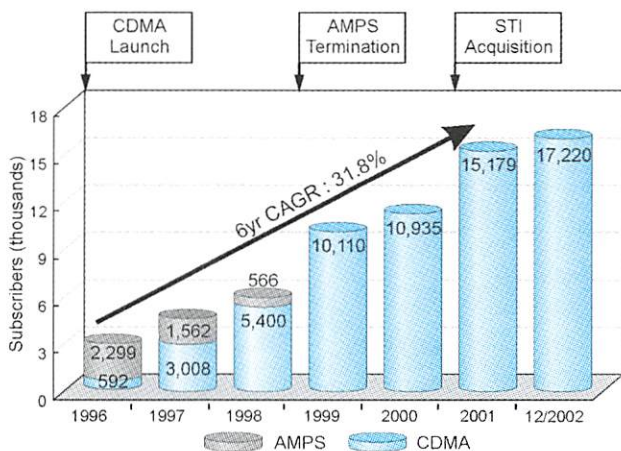
General Chair Professor Jae J. Lee reported that 588 papers were selected for the conference and published in the proceedings. The three-day conference was preceded by a day of tutorials, with two full-day and four half-day tutorials presented.

Four presentations addressed the state of wireless/mobile communications in Korea, and directions for the future, by speakers from ETRI, SK Telecom, Samsung Electronics, and KTF. The first three were made in the plenary session and the last one was presented at the banquet.

South Korea is quite advanced in the adoption of wireless and of wideband Internet connections. In the plenary session speakers highlighted

- ◆ the directions of 4th generation (4G) mobile communications technology development in Korea;
- ◆ experience with 3G systems and the view beyond 3G; and
- ◆ the future of wireless telephony networks.

Myung Sung Lee from SK Telecom noted that the rapid growth in wireless services in Korea since 1995, when the wireless subscribers numbered less than a tenth of wireline, resulted in the number of wireless subscribers surpassing wireline subscribers in 1999. By 2002 there were some 40 percent more wireless subscribers. With a population of 48 million, South Korea has over 32 million wireless users.



Subscriber growth for SK Telecom in Korea

Penetration of broadband Internet connections is higher in South Korea than anywhere else – some 68% of households, compared to 28% in Canada, 15% in the U.S., and 8% in western Europe, according to *The Economist*.

Wireless services offered in Korea have evolved from basic voice and short message service (SMS) in 1996 (2G) in 1996 through 3G in 2003, which added distinctive ring tones (“color ring”, for which SK Telecom expects 4 million subscribers by mid-2003) and location services such as telematics and map service, as the bandwidth grew from 64 kbps up to 2.4 Mbps, with Wideband Code Division Multiple Access. For the future, beyond 3G, services available can include multimedia service (MMS) – voice on demand, video streaming, and video telephony, with bandwidth approaching 100 Mbps, a limit that is technology driven.

Seamless service is already here, with the same wireless unit used with the mobile subscriber and also in the office, where the subscriber’s presence can be sensed by the PBX and his calls routed either to his wireline desk set or to him personally anywhere in the building through wireless LANs.

Developing services include Broadcast Multicast Service (BCMCS) through the 1xEV-DO hybrid voice and data network, and Multimedia Broadcast Service (MBS) through the WCDMA network. Samsung Electronics anticipates “converged operation” – a ubiquitous network, including 1x, EV-DO, wireless PABX, WLAN, and Bluetooth, offering always the best connection. The goal is convenient, efficient service anywhere, anytime, with the added feature of fun and stylish subscriber sets to appeal to the widest possible market.

Third-generation mobile phone networks have been more of a technology challenge than a financial triumph, owing to the high price operators paid for licenses to run 3G networks (100 billion euros, worldwide, according to *The Economist*). However, the prospects are better for 4G, with Wi-Fi-style Internet access, and the blanket coverage of mobile networks. The convergence of wireless and broadband provides the capability of a fast Internet connection that follows the user around.

On hand at the Awards Luncheon to receive VTS 2003 awards were Professor Matthias Patzold, one of three authors of the 2002 Neal Shepherd Memorial Best Propagation Paper Award, and Professor Gordon Stuber, who was awarded a James R. Evans Avant Garde Award.

Organizations participating in the conference in addition to IEEE included the Korean Institute of Communication Sciences, the Korea Information Science Society, and the Institute of Electronics Engineers of Korea.

Travel beyond 3G ... Visit VTC2003-Fall in Florida

VTC2003-Fall will be held in Orlando, Florida, October 6-9, 2003. VTC has been showcasing the finest research in mobile communications since the early 1950s, and this year the conference will be looking towards 4G.

Technical Sessions

VTC2003-Fall in Orlando will be the biggest VTC ever in terms of papers, with over 720 papers and posters being presented over the three days of the conference. These were selected from a total of 2400 submissions, also a record for VTC. The large number of submissions meant that although we have tried to accommodate as many papers as possible, many excellent papers had to be rejected. The result, however, is a varied program of high quality contributions from across the spectrum of wireless communications and vehicular technology.

In an experiment this year, a number of symposia have been included in the program. Some of these symposia are focussed on specific areas, such as IP Mobility, while others, such as Wireless Communications: 3G and Beyond are more wide-ranging. The conference sessions have been arranged in tracks as usual, with specialist symposia appearing in the relevant track. However, take care to check the more general symposia for papers which you may find of interest, and remember that most symposia also have a corresponding poster session.

The full program is available at the VTC web site, www.vtc2004.com.

Location

VTC2003-Fall will be held in the Hyatt Orlando, conveniently located in Kissimmee, 1.5 miles from Walt Disney World Resort. The local attractions make it an ideal family destination, and Orlando International Airport has a wide range of international connections.

Sponsoring and Exhibiting

VTC2003-Fall will feature a number of exhibits. If your company is interested in exhibiting, contact JBudwey@HHEvents.com or visit www.hhevents.com

Panels

Two panels will be held on the evolution of 3G standards, and on technologies which can shape the industry beyond 3G, to allow attendees to seek the opinion of key industrial figures.

Evolution of 3G standards (HSDPA and 1xEV-DV) and their enabling technologies

Chair: Gibong Jeong, *Texas Instruments, USA*

Panelists: Young C. Yoon, *Ericsson, USA*; R. Thomas Derryberry, *Nokia Research Center, USA*; Hyeon Woo Lee, *Samsung Electronics Co., Korea*; Rob Dalgleish, *Nortel Networks, USA*; Erik Dahlman, *Ericsson, Sweden*

Many wireless operators are indeed rolling out 3G cellular networks to meet demand for data services; the cdma2000 systems has already been deployed in Asia and North America, and the WCDMA systems are gaining wider acceptance in Japan and started deployment in Europe. However, the prices for high-speed data service are still high. For inexpensive data service, the 3G systems must be evolved toward (1) increasing user data throughput and efficiency of the air interface while managing mobility in outdoor environment and (2) providing truly packet-switched air interface while allowing for concurrent services of voice and data. To address the demand, the two 3G standardization bodies responded with evolved 3G specifications, known as 1xEV-DV and HSDPA.

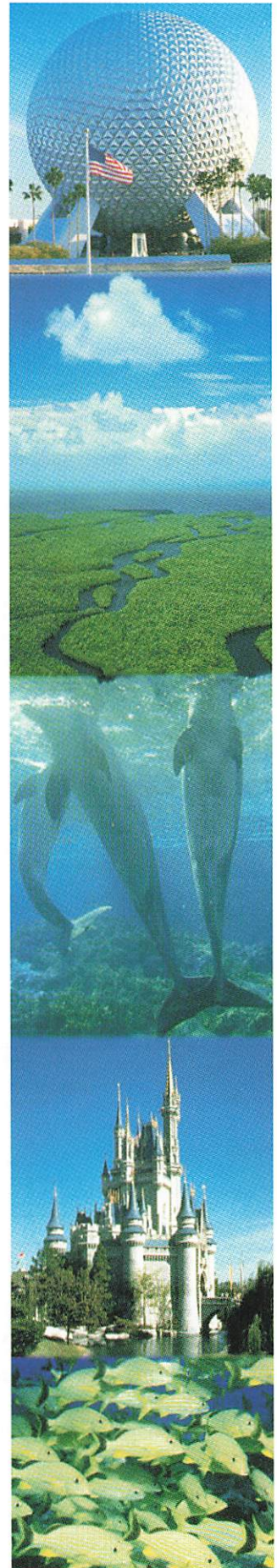
The 3G evolution aims at taking advantage of the interplay between physical layer technology (link adaptation and hybrid-ARQ) and MAC layer packet scheduling. However, an optimal design across physical and MAC layers opens many new system issues. To address these issues, this panel, consisting of experts in HSDPA and 1xEV-DV technologies, will discuss the following: (1) capacity and data throughput improvement: assessment methodology and predicted improvement; (2) the key enabling technologies: adaptive modulation-and-coding, hybrid-ARQ, packet scheduling, multiple antenna (multiplexing vs. diversity); (3) advanced receiver: interference cancellation, equalization; (4) radio access network technology: fast cell switching, packet routing; (5) inter-working between MAC-layer error control and link-layer error control; (6) TCP/IP over wireless packet channel, seamless roaming to/from WLAN. We expect that the discussions will give perspectives on fundamental issues and check common understanding between two different standards and between mobile and network equipment developers.

Beyond 3G – The Future of Wireless – Fixed and Mobile Communications Technologies

Chair: William C.Y. Lee, *LinkAir Comms, Inc., USA*

Panelists: Jack Winters, *Jack Winters Communications, LLC, USA*; Anil Kripalani, *Qualcomm Inc, USA*; Neil D. Schuster, *ITS America, USA*

With the rapid growth in wireless communications technologies and applications, this panel is initiated to discuss the B3G, which





Conference Registration

Register online @ www.vtc2003.com
Kissimmee, Florida 6-9 October 2003



1. Please Print All Information

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I am a paper presenter/paper number _____ (Authors must supply this information)

2. Conference Registration Fee	Thru 26-September 2003	At Conference	TOTAL
IEEE Member*	\$575	\$650	\$ _____
Non-Member*	\$650	\$725	\$ _____
IEEE Life Member **	\$175	\$225	\$ _____
Student Member **	\$175	\$225	\$ _____

FOR AUTHORS ONLY An excess page charge of \$100 is required for papers exceeding 5 pages in total length

*Full Registration includes entry to all sessions, Conference Record CD, Welcome Reception & Tuesday Lunch, Wednesday Awards Luncheon and Thursday Lunch
**IEEE Student Member & Life Member Registration includes entry to sessions, Conference Record CD & Welcome Reception. Student ID required to verify full time status.

3. Tutorial Registration

If it is necessary to cancel a tutorial, liability of VTC 2003-Fall is limited to return of tutorial fee (see website for tutorial details).

Please check all Tutorial Sessions you plan to attend. Tutorials are on Monday 6 October. **Select at most one from each time period (AM or PM).**

AM Tutorial	<input type="checkbox"/> T1	<input type="checkbox"/> T3	<input type="checkbox"/> T5	<input type="checkbox"/> T7	<input type="checkbox"/> T9	<input type="checkbox"/> T11	<input type="checkbox"/> T13	<input type="checkbox"/> T15
PM Tutorial	<input type="checkbox"/> T2	<input type="checkbox"/> T4	<input type="checkbox"/> T6	<input type="checkbox"/> T8	<input type="checkbox"/> T10	<input type="checkbox"/> T12	<input type="checkbox"/> T14	<input type="checkbox"/> T16

Tutorial (per tutorial) Thru 26 Sept. 2003: Member \$245, Non-member \$270; At conference Member \$270; Non-member \$295) \$ _____

4. Optional Items

Extra CD Proceedings	_____ @ \$25	\$ _____
Extra Reception Tickets (Tuesday)	_____ @ \$40	\$ _____
Extra Lunch Tickets (Tuesday)	_____ @ \$35	\$ _____
Extra Lunch Tickets (Wednesday Awards Luncheon)	_____ @ \$35	\$ _____
Extra Lunch Tickets (Thursday)	_____ @ \$35	\$ _____

5. Conference Payment

Total 2 + 3 + 4 = \$ _____

Cancellation Policy - All Cancellation must be in WRITING. All cancellation refunds will be subject to a \$50 handling fee. No refunds can be issued for cancellation requests received after 5 September 2003. Authors are ineligible for refunds after 15 July 2003.

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includes the integration of wireless fixed and mobile communications systems, the spectrum efficiency issues, the possible variations of future CDMA systems, the integration with advanced ITS (Intelligent Transportation Systems), and the impact from Nano technologies and System-on-Chip. The five panelists will address the following topics.

- ♦ The future variations on CDMA systems (William C. Y. Lee)
- ♦ Integration of cellular systems with WLAN and Internet (Jack Winters)
- ♦ Innovations to increase capacity (Anil Kripalani)
- ♦ Wireless communications integrated with advanced ITS in the future (Neil D. Schuster)
- ♦ Impact on the future wireless communications from Nano technologies and SOC



Tutorials

A wide range of tutorials will be held on Monday, 6 October, given by experts from industry and academia. Odd numbered tutorials will be held in the morning, and even numbered ones in the afternoon.

T1: Space-Time Coding

Hamid Jafarkhani, UC Irvine

We present space-time coding to achieve diversity using multiple antennas in a wireless environment. We discuss the outage capacity of multiple antenna wireless systems to show the huge potential increase in the capacity. To approach these capacity limits we propose space-time codes. After discussing the design criteria, we introduce orthogonal space-time block codes, space-time trellis codes, super-orthogonal space-time trellis codes, and quasi-orthogonal space-time block codes. In each case, we describe the details of code design, complexity, and performance. Then we discuss differential detection schemes for transmission using multiple antennas assuming that neither the transmitter nor the receiver knows the channel. Finally, we discuss combination of space-time coding with other signal processing methods, i.e., combined array processing and space-time coding.

T2: Space-Time Signaling

Hesham El Gamal, Ohio State University

Details from helgamal@ee.eng.ohio-state.edu

T3: Smart antennas and MIMO systems

Andreas F. Molisch, Mitsubishi Electric Research Lab, and Lund University, Sweden; Juha Laurila & Klaus Hugl, Nokia Research Center, Helsinki, Finland; Ernst Bonek, Technische Universität Wien, Austria

Smart antennas are one of the most promising methods for increasing capacity of mobile radio systems. Research into this subject has grown explosively in the last five years. MIMO systems, which use multiple antennas at both link ends, are able to increase the capacity even further. The tutorial will give a comprehensive overview over all relevant aspects of both smart antenna and MIMO systems. Mea-

surement and modeling of the spatial propagation characteristics, which form the physical basis for any smart antenna system are discussed as well as signal processing algorithms, hardware architectures, experiences from the construction of an actual testbed, and capacity issues.

T4: MIMO communications with Partial Channel State Information (CSI)

Georgios B. Giannakis, University of Minnesota, and Shengli Zhou, University of Connecticut

Adaptive modems relying on channel state information (CSI) that must be perfectly known and regularly updated at the transmitter can boost rates, only when the fading is sufficiently slow. On the other hand, the proliferation of space time (ST) coding research we have witnessed lately, testifies to the efforts put towards the other extreme: non-adaptive (and thus conservative) designs requiring *no* CSI to be available at the transmitter. As no-CSI leads to robust but pessimistic designs, and perfect-CSI is a utopia for most wireless links, exciting recent research deals with multi-input multi-output (MIMO) multi-antenna systems based on *partial* CSI, which offers the "jack of both trades," while encompassing the perfect-CSI and no-CSI paradigms. Such systems are the focus of this tutorial.

T5: A Unified View of Ultrawideband Communications

Ahmed H. Tewfik, University of Minnesota

Details from tewfik@ece.umn.edu

T6: Insights on OFDM Technology, Applications and Research Issues

Vijay Bhargava, University of British Columbia, Canada

Details from v.bhargava@ieee.org

T7: Joint Physical and Network Layer Optimisation of Wireless Systems: Smart Antennas, Turbo Coding, Space-Time Coding, Adaptive Transceivers and 'all that' for Improved QoS

Lajos Hanzo, University of Southampton, UK

Based on three Wiley/IEEE Press monographs authored by the presenter, this short course provides an insight into the effects of turbo-coded, turbo-equalised and space-time coded adaptive TDMA, CDMA and OFDM transceivers as well as smart antennas and a range of other efficient networking techniques on the achievable teletraffic capacity of adaptive wireless systems. Conventional systems would drop a call in progress if the communications quality falls below the target quality of service and it cannot be improved by handing over to another physical channel. By contrast, the adaptive transceivers considered simply 'instantaneously drop the throughput, rather than dropping the call' by reconfiguring themselves in a more robust mode of operation. The tutorial demonstrates that the proposed beam-forming and adaptive transmission techniques may double the expected teletraffic capacity of the system.

T8: An Introduction to Interference Mitigation Techniques for Wireless Communication

Prof. Peter Stavroulakis, Technical University of Crete

Over the last few years the subject of interference as a self-contained discipline, has been followed with special attention. The field of communications has experienced an unprecedented expansion and development on theoretical and

applied fronts (radio, mobile, fiber, and satellite), and interference presents unavoidable limitations to capacity, efficiency, reliability, and cost of systems. Interference mechanisms must therefore be fully understood for optimal communication systems to be designed. This tutorial seeks to cover all modern tools of interference analysis for wireless communication systems and presents the most relevant ways for reduction and/or cancellation of interference. Fading is also approached as an interference problem. This work will be an essential set of material for graduate students, researchers, practicing engineers and instructors in the general field of wireless communication systems.

T9: Game theory and its application in wireless communications

Markus Radimirsch, University of Hannover, Germany

Game theory is a mathematical field dealing with situations where two or more actors compete for a limited resource. The frequency resource in radio networks is limited due to mutual interference. The principle behind it is to find equilibria where no actor has a benefit from deviating. The purpose of this tutorial is to introduce the basic terms and methods of game theory: Among them are equilibria and their optimality, expressed in terms of Pareto efficiency. Some application examples in wireless communications shall give a notion of the capabilities and limits of game theory in the considered field.

T10: Enhanced Receiver Technologies for 3G and Beyond

Sofiene Affes, INRS, University of Quebec; Henrik Hansen, Ericsson

This tutorial will provide a general survey of recent research on multiuser detection and interference cancellation for 3G cellular applications and beyond. We will discuss enhanced channel acquisition and use of adaptive/smart antennas as critical components of novel MIMO multi-user transceiver technologies. We will also show that enhanced radio-network design allows significant optimization of interference suppression gains as well as complexity reduction of MIMO multi-user receiver processing structures. We will finally present a generic business case that demonstrates to participants the potential revenue gains that could be achieved by these low-cost spectrum-efficient high-speed receiver implementations.

T11: Radio Resource Management in Wireless Multimedia Networks

Halim Yanikomeroglu, Carleton University, Canada, Mohamed Hossam Ahmed, Memorial University, Canada, and Bassam Hashem

It is expected that there will be a strong market for a rich variety of wireless internet-based multimedia devices in a not-too-distant future. It is quite difficult to predict the nature of these devices as well as the corresponding applications from today; but, it is certain that those devices and applications will have very different QoS, rate, delay, and power constraints. Arguably, effective RRM is not only essential in such future networks, but it is *the* key element in feasible and affordable deployment and operation of these networks. This tutorial will discuss the fundamental dynamics of RRM along with the current advances in the field; many implementation issues will be addressed as well.

T12: The Theory and Practice of Wireless LANs and Wireless MANs: Design, Performance, Architecture and Applications

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The market response to IEEE 802.11 WLAN standard-based products has been extremely positive. The broadband fixed wireless access industry has matured to 802.16, which sets the stage for widespread deployments worldwide. This tutorial will explain the key design aspects of 802.11 and 802.16, and illustrate how technology innovation and market forces are shaping their evolution at different stages. We will give an overview of 802.11 and 802.16 specifications, followed by their applications and current commercial focuses. The theoretical and real-world performance will be discussed, along with their impact on higher layer networks and applications. We will then briefly address the large scale deployment and management of WLAN/MAN systems. The final part will be devoted to future directions and open research issues.

T13: 4G Wireless Networks: Architectures, QoS, and Issues

Upkar Varshney, Georgia State University

With recent advances in 3G wireless networks, the research and development efforts now are directed towards 4G wireless networks. The 4G networks will allow users to roam across multiple heterogeneous wireless networks. The support for such roaming, high bandwidth services and the emerging wireless Internet applications require significant amount of research and development efforts. In the proposed tutorial, we will cover issues in 4G wireless networks, possible network architectures, QoS schemes, and open research problems. Issues related to QoS support for transactions in the wireless Internet environment will also be covered. We will address 4G services and contents including mobile commerce services.

T14: Radio Resource Management Strategies for QoS Provision in UTRA

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The definition and assessment of suitable Radio Resource Management (RRM) strategies for the UTRA segment of UMTS is a key issue for achieving the expectations created on 3G technology regarding the provision of new wideband multimedia services. Additionally, RRM strategies are not subject of standardisation, so that they can be a differentiation issue among equipment producers and operators. RRM functions in UMTS include admission and load control, packet scheduling, handover and power control. Under this context, this tutorial aims at presenting an overview of these functions taking into account the constraints imposed by the UMTS radio interface architecture together with some examples of specific solutions.

T15: Security in Wireless Networks

Farooq Anjum and Subir Das, Telcordia

Wireless access networks are rapidly becoming a part of the ubiquitous computing environment whether based on 802.11 LANs in enterprise networks and public hot spots or 2G/3G/4G WANS. Amongst several other issues, security is a major concern for users as well as operators. This tutorial will focus on why many conventional security solutions and architectures are inappropriate and infeasible in these networks. Participants will learn about the vulnerabilities,

threats, and attacks that are possible in such networks as well as the research issues and open challenges. At the end we will also have some hands-on exercises demonstrating various attacks that can be launched on a WLAN and their detection by setting up a wireless network.

T16: Location Management in Mobile and Wireless Computing Systems

Waleed W. Smari, University of Dayton

The rapid growth in mobile and wireless computing technology continuous to present new challenges. Mobile users access information, independent of their location, through wireless and wired networks. In mobile computing, location management is needed whenever users move from one place to another. In order to track a mobile user, the system must store information about its current location and report new locations to a home base station. Several techniques have been proposed in order to optimally manage the location of mobile hosts. In this tutorial, we discuss basic concepts and definitions of location management, study and assess main location management techniques and algorithms and the state-of-the-art in this field. Lastly, we will identify future work and directions.

T17: Theory and Application of Ultracapacitors for Automotive Systems

John M. Miller, J-N-J Miller Des. Svcs., plc and Mark Cohen, Maxwell Technologies, Inc.

Adequate and reliable sources of energy storage in the automobile are perplexing issues that persist to this day. Hybrid electric vehicles demand energy storage systems having high pulse power and very high energy throughput life.

Fuel cell technology imposes even more demands on the energy storage system because the fuel cell stack is not a stiff voltage source, it cannot tolerate reverse current flow, nor is its behavior to discontinuous current flow understood. X-by-wire functionality is now advancing in automotive systems and with it electrification of ancillaries, some of which are critical functions that require redundant energy storage. This technical tutorial will introduce that ultracapacitor as one means of energy buffering that is capable of meeting hybrid, fuel cell, and x-by-wire transient energy storage requirements.

T18: Power Generation Systems and Integrated Starter/Alternators for Automotive Applications

Ali Emadi and Ranjit Jayabalan, Illinois Institute of Technology

This tutorial presents the power generation systems in automobiles. Major fuel cell structures, operation, and characteristics are explained. The new high power alternators are also described and their performance and system features are comprehensively outlined and compared to the conventional systems. The concept of integrated starter/alternator, a single machine that performs the function of both the starter and the alternator, is introduced from the point of system characteristics, design, and integration into the drive train of the vehicle. The current and future trends in power electronics are also highlighted from the perspective of applications to the automotive power generation systems for higher system flexibility, reliability, performance, and efficiency. This tutorial will conclude with the inherent advantages of these generation systems and the cost aspects for commercial introduction.



A New Mobile Environment: Mobile Ad Hoc Networks (MANET)

Dongkyun Kim, Kyungpook National University, Korea

Recently, interest in Mobile Ad Hoc Network (MANET) has increased due to its ability to enable the network to be easily deployed and allow all nodes with wireless interfaces to move around freely and communicate with each other without relying on a network infrastructure. To support the MANET environment, development of the corresponding protocols at different layers has been essential. In this paper, we investigate the candidate protocols proposed in the literature for each layer.

1 Introduction

Mobile Ad Hoc Networks, called MANET, have attracted much research into protocol development at each layer,

from MAC, through network, to transport layers. MANETs are attractive due to their flexibility and easy network deployment. Node mobility changes the network topologies dynamically. All nodes equipped with wireless network cards can communicate with each other by intermediate nodes forwarding packets in a multi-hop fashion even though the source-destination pairs are not within ranges of direct radio communication. This means that some of the MANET nodes must be able to participate in routing packets on behalf of source-destination pairs. Battle fields, rescue operations, large-scale wireless conferences, home networking, etc., are the candidate applications of MANET,

where the data transfer cannot rely on a fixed network infrastructure (Figure 1). When using MANETs for Internet services, some fundamental protocols used in the fixed Internet such as IP routing protocol and TCP must be modified to support the service extensions to accommodate node mobility. The MANET working group [1] of the IETF (Internet Engineering Task Force) has tried to make a standard for IP routing protocol to provide unicast services as well as multicast ones. To adapt existing IP technologies to this MANET environment, we need to modify, enhance and develop link-layer, network-layer, and transport-layer protocols currently used in the Internet.

In this paper, we present the research trends of each layer for MANET. In Section 2, MAC (Medium Access Control) protocols are described in brief. Routing protocols which are most important to support MANET due to node mobility are introduced in Section 3. In addition to how to route the packets, some problems which should be resolved when the existing TCP is used in MANET are dealt with in Section 4. Section 5 gives other research issues currently tackled in this field. Finally, we conclude this paper with a summary in Section 6.

2 How to resolve the contention at wireless shared channels : Link-Layer MAC Issues

Communication using wireless multi-hop for route acquisition, or for data transfer over the route acquired, depends on the underlying media access protocol. The lack of a centralized entity in MANET implies that a distributed control protocol is necessary for accessing the shared wireless medium. Since synchronous MAC protocols are less likely to be suitable due to the absence of the centralized server, and this is further backed by the limitations of power and bandwidth with the presence of mobility, asynchronous MAC protocols are more attractive due to their distributed operation and robustness. In the past, the carrier sense multiple access (CSMA) protocols have been used in the packet radio networks. The well-known problems associated with carrier sense protocols are the hidden-terminal and the exposed node problems. To resolve these problems, various approaches have been proposed, such as MACA (Multiple Access with Collision Avoidance) [2] using RTS (Request-to-Send) and CTS (Clear-to-Send) handshake messages prior to data transmission. Most Wireless LANs today have an 802.11 compliant wireless adapter card implementing the 802.11 DFWMAC (Distributed Foundation Wireless MAC) protocol [4], which essentially uses a similar concept to RTS/CTS handshaking. However, it adds an ACK

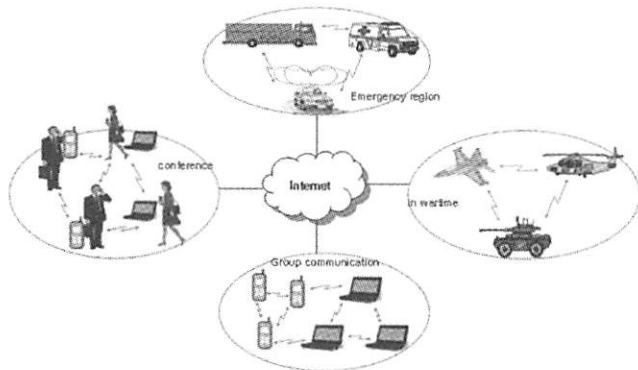


Figure 1 The Candidate Applications of MANET.

message to enhance the reliability of data transmission, which is not present in MACA. Existing asynchronous MAC protocols can be categorized into two classes, namely: (a) sender-initiated and (b) receiver-initiated. In the sender-initiated protocols, a message transmitted by the sender like RTS triggers the receiver to send a special message like CTS to the sender, which allows the sender to transmit its data packet. MACA, FAMA (Floor Acquisition Multiple Access) [3], DFWMAC fall into the class of sender-initiated protocols. In the receiver-initiated protocols, the pending arrival of data packets from the sender is predicted at the receiver and then the receiver invites the transmission of data packet without relying on the RTS message from the sender. However, in reality, it is difficult to predict the arrival of packets accurately. MACA-BI (MACA By Invitation) [5] can be put into this class. To overcome the requirement of the accurately predicting packet arrival, the MARCH (Multiple Access with Reduced Handshake) protocol [6] was developed, and this also belongs to the receiver-initiated protocol class.

In order to pursue the capacity increase of MANET with reduced channel contention and lower power consumption, MAC protocols using directional antenna or transmission power adjustments are promising avenues for further research.

3 How to route the packets between a source-destination pair: Network-Layer Routing Issues

In order to support data communications, the problem of routing data packets to their destinations must be solved. PCS, Mobile IP and cellular networks can handle the nodes' mobility by updating their location information with the concept of home network and foreign, or visiting, network. However, in MANET, since all the nodes are free to move around, they must have inbuilt functionality for routing and forwarding the data packets. In a highly mobile situation, a flooding scheme, where packets are broadcast to all nodes, is the most reliable. However, since the link channel resource is very scarce, more efficient schemes must be devised. Distance vector and link state protocols used in the existing fixed networks are not suitable for supporting host movements. Variations of distance vector and link-state protocols have been suggested to solve the routing problem. We can classify all candidate protocols for MANET from several viewpoints (Figure 2).

In the first dimension, we can categorize the routing protocols proposed in the literature into proactive and reactive routing protocols. In proactive protocols, all nodes in MA-

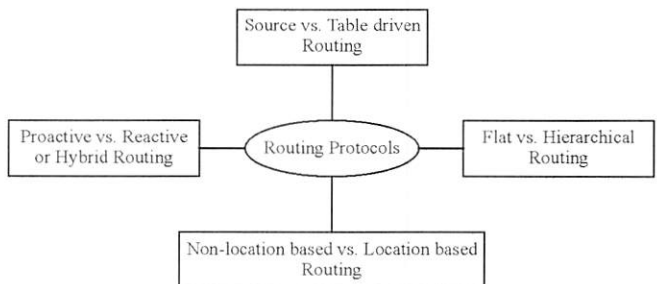


Figure 2 The Classification of Routing Protocols.

NET should maintain their routing tables for all possible destinations without regard to whether they actually need this route to send data at that point in time. Therefore, some changes of a network topology in the MANET can trigger an exchange of messages among nodes in order to keep routing entries updated. The protocols in the literature such as DSDV (Destination Sequenced Distance Vector) [7], OLSR (Optimized Link State Routing) [8], TBRPF (Topology Broadcast based on Reverse-Path Forwarding) [9] and FSR (Fisheye State Routing) [10] can be categorized as proactive routing protocols. In reactive routing protocols, whenever a source node wants to send data packets to the destination node, it tries to acquire the route from the source toward the destination node in an on-demand manner. Reactive or on-demand approaches enable nodes to be free of the burden of maintaining routing tables when there is no desire for transmission over these routes. In order to obtain a route to the destination, route discovery packets are flooded into the network instead of periodic exchange of routing messages among nodes as used in proactive routing protocols. DSR (Dynamic Source Routing) [11], AODV (Ad-hoc On-demand Distance Vector) [12], ABR (Associativity-Based Routing) [13] and TORA (Temporally Ordered Routing Algorithm) [14] can be put into the class of reactive routing protocols.

In the flooding-based route discovery approaches, the flooding of packets wastes the scarce wireless link resources. Therefore, some candidate approaches can be used to reduce the total number of packet transmission in MANET for the purpose of flooding. There are hybrid routing protocols having both proactive and reactive characteristics such as ZRP (Zone Routing Protocol) [15]. In ZRP, every node has its own cluster consisting of nodes within a given hop-distance and the scheme uses a proactive approach in the cluster of each node while a reactive protocol is applied between clusters.

In the second dimension, source-routing and table-driven routing protocols can be discriminated. In source-routing protocols like DSR, the route discovery packets contain all the visited intermediate nodes, and thereafter the header portion of packets transmitted by the source node also contains all the path information from the source to destination node. However, a scalability problem arises. If the network size increases, the size of route recording field (IP option for IPv4 or routing header for IPv6) must be increased. By contrast, in table-driven protocols, which include most proactive and reactive protocols (e.g. DSDV, AODV and ABR), all nodes maintain the routing entries for the next-hop node toward the destination without inserting the path information into the header of packets.

In the third dimension, flat and hierarchical routing protocols can be distinguished. In flat protocols, all nodes in the MANET have homogeneous roles in routing activities. In hierarchical protocols, all nodes in the MANET are grouped into a set of clusters to overcome the network scalability problem experienced in the flat structure. Some nodes are designated as cluster-heads, which play a role in managing their clusters. Clusters are formed by cluster generation algorithms performed amongst nodes. Approaches like CGSR (Clusterhead Gateway Switch Routing) [16] and LANMAR (Landmark Ad-hoc Routing) [17] are examples of hierarchical protocols.

In addition, we can also categorize routing protocols into non-location based protocols and location-based protocols. In location-based protocols, some geographic information, obtained for example using GPS (Global Positioning System), is used for routing: nodes are informed of their own

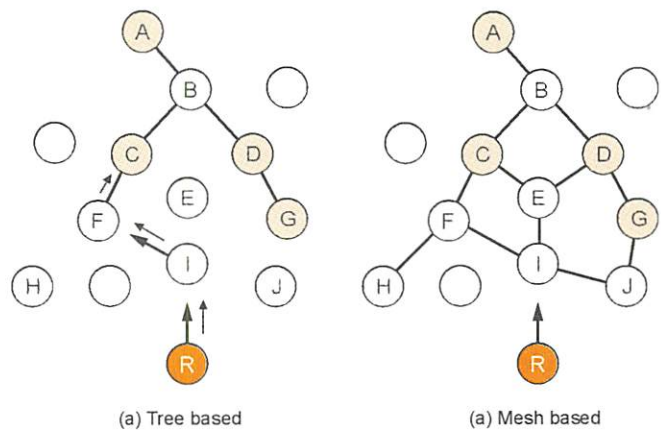


Figure 3 The Classification of Multicast Routing Protocols.

geographic positions, and those of other nodes. The geographical information is used to limit the scope of data flooding, resulting in reducing the number of flooded messages. LAR (Location-Aided Routing) [18], GPSR (Greedy Perimeter Stateless Routing) [19] and DREAM (Distance Routing Effect Algorithm for Mobility) [20] can be put into this class.

For group communication, many multicast routing protocols have been developed. They can also be classified into two classes: (a) tree-based and (b) mesh-based (Figure 3). In tree-based routing protocols, tree topologies need to be maintained among group members due to link breakage. Generally, new joining nodes become attached to the existing tree topology. As shown in Figure 3 (a), where nodes A, C, D and G are multicast group members and nodes B and F are forwarding nodes for relaying the packets among multicast members, a new joining node R becomes attached to node F which is a member of the existing tree, through node I, which is a forwarding node. In this tree, if a link breakage occurs, for example, between nodes B and C, the tree should be reconfigured to form a new stable tree. MAODV (Multicast Ad-Hoc On-Demand Distance Vector Routing) [21], AMRoute (Ad-Hoc Multicast Routing) [22] and AMRIS (Ad hoc Multicast Routing protocol utilizing Increasing id-numberS) [23] form and maintain multicast trees according to node mobility to enable the group communication.

In order to avoid the high overhead in maintaining trees whenever a branch is broken by node mobility, a mesh topology is used as paths among group members in the mesh can exist even if some link breakage occurs, resulting in continuous data transmission. As shown in Figure 3 (b), even if the link between nodes B and C becomes broken, another path still exists and the multicast packets, therefore, can arrive at node C through the path B-D-E-C. ODMRP (On Demand Multicast Routing Protocol) [24] and CAMP (Core Assisted Mesh Protocol) [25] are candidate approaches. However, particularly for mesh-based protocols, they still require to make new meshes periodically to reflect node mobility and naturally accommodate new joining nodes.

In the past, the IETF MANET working group has focused on exploring a broad range of various MANET routing protocols. However, at least for unicast routing protocols, the 54th IETF meeting decided from the proposed protocols to target the promotion of DSR, AODV, OLSR and TBRPF to experimental RFC status, under the assumption that stable performance results had been obtained through simula-

tions and tests. The design problems encountered during the standardization of those protocols may be put into a new problem space for the working group and the group has a long-term plan to develop a common routing specification. At the time of writing, the specification of AODV has been submitted to IESG (Internet Engineering Steering Group) as the experimental RFC specification. DSR, OLSR and TBRPF are in progress for the same procedure.

4 How to guarantee reliable data transmissions : Transport-Layer TCP Issues

TCP (Transmission Control Protocol) is widely used in the current Internet as the reliable end-to-end transport protocol. However, earlier research work has confirmed that TCP cannot be directly applied to wireless networks due to the presence of the time-varying link characteristics and node mobility issues. If a TCP source does not receive acknowledgement packets from the destination in a timely fashion, timeout events for the transmitted segments will occur. TCP assumes that congestion has occurred within the network and initiates congestion control procedures even if the actual packet loss occurred due to node mobility. This results in performance degradation. Most proposals for improving TCP performance have focused on the cellular-style wireless network – a last-hop wireless network – where base stations play a significant role in providing wireless access from mobile users to the fixed network. Distinct mobile connections are partitioned into segments, one between the mobile host and base station, and the other between the base station and the correspondent host. I-TCP [26] and SNOOP [27] are examples of such schemes which employ the concept of distinct connection segments. In these approaches, the base station buffers the transferred TCP segments and masquerades the mobile hosts from the fixed side of the network. However, since all nodes are movable in MANETs, route reconstruction procedures are frequently invoked during data transmission due to node movements. It is not possible for the buffering capability for masquerading to be performed by the node detecting the route disconnection every time a route disconnection occurs. Moreover, a route failure is unavoidable due to the ad hoc nature of MANETs. If the TCP used in existing wired networks is applied to MANETs, the degradation of TCP performance will be experienced as TCP cannot distinguish congestion from a route failure.

To overcome the performance degradation when we use TCP used in the fixed Internet, several approaches have been proposed in the literature. In TCP-feedback [28], two special messages, RFN (Route Failure Notification) and RRN (Route Re-establishment Notification), are generated when the route breakage occurs and a new path is acquired. On receiving the RFN message, the TCP sender freezes its all variables such as timers and the congestion window size, and resumes the TCP process from the frozen information after receiving the RRN message. In the ELFN-based approach [29], an ELFN (Explicit Link Failure Notification) message like the RFN message can be used to inform the TCP sender of the route breakage. However, instead of using RRN message like TCP-Feedback, probe messages are sent regularly toward the destination in order to detect the route restoration. In TCPBuS (TCP with Buffering capability and Sequence Information) [30], the buffering mechanism at intermediate nodes can help improve the TCP performance along with using explicit notification messages related to route breakage and restoration. Unlike three approaches mentioned above, ATCP [31] implements an inter-

mediate layer between network and transport layers rather than imposing changes to the TCP standard itself. It relies on an ECN (Explicit Congestion Notification) mechanism for congestion and an ICMP (Internet Control Message Protocol) protocol for detecting the route failures. In addition, TCPDOOR [32] utilizes only out-of-order packet information for indicating the link failure without requiring intermediate nodes' cooperation.

5 Other Issues

Most routing protocols in the literature assume that all the nodes have the same radio transmission range. This assumption, however, does not reflect real life scenarios where radio transmission ranges of nodes can decrease due to battery power consumption. This is shown in Figure 4, where if node B is within the radio transmission range of node A, but not vice versa, we can say that there exists an asymmetric or unidirectional link between node A and node B. If we are to use existing routing protocols in an environment with asymmetric or unidirectional wireless links, a route which constitutes only links of the same radio transmission/reception ranges should be selected. In fact, all the nodes have to maintain relatively constant power consumption to ensure that their transmission/reception range is not affected. Otherwise, the assumption on symmetric wireless links could be violated over time. SRL (Sub Routing Layer) [33], ReversePathSearch [34] and GAHA/GAPA [35] are their candidate solutions to accommodate the asymmetric links in MANET.

While developing core protocols (at different layers, e.g., MAC and network layers) for MANETs has been an area of extensive research in the past few years, several route selection protocols for the purpose of prolonging the node lifetime and reducing the total transmission power consumption have been developed because MANET nodes are often power-constrained. MTPR (Minimum Total Transmission Power Routing), MMBCR (Min-Max Battery Cost Routing), MDR (Minimum Drain Routing), CMMBCR (Conditional Max-Min Battery Capacity Routing) and CMDR (Conditional Minimum Drain Rate Routing) protocols have been proposed to balance the power consumption among nodes [36, 37]. In addition, in order to perform data transmission amongst nodes in MANET, all nodes should be identified with their own IP addresses. Due to the nature of MANETs, there is no centralized server for assigning unique IP addresses to the nodes joining an existing MANET, so an efficient distributed protocol for IP addressing in MANET must be developed. When a node joins an existing MANET, the

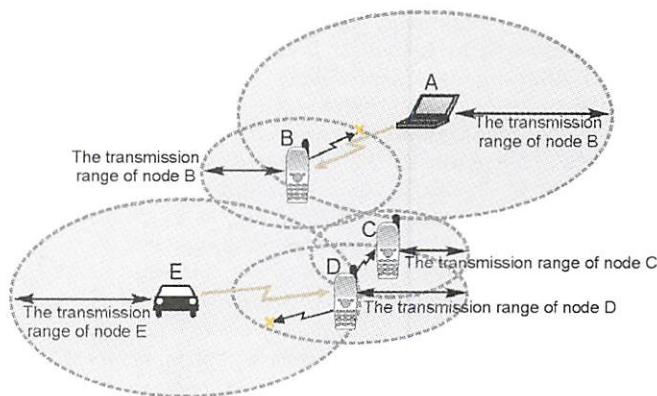


Figure 4 The Occurrences of Asymmetric Links in MANET.

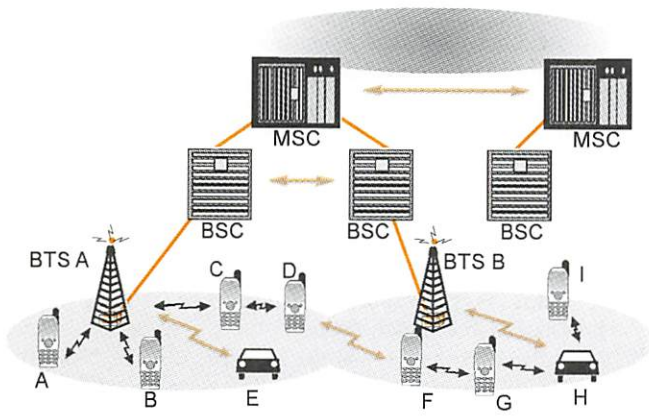


Figure 5 The Example of Application to Cellular Network.

node selects a random address and performs the route discovery procedure using the selected address as the target destination address. If the node receives a route reply message, it means that a node in the network has already occupied the address and it should select another IP address and perform the same procedure until no route reply message cannot be received for a given timeout interval. Otherwise, for the purpose of duplicate address detection, some explicit messages like AREQ (Address Request) and AREP (Address Reply) can be used [38]. Alternatively, the nodes which are already in MANET cooperate to allow joining nodes to have a unique IP address [39]. In these schemes, IPv6 auto-configuration mechanisms can be adopted for getting an initial random IP address to reduce the possibility of duplicated IP addresses. Recently, much work has been done on how to integrate MANET with the fixed Internet for global Internet access. Through node-to-gateway affiliation, nodes in a MANET can access any node in the Internet outside MANET. For this integration, obtaining a path from the nodes to gateway and vice versa is of great importance. If MANET supports on-demand routing protocols, a node in MANET can send a request for the gateway information whenever it needs this information. Alternatively, an approach in which gateways send unsolicited advertisements with an appropriate period has recently become a possible solution. MIPMANET [40] shows that periodic gateway advertisements can decrease the number of packet transmissions in MANET, because they provide the nodes with more opportunities to use gateways closer to them. In [41], however, it is claimed that gateways should not send any unsolicited advertisements because unnecessary packets can be generated within the networks.

Work reported in [42] applies MANET technologies to a cellular network environment in order to overcome the situation in which the channel of a cell is full. The objective of the integration of MANET with cellular networks is to enable the nodes in one cell to obtain channels to base stations in adjacent cells with better channel condition when they cannot communicate with the local base station due to lack of available channels. The intermediate nodes participate in the ad-hoc routing process for the data transmitted by the source node towards a node which can access a channel in its cell. For the purpose of such integration, each node should be equipped with dual interfaces, each of which performs an ad hoc routing process or cellular communication between a node and its base station (Figure 5).

As shown in Figure 5, since node C cannot acquire a channel to BTS A, the multihop service via the path C-D-F-G-H-BTS B can be enabled for the node C to obtain a new channel when a channel between node H and BTS B is available.

QoS (Quality-of-Service) issues should not be ignored for multimedia data transmission over MANET, with some constraint such as delay, jitter, throughput and packet loss. At the MAC level which directly controls wireless resources, QoS guarantees should be supported by using various techniques such as a differential contention resolution mechanism [43] or a channel reservation one [44]. At the network level, network models suitable for QoS support in MANET have recently been developed, for example, FQMM (Flexible QoS Model for MANETs) [45] and SWAN (Stateless Wireless Ad Hoc Networks) [46]. Furthermore, we need some signaling protocols like INSIGNIA [48] to provide a QoS-enabled mechanism along with the existing routing protocols modified for supporting QoS-aware paths or a new QoS routing protocol like CEDAR (Core Extraction Distributed Ad Hoc Routing Algorithm) [47].

6 Conclusions and Future Directions

The need of multi-hop wireless communication has created the new MANET network environment. Due to node mobility and the characteristics of wireless links, the protocols used in the fixed network environment have been modified to reflect this dynamic network. Specially, MAC protocols have been devised to resolve the channel contention at shared wireless links and routing protocols have enabled the continued progress of data communication even with high possibility of route breakage caused by node mobility. In addition, an effort to develop an efficient transport protocol for reliable data exchange between end-nodes has been made. For the power-saving purpose, various power-aware protocols including MAC and routing layers have been developed. Also, the need for QoS over MANET has been recognized for multimedia communication and its supporting mechanisms have been in the literature. In a small scale, all these technologies can be applied to WPAN (Wireless Personal Area Network) and Bluetooth.

In particular, although many MAC protocols especially suitable for MANET have been researched, the concept of MANET can be applied to any wireless link technology like Bluetooth, IrDA, WLAN, and others at a higher layer. Currently, as the wireless LAN technologies become more mature, many groups are trying to implement MANET using WLAN cards.

In a large scale, in conjunction with cellular network technology, multi-hop packet transmission can be applied to inter-cell or intra-cell in order to increase the number of simultaneous users in the network. In the near future, MANETs will be attached to the global Internet through the internetworking functions like fourth generation networks.

References

- [1] Internet Engineering Task Force, "Manet working group charter," <http://www.ietf.org/html.charters/manetcharter.html>.
- [2] P. Karn, "MACA-a New Channel Access Method for Packet Radio", ARRL/CRRL Amateur Radio 9th Computer Networking Conference, pp. 134-140, ARRL, 1990.
- [3] C. L. Fullmer, J. J. Garcia-Luna-Aceves, "Floor Acquisition Multiple Access (FAMA) for Packet-Radio Networks", ACM SIGCOMM, Cambridge, MA, Aug. 1995.

- [4] IEEE 802.11, "Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications", IEEE, November 1993.
- [5] F. Talucci, M. Gerla, L. Fratta, "MACA/BI (MACA By Invitation): A receiver oriented access protocol for wireless multiple networks", IEEE PIMRC '97, 1997.
- [6] C-K Toh, V. Vassiliou, G. Guichal, C-H Shih, "MARCH: A Medium Access Control Protocol for Multihop Wireless Ad Hoc Networks", IEEE MILCOM 2000.
- [7] C. E. Perkins, P. Bhagwat, "Highly dynamic Destination-Sequenced Distance-Vector routing (DSDV) for Mobile Computers", SIGCOMM Symposium on Communications Architectures and Protocols, (London, UK), Sept. 1994.
- [8] T. Clausen, P. Jacquet, A. Laouiti, P. Minet, P. Muhlethaler, A. Qayyum, and L. Viennot, "Optimized Link State Routing Protocol (OLSR)", IETF Internet Draft, draft-ietf-manet-olsr-08.txt, March 2003.
- [9] R. G. Ogier, F. L. Templin, B. Bellur, and M. G. Lewis, "Topology Broadcast Based on Reverse-Path Forwarding (TBRPF)", IETF Internet Draft, draft-ietf-manet-tbrpf-07.txt, March 2003.
- [10] M. Gerla, X. Hong, and G. Pei, "Fisheye State Routing Protocol (FSR) for Ad-hoc Networks", IETF Internet Draft, draft-ietf-manet-fsr-02.txt, December 2001.
- [11] D. B. Johnson, D. A. Maltz, and Y. Hu, "The Dynamic Source Routing Protocol for Mobile Ad-hoc Networks (DSR)", IETF Internet Draft, draft-ietf-manet-dsr-08.txt, February 2003.
- [12] C. E. Perkins, E. M. Belding-Royer, and S. R. Das, "Ad-hoc On-Demand Distance Vector (AODV) Routing", IETF Internet Draft, draft-ietf-manet-aodv-13.txt, February 2003.
- [13] C. K. Toh, "Associativity based Routing for Ad Hoc Mobile Networks", *Wireless Personal Communications*, 4 (2), pp.1-36, March 1997.
- [14] V. Park and S. Corson, "Temporally-Ordered Routing Algorithm (TORA) Version 1 Functional Specification", IETF Internet Draft, draft-ietf-manet-tora-spec-04.txt, July 2001.
- [15] Z. J. Haas, M. R. Pearlman, Prince Samar, "The Zone Routing Protocol (ZRP) for Ad Hoc Networks", IETF MANET Internet Draft, July 2002.
- [16] C. C. Chang, H. K. Wu, W. Liu, and M. Gerla, "Routing in Cluster Multihop Mobile Wireless Networks with Fading Channel", IEEE SICON'97, pp.197-211, April 1997.
- [17] M. Gerla, X. Hong, and G. Pei, "Landmark Routing Protocol (LANMAR) for Large Scale Ad-hoc Networks", IETF Internet Draft, draft-ietf-manet-lanmar-03.txt, December 2001.
- [18] Y. B. Ko and N. H. Viadya, "Location-Aided Routing (LAR) in Mobile Ad Hoc Networks", ACM MobiCom'00, pp.234-242, 2000.
- [19] B. Karp and H. T. Kung, "GPSR: Greedy Perimeter Stateless Routing for Wireless Networks", ACM MobiCom'00, pp.243-254, 2000.
- [20] S. Basagni, I. Chlamatac, V. Syrotiuk, and B. Woodward, "A Distance Routing Effect Algorithm for Mobility", ACM MobiCom'98, pp.76-84, 1998.
- [21] E. M. Royer, and C. Perkins, "Multicast Operation of the Ad-hoc On-Demand Distance Vector Routing Protocol", ACM MobiCom '99, Seattle, WA, August 1999, pp. 207-218.
- [22] E. Bommaiah, M. Liu, A. MvAuley, and R. Talpade, "AMRoute: Ad hoc Multicast Routing Protocol", Internet Draft, IETF, August 1998.
- [23] C. W. Wu, Y. C. Tay, and C-K Toh, "Ad hoc Multicast Routing Procol Utilizing Increasing id-numberS (AMRIS) Functional Specification", Internet draft, draft-ietf-manetamris-spec-00.txt, Nov. 1998.
- [24] S. Lee, W. Su, and M. Gerla, "Ad hoc Wireless Multicast with Mobility Prediction", IEEE ICCCN '99, Boston, Oct. 1999.
- [25] J. J. Garcia-Luna-Aceves, and E. L. Madruga, "The Core-Assisted Mesh Protocol", *IEEE Journal on Selected Areas in Communication*, Special Issue on Ad-Hoc Networks, 17 (8), Aug. 1999.
- [26] A. Bakre, B. Badrinath, "I-TCP: indirect TCP for mobile hosts", IEEE ICDCS, 1995.
- [27] H. Balakrishnan, S. Seshan, E. Amir, R. Katz, "Improving TCP/IP performance over wireless networks", ACM MobiCom '95.
- [28] K. Chandran, S. Raghunathan, S. Venkatesan, and R. Prakash, "A Feedback Based Scheme For Improving TCP Performance In Ad-Hoc Wireless Networks", IEEE ICDCS 1998.
- [29] G. Holland and N. H. Vaidya, "Analysis of TCP Performance over Mobile Ad Hoc Networks", ACM MobiCom, 1999.
- [30] D. Kim, C.-K. Toh and Y. Choi, "TCP-BuS : Improving TCP Performance in Wireless Ad Hoc Networks", *Journal of Communications and Networks*, 3 (2), 2001.
- [31] J. Liu, S. Singh, "ATCP: TCP for Mobile Ad Hoc Networks", *IEEE Journal on Selected Areas in Communication*, Special Issue on Ad-Hoc Networks, 19 (7), July 2001.
- [32] F. Wang and Y. Zhang, "Improving TCP Performance over Mobile Ad-Hoc Networks with Out-of- Order Detection and Response", ACM Mobihoc02, June 2002. (Available at <http://www.cs.utexas.edu/users/wangf/>).
- [33] V. Ramasubramanian, R. Chandra and D. Mosse, "Providing a Bidirectional Abstraction for Unidirectional Ad Hoc Networks", IEEE INFOCOM 2002.
- [34] M.K. Marina and S.R. Das, "Routing Performance in the Presence of Unidirectional Links in Multihop Wireless Networks", ACM Mobihoc 2002.
- [35] D. Kim, C.K. Toh and Y. Choi, "On Supporting Link Asymmetry in Mobile Ad Hoc Networks", IEEE GLOBECOM (SAWN) 2001.
- [36] C.-K. Toh, "Maximum Battery Life Routing to Support Ubiquitous Mobile Computing in Wireless Ad Hoc Networks", *IEEE Communications*, June 2001.
- [37] D. Kim, J. Cano, J.J Garcia-Luna-Aceves, K. Obraczka and P. Manzoni, "CMDR: Conditional Minimum Drain Rate Route Selection Protocol for Mobile Ad Hoc Networks", ICOIN 2003.
- [38] C. Perkins, J. T. Malinen, R. Wakkawa, E.M. Belding-Royer and Y. Sun, "Ad Hoc Address Autoconfiguration", draft-ietf-manet-autoconf-01.txt, November 2001.
- [39] S. Nesargi and R. Prakash, "MANETconf: Configuration of Hosts in a Mobile Ad Hoc Network", IEEE INFOCOM 2002.
- [40] U. Jonsson et al., "MIPMANET-mobile IP for mobile ad hoc networks," IEEE MobiHOC 2000, pp 76-85.
- [41] R. Wakikawa et al., "Global connectivity for IPv6 Mobile Ad Hoc Networks," IETF Internet-Draft, draft-wakikawamanet-globalv6-00.txt, 2002
- [42] H. Wu et al., "Integrated cellular and ad hoc relaying systems: iCAR", *IEEE Journal on Selected Areas in Communication*, Special Issue on Ad-Hoc Networks, 19 (10), Oct. 2001, pp 2105-2115.

- [43] J. L. Sobrinho and A. S. Krishnakumar, "Quality-of-Service in Ad Hoc Carrier Sense Multiple Access Wireless Networks", *IEEE Journal on Selected Areas in Communication*, Special Issue on Ad-Hoc Networks, **17** (8), Aug. 1999.
- [44] C. R. Lin and M. Gerla, "MACA/PR: An Asynchronous Multimedia Multihop Wireless Network", *IEEE INFOCOM'97*, 1997.
- [45] H. Xiao, "A Flexible Quality of Service Model for Mobile Ad-Hoc Networks", *IEEE2000*, 2000.
- [46] G-S. Ahn, A. Campbell, A. Veres and L-H Sun, "SWAN: Service Differentiation in Stateless Wireless Ad Hoc Networks", *IEEE INFOCOM'2002*, June 2002.
- [47] R. Sivakumar, P. Sinha, V. Bharghavan, "CEDAR: A Core-Extraction Distributed Ad Hoc Routing Algorithm", *IEEE Journal on Selected Areas in Communication*, Special Issue on Ad-Hoc Networks, **17** (8), Aug. 1999.

[48] <http://www.comet.columbia.edu/insignia>

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Professor Kim was TPC chairman of Symposium on Ad Hoc Wireless Networks (SAWN 2002) and has been a TPC member of several IEEE conferences and IASTED. He obtained the best paper award from the Korean Federation of Science and Technology Societies, 2002. His research interests include the Internet, high-speed networks, mobile networks, and mobile ad hoc networks.



Standards

Dennis Bodson, Senior Editor

IEEE Standards Association Announces Standards Europe

The IEEE Standards Association is proceeding with the global portal network (aka the "geoport" project) to better serve its constituencies worldwide. The first portal, StandardsAsia, was successfully launched in July 2002. StandardsAmericas was launched this past December. Keeping to schedule, StandardsEurope (www.standardseurope.net) was officially launched March 31, 2003 with communities for Germany and the United Kingdom. The Community Spotlight features profiles of individuals from both countries. Additional countries and individuals will appear throughout the year.

- ◆ To coincide with the launch of StandardsEurope, several platform enhancements will make their debut:
- ◆ Industry News-to closely associate standards with industry
- ◆ Relevance, the portals now feature real-time news for venture capital and international markets.
- ◆ StandardsWire-the module containing IEEE-SA press releases has been renamed from "IEEE-SA Headlines" to StandardsWire. The more generic renaming of this feature will enable greater outreach to organizations (e.g., Societies) that would like to extend communications about their standardization efforts. Capabilities for link-forwarding, printer-friendly, and StandardsShop search integration are now enabled.
- ◆ Sponsorship Awareness-the value proposition to prospective sponsors has been increased exponentially through integration with the new, viral marketing capability (link forwarding) of StandardsWire.

- ◆ Community Spotlight-uploading a profile is now more intuitive with an icon for submitting profiles now imbedded within the module's graphic header.

These enhancements will be applied concurrently to StandardsAsia and StandardsAmericas.

IEEE-ISTO Leadership Succession Now in Effect

A new senior leadership team took effect on 1 April 2003 for the IEEE Industry Standards and Technology Organization (ISTO) as Marco Migliaro became its President and CEO, and Gerald T. Lane of IBM its Chairman of the Board. The appointments complete a succession plan following last year's retirement of ISTO's founding President and CEO, Andrew Salem.

The IEEE ISTO is a global, not-for-profit corporation designed to provide a legal umbrella for consortia, with a flexible array of program management support. The ISTO is affiliated with the IEEE and the IEEE Standards Association. Currently, there are eight initiatives organized as programs of the ISTO: 1355 Association; Broadband Wireless Internet Forum; Customized Learning Experience Online (CLEO) Lab; Liberty Alliance Project; Medical Device Communications Industry Group; Nexus 5001 Forum; Printer Working Group; and VoiceXML Forum.

Migliaro comes to ISTO from Florida Power & Light, where he served as Chief Electrical/I&C Engineer for the company's Nuclear Division. He is a fellow member of the IEEE, was President of the IEEE Standards Association in

2001, has served on the IEEE Board of Directors, and was previously ISTO's chairman since 2001.

A standards pioneer, Migliaro has been repeatedly recognized by the IEEE for his contributions to the development of standards. He has authored more than 40 published technical papers and articles and has developed of a number of training programs in the field of electric power. Migliaro will leverage his extensive standards experience in guiding the ISTO.

Gerald T. Lane, Director of Corporate Standards Practices at IBM, assumes the post of ISTO chairman of the board. As chairman, Lane will guide the ISTO's Board in managing the business and affairs of the not-for-profit corporation.

"There is a surge in the number of standards development activities being conducted outside of the traditional standards development organizations," says Lane. "Many of these special interest groups and consortia have the objective of creating information technology or communications related standards which permit interoperability and interconnection, while doing so on tremendously expedited schedules to meet marketplace demand. The ISTO has developed the capability to completely support the needs of these standards developing activities."

Peter Lefkin completes ISTO's senior management team. He is the Chief Operating Officer and Secretary Treasurer and CFO, and has served in this role with the ISTO since its formation in 1999.

Wi-Fi Security Gets a Boost

The Wi-Fi Alliance has announced the certification of products using the latest security specification, as it works to allay concerns about wirelessly transmitting data over networks. One of the chief concerns for businesses about the Wi-Fi wireless networking technology has been the lack of a security standard. The IEEE has been working to develop and approve 802.11i, a security standard that won't be finished for at least another year. The latest security specification, Wi-Fi Protected Access (WPA), is a subset of what will become the 802.11i standard. WPA replaces the existing security protocol, called Wired Equivalent Privacy.

WPA is the third specification related to Wi-Fi to receive certification from the Wi-Fi Alliance for interoperability, which means that approved products are supposed to work with each other no matter which company manufactured the product. The certification is meant to broaden Wi-Fi's reach and expand the number of networks that people will be able to access. The Wi-Fi Alliance has approved products based on the 802.11a and 802.11b standards and is working on 802.11g-based products. Consumers and businesses will be able to tell which products have been certified to be interoperable for WPA by looking for the Wi-Fi label. The Wi-Fi Alliance also will maintain a list on its Web site. Certified products will be available in May.

What will TETRA look like tomorrow?

One major step for the success of TETRA release 2 has been successfully achieved by ETSI Project (EP) TETRA and in particular Working Group 1. The User Requirement Specifications (URS) for TETRA release 2, a multipart standard, have been completely approved and published.

The aim of TETRA Release 2 suite of standards is to enhance the services and facilities of TETRA in order to meet the emerging user requirements, utilize new technologies and, by maintaining the competitiveness with other wire-

less technologies, ensure TETRA remains the standard of the future for PMR and PAMR worldwide.

The approved programme for TETRA Release 2 covers five work areas, namely:

- ◆ high speed data;
- ◆ speech coding;
- ◆ air interface enhancements;
- ◆ interworking and roaming;
- ◆ SIM

Within EP TETRA, WG1 has been given the responsibility for capturing the requirements of the "TETRA Market" from a variety of user entities and for producing URSs. These are then used as a basis for all other EP TETRA working groups, each of which is responsible for the development of a particular aspect of the Release 2 standard, e.g. air interface, network aspects, data, codec, etc.

WG1 membership consists of representatives from end-users of TETRA systems and equipment: Network Operators, Regulators, Manufacturers and Administrations; its task is to collate, often conflicting, requirements from different user entities. The URSs comprise the list of services and facilities to be included in the new product/specification, the relative attractiveness of the market opportunity associated with each one, and the indication by when the product/specification should be available in the market place.

As a first step, WG1 undertook to produce and send out a comprehensive Market Questionnaire, which was sent to the members of EP TETRA and the TETRA MoU. The organizations responding to the questionnaire were large Public Safety and PAMR TETRA users, whose investment in TETRA is estimated to represent over 70% of the TETRA market in Western Europe. Replies were used as the main references for Release 2 URSs. Based on these replies, the relative importance of each area of Release 2 is shown in Figure 1.

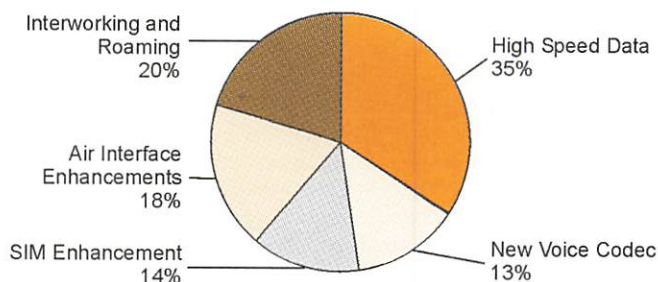


Figure 1 Relative importance of each area of TETRA Release 2

Following approval of the URSs WG1 continues to provide, as required by the other Working Groups, clarification and guidance during the standard development process, as well as interpretation of the URSs in cases of ambiguity. In addition, WG1 is expected to continuously monitor the market in terms of new major technologies and the services and facilities they offer to the users and to assess their potential impact on Release 2, taking the necessary steps to keep it up-to-date or to document the requirements for future releases.

The documents, which can be downloaded from the ETSI web site at <http://pda.etsi.org/pda>, consist of the following:

Part 1: General Overview (TR 102 021-1), outlining the process employed by Working Group 1 to generate

user requirements in general and the methodology used for creating URSSs for Release 2 in particular.

Part 2: High Speed Data (TR 102 021-2);

Part 3: Codec (TR 102 021-3);

Part 4: Air Interface Enhancements; (TR 102 021-4);

Part 5: Interworking and roaming; (TR 102 021-5);

Part 6: SIM (TR 102 021-6); which provides the user requirement for the Subscriber Identity Module;

Part 7: Security (TR 102 021-7)

Global Standardization Groups Work to Enhance Collaboration on Communications Issues

Senior representatives of the world's leading radio, information and communications technologies standards organizations met 27 April through May 1, 2003, in Ottawa, Canada, in a continuing show of support for the world-wide communications standards development processes and a renewed commitment towards improving communication collaboration between their respective organizations. The Eighth Global Standards Collaboration meeting (GSC-8), that included the Global Telecommunications Standards Collaboration (GTSC-1) and Global Radio Standards Collaboration (GRSC-1) meetings, was hosted by the Telecommunications Standards Advisory Council of Canada (TSACC).

"The mission of the GSC is to exchange information between participating standards organizations to facilitate collaboration and to enhance the process of global telecommunication standardization in the International Telecommunication Union," said Jim MacFie, GSC-8 Chairman and Chair of TSACC. "This meeting is an example of the growing convergence between fixed, wireless and associated information technology communities."

Areas of particular emphasis for GTSC and GRSC included the development of Next Generation Networks, security of networks, emergency communications services, broadband access, beyond third-generation mobile technology, with agreement on many other related topics and joint actions. GTSC and GRSC have confirmed the need to work together to support the developing convergence between radio and other communications technologies while respecting the need for differing expertise in different areas.

The meetings received progress reports from the two 3rd Generation Mobile Partnership Projects, 3GPP and 3GPP2. These bodies represent the collaborative work being undertaken by a number of GSC-8 Participating Standards Organizations (PSOs) as part of the IMT-2000 (3G) family of technologies being standardized by the ITU.

The meetings considered issues of importance to standardization bodies likely to be addressed by the upcoming World Summit on the Information Society and the World Radiocommunication Conference, and the need to strengthen collaboration and information exchange between the ITU and PSOs.

The PSOs shared information about Intellectual Property Rights issues worldwide, particularly copyrights related to software code reflected in standards and growing erosion of intellectual property rights protection in some venues outside of the PSO standardization process.

Subjects given particular priority in the meetings were:

- ◆ Beyond 3rd generation mobile networks;
- ◆ Next Generation Networks;
- ◆ Fixed and wireless access networks;
- ◆ Optical transport networks;
- ◆ Public protection and disaster relief;
- ◆ Generic regulation of radio products;

- ◆ Electromagnetic Radiation;
- ◆ Intelligent transportation systems;
- ◆ Quality of service;
- ◆ Measurement uncertainty; and
- ◆ Consumer and user issues.

The GSC-8 meeting produced several resolutions including those dealing with:

- ◆ Facilitating Liaison in Relation to Measurement Methodologies for Assessing Human Exposure to RF Energy
- ◆ Collaborative standards development, e.g., Radio Microphones
- ◆ Global Radio Standards Collaboration on radio local area network (RLAN) standardization
- ◆ Standards for wireless access systems including RLANs operating in the 5GHz range
- ◆ Broadband Services in Rural and Remote Areas
- ◆ Emergency Communications
- ◆ Mapping Standards for "Beyond IMT 2000"
- ◆ Global Cooperation And Collaboration On Lawful Access And Interception
- ◆ Patent Policies
- ◆ User Interests in Standardisation

The participating organizations agreed to increase the exchange of information (including information relating to work plans), principally by electronic means and meetings between the heads of each organization. They agreed to build upon their efforts to distribute information electronically and to conduct 'virtual meetings' as a means of continuing their work.

Emphasizing the importance of user input into the standardization process, a major area of discussion was challenges facing consumers in participating in the development of standards. Further avenues for collaboration and consultation were proposed which could provide valuable and timely insight into consumer needs in future standardisation. The group is also concerned with special communication needs of people with disabilities and the aged community.

The meeting, attended by approximately 100 representatives from PSOs. It was the latest in a series of such events that commenced in Fredericksburg, Virginia, in 1990, with the goal of promoting informal linkages among senior officials from national, regional and international telecommunication standards bodies in support of the work of the International Telecommunication Union. The next GSC meeting in this series has been scheduled for 9-13 May 2004 in Seoul, Korea.

Further information on these meetings, including all approved Resolutions, can be found at: <http://www.tsacc.ca> and www.gsc.etsi.org

DECT™ for Everyone

DECT™ have recently revised and published a technical report TR 101 178 entitled "A High Level Guide to Digital Enhanced Cordless Telecommunications (DECT™) Standardization".

The report is directed at a wide audience and provides a comprehensive overview of DECT™ standards and profiles, basic technological aspects; so readers do not need technical knowledge of DECT™ technology as a prerequisite for using it.

It also describes the services and applications for which DECT™ may be used, and the related ETSI publications besides Market acceptance and product availability. In addition, it covers which documents are related to conformance testing and regulation of DECT™ products. Finally, it gives a view of new developments for the DECT™ technology.

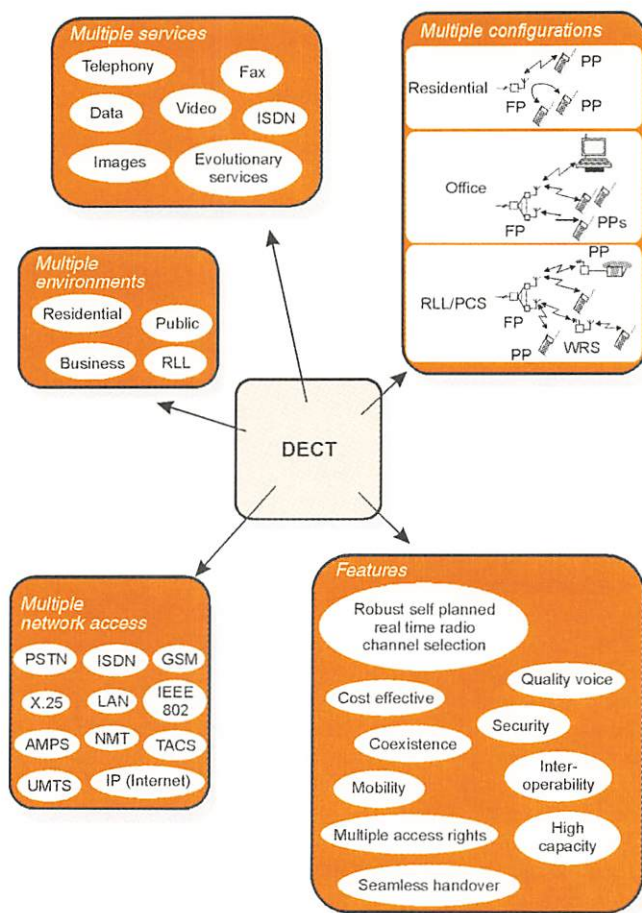


Figure 2 Overview of applications and features of DECT™

Home Control, next step for DECT™: Call for collecting requirements

Over the years DECT technology has had to compete with other technologies for different market segments, but one of the “kingdoms” where it can be said to be dominant is the residential market; our homes have been used to hosting DECT systems for some years now. Levering on this strength one of the next steps forward has been recently identified by ETSI Project DECT.

During the last plenary meeting the definition of an ‘Open Platform for Cordless Applications’ (OPCAP) to be used for ‘Home Control’ was discussed. The purpose is the standardisation of a transparent channel to exchange information via a DECT base station with Cordless Units (CoUs) for wireless control purposes possibly programmed via a normal DECT handset. CoUs could be standalone, connected to a device-to-be-controlled, or provide access to another network. The DECT base stations supporting OPCAP will provide internal and/or external access to the CoUs. The general scenario is depicted below:

The scenario shown in the figure has a Portable Part as the I/O device for Cordless Unit (CoU), which transmits/receives via base station to/from external or internal network. End-to-end applications would be feasible.

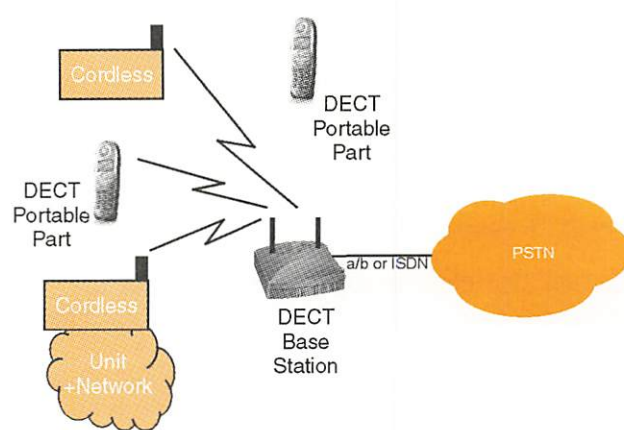


Figure 3 General scenario for DECT

This new platform would even enlarge the already wide potential of DECT technology to support different applications, some of them may be:

- ◆ Alert sensors to transmit alert signal
- ◆ PCs to signal sudden events
- ◆ Health care systems to inform physicians
- ◆ Consumer equipment to order service in advance
- ◆ Send meter reading information regularly
- ◆ Vending machines to order missing products
- ◆ Door opener
- ◆ Specialized telephones

The necessary features to support the above may include:

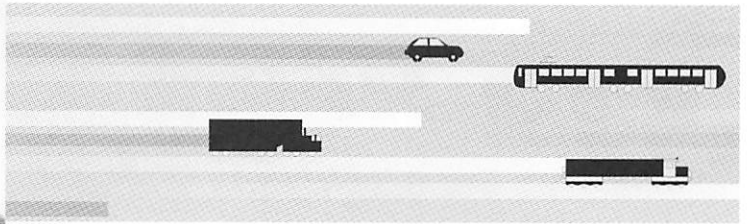
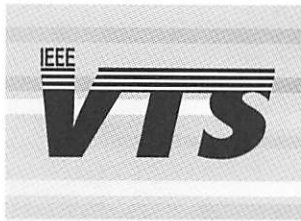
- ◆ Calling-through from the external network to the CoU
 - CoU can be connected directly over DECT base station by direct dialing
 - Receiving commands
 - Requesting status, sending feedback
- ◆ Automatically calling-through to the external network from the CoU
 - Event and priority list
 - Sending messages
- ◆ Calling-through from the internal network to the CoU
 - CoU can be connected directly over DECT base station
 - CoU transfers user interface to the requesting handset (transparent channel)
- ◆ Automatically calling-through to the internal network from the CoU
 - CoU transfers user interface to the selected handset (transparent channel)

The next standardization step to bring this promising idea forward is to collect requirements for this OPCAP. To do this, the DECT email-explorer will be used.

If you are interested in this matter please join the discussion on the DECT exploder list epdect@list.etsi.org.

References

- ISTO Press release, April 10, 2003.
- Richard Shim, CNET News.com, April 29, 2003.
- ETSI Press Release, March 26, 2003.
- ETSI Press Release, April 3, 2003.
- ETSI Press Release, May 9, 2003.



Book Review

Dirk Pesch, Senior Editor

Subtitle: Voice Compression and Communications – Principles and Applications for Fixed and Wireless Channels

Lajos Hanzo, F. Clare A. Somerville and Jason P. Woodard
Published 2001 by
Wiley/IEEE Press
ISBN 0 471 1 15039 8
642 pages
Price \$125 (US), £87.50/ €138.90 (Europe)

Reviewed by Jon Gibbs, Motorola Research, UK

The digital mobile revolution has led to a proliferation in the number of speech coding standards and the complementary forward error correction and air interface standards to match. This burst of activity in the mobile field has fuelled acceleration in the development of speech compression algorithms. A book addressing the design and optimization of such speech codecs is well overdue.

In contrast to previous books on speech compression, the authors place great emphasis on the impact of the mobile radio channel on the development of the desirable error resilience properties of speech codecs. This is a welcome departure with the material comprising of a series of reviews of existing systems accompanied by results of research conducted within the University of Southampton. As expected, the book addresses the three main application areas for speech compression and transmission research; high quality narrowband speech, wideband speech and low bit rate communications quality narrowband speech. Reflecting the emphasis on transmission aspects, each coder type is also matched with various modem schemes in order to build up a picture of the system design options available.

The book is divided into four parts. Part 1 is dedicated to an introduction to speech signals and a review of PCM and predictive coding applied to speech. The three remaining parts address each of the main speech compression application areas in turn. The general format comprises a review of existing standards and then a review of algorithm and transmission research.

Part 2 concerns the most widely applied speech coding paradigm to date; that of analysis-by-synthesis coding. This part contains a review of almost all of the major mobile radio speech coding standards deployed, detailing their main algorithmic characteristics and highlighting similarities and

differences. Following the emphasis on error resilience, high-level descriptions of the corresponding forward error correction coding (FEC) schemes are also included. Standard ITU-T recommended speech coding standards, both the conventional forward adaptive and backwards adaptive coding methods, are also reviewed in this part of the book. This part is one of the major strengths of the book.

Wideband speech compression is addressed in part 3. This part of the book is very timely since the main focus of recent speech compression research has been in the wideband area and there have also been standardization activities in ITU-T and 3GPP. Both full-band and split-band approaches to wideband speech coding are described, commencing with a review of the first viable wideband speech coding standard; G.722. Transform coded and CELP coded systems are also described and this part of the book is concluded with a description of the relatively new 16/24/32 kb/s ITU-T Wideband standard G.722.1.

In the final part of the book, very low bit rate coding and transmission is dealt with. An overview of the main paradigms in low bit rate coding is followed by a thorough review of four techniques; Linear Predictive Coding (LPC), Zinc Function Excited LPC, Mixed-Multiband Excited LPC and Sinusoidal Transform Coding. This part of the book also describes an application of wavelets to the perennial but crucial problem of pitch detection and there is a review of objective and subjective assessment methods for speech codecs and their resilience to transmission impairments.

This book contains a wealth of information. It would be eminently suitable as a post-graduate introduction to the field of speech compression and communications. The layout is logical, it is easy to read and there are examples that cover the full range of radio system designs, which are likely to be encountered in current and future systems. Several detailed coding techniques are however only described in one of the three main parts of the book; making it necessary to be familiar with the entire contents of the book to extract its full potential in an area of interest. For less readable books this would be a significant disadvantage but here it can be an opportunity to become familiar with other coding paradigms.

James R. Evans Avant Garde Award

This VTS award is presented to a member who is being recognized for his/her pioneering work, leadership and other contributions to VTS and its activities. The term, "Avant Garde" is described for one who creates, produces or applies new, original or experimental ideas, designs and techniques in the field or interest; in this case, Vehicular Technology.

The award is named for James R. Evans, one of the founders of the Vehicular Technology Society over 50 years ago.

An attractive desk-top/mantel, engraved, acrylic piece is awarded, along with a stipend of \$250. This year's awardees were Gordon Stüber, Henry Bertoni and David Goodman.

If you know someone in VTS who is deserving of recognition for their pioneering work in Vehicular Technology, please send details of your name, address and telephone number, along with details of who you wish to nominate (who must be a VTS member), and why you think they should receive the award and their VTS contributions to:

Raymond C. Trott, P.E.

c/o Trott Communications Group, Inc.

1425 Greenway Drive, #350

Irving, TX 75038

or email: ray.trott@trottgroup.com. A form can be found on the VTS web site.



Chapter News & Meetings

Gasper Messina, Senior Editor

Ottawa

The Ottawa chapter has held a number of meetings this year.

On April 28, 2003, Berthold Tepper of the Canadian Coast Guard presented a paper on the working of the St. Lawrence Seaway Auto Identification System. This talk was followed by one from George Olmstead of the Canadian Coast Guard which gave an introduction to Ship-Shore Communications in Canada.

The Ottawa chapter has also held some joint meetings. A joint meeting with the Microwave Theory and Techniques Society and the Antennas and Propagation Society was held

on May 6, 2003. Two papers were presented by Dr. Jack Winters of Jack Winters Communications, and a VTS Distinguished Lecturer, 'Smart Antennas for Mobile Wireless Systems' and 'Fourth Generation Wireless Systems'.

A joint meeting with the Aerospace & Electronic Systems Society took place on May 24, 2003. A paper entitled 'Vessel Information System in the Canadian Coast Guard' was presented by Lea Barker of the Canadian Coast Guard, while 'Vessel Information Systems for the St. Lawrence Seaway' was presented by Steven Hung of the U.S. Seaway Authority.

IEEE VTS Board of Governors' Meeting, 1 February 2003

The first IEEE VTS Board of Governors meeting of 2003 was held at the Hyatt Orlando, the venue of VTC2003-Fall, to allow Board members to inspect facilities and view progress on the conference. Newly elected VTS President Charles Backof was the chair. Other Board of Governors members present were Dennis Bodson, Mark Ehsani, Robert French, James Irvine, Roger Madden, Robert Mazzola, George McClure, Sam

McConoughey, Tom Rubinstein, Eric Schimmel, Gordon Stüber Raymond Trott and Jim Worsham. Others present included Clotilde Canepa-Fertini, Committee Representative for VTC2004-Spring, Teresa Collins, Administrative Assistant for VTC2003-Fall, Harvey Glickenstein Vice President-Land Transportation, Ratan Guha, Committee Representative for VTC2003-Fall and VTS Secretary Tracy Fulghum.

The minutes of the previous meeting held on 27 September 2003 were approved without amendment, and there were no matters arising. The newly appointed Secretary Tracy Fulghum thanked the Board for his appointment

Treasurer's Report: Incoming Treasurer George McClure gave a run down of the Society's accounts, and also reviewed the IEEE Travel and Reimbursement policies. The Society has 5412 'budgeted Society memberships', which does not include permanent/life members who don't pay dues. The cost of each membership in terms of newsletter expenditure, Xplore access and IEEE and society administration is slightly more than the \$15 annual dues. The charge on reserves to cover the central IEEE deficit is likely to be about \$138k, reducing reserves from \$893k in at the end of 2001 to about \$755k at the end of 2002.

President's Report: President Charles Backof reported that Mel Lewis is stepping down from his post as Conference Coordinator due to the increased demands of his teaching position. Glenda McClure, an experienced meeting planner with a masters in business who assisted in running VTC1990 in Orlando was appointed to replace him.

A request for financial support from the New Jersey Coastal Section for a luncheon lecture series. It was concluded that this lecture series would fall under the category of "Distinguished Lecturer Series," and that the existing arrangements (detailed on the VTS web site) would be able to cover this.

A request was made for non-financial support of the Multi-Dimensional Mobile Conference. The conclusion of discussion was that more information was needed, which broadened into a debate as to how to deal with these somewhat frequent requests for technical co-sponsorship of conferences. It was agreed to form a committee with approval power to consider non-financial support of conferences and lecture series, in response to frequent request for sponsorship.

Ray Trott reported on the **Awards Committee**. Not all the awardees for 2003 had yet been identified, although it was likely that US awardees would wish to receive their awards at VTC2003-Fall in Orlando rather than the spring conference in Jeju.

James Irvine presented report on **VTS News** publication. Newsletter material cannot be archived on Xplore, which is a problem given the feature material in the VTS News. A discussion arose as to whether the VTS News should be a magazine as opposed to a newsletter, but this would have a number of implications on the publication's structure.

James Irvine also reported on the standardised logo for future VTCs which had been agreed after the Tokyo conference. He proposed that the Society should produce this logo for the conferences in order to simplify production. This was agreed.

Tracy Fulghum presented a report on behalf of Greg Bottomley on **Transactions on Vehicular Technology**. It was agreed budget for 2000 pages annually for 2003 and 2004.

Clotilde Canepa-Fertini presented the status for **VTC2004-Spring** in Genoa, Italy, giving details of the budget and venue. A web site has been set up and a Call for Papers issued. It was agreed to approve \$15,000 seed money for the conference

George McClure gave an overview of the status of other VTC2005-Spring in Stockholm. The conference committee is being formed and they expect to have a first announcement ready for VTC2003-Spring in Jeju. VTC2006-Spring is working on a memorandum of understanding with the local IEEE section. The dates of the conference are likely to be confirmed after VTC2003-Spring in Jeju.

Due to a cancelled flight, **VTC2003-Fall** chair was unable to attend, so Ratan Guha presented the status of the conference. They are using the EDAS system to automate paper submission and review processing, and are on target for a good number of abstracts.

George McClure presented highlights of the Jae H. Lee's slide presentation on the status of **VTC2003-Spring**. Over 100 abstracts had been received, with 440 oral papers and 187 poster papers. Local arrangements are all now in place. The conference had been delayed by a day to avoid delegates in America having to travel on Easter Monday to reach the conference.

A Memorandum of Understanding between VTS, VTS Los Angeles Chapter, and The Aerospace Corporation regarding **VTC2004-Fall** was discussed. \$15,000 seed money for the conference was approved. A conference web site is under construction and will soon go live.

Jim Worsham reported on past conferences. **VTC2001-Fall** in Atlantic City has been closed, and \$34,663 surplus, with the Society receiving two thirds. Given the circumstances, that the conference managed to break even was highly commendable. **VTC2002-Spring** (Birmingham, AL) is currently being audited, and a surplus of about \$37k is expected. He passed on a report from Vijay Bhargava about **VTC2002-Fall**. The conference has 620 registrations, of which 110 were students, although more students attended (students have to pay full registration if they are the sole author of a paper). There were very few walk in registrations, with industrial participation much reduced. Some people could not attend because they were not able to receive visas in time. Vijay expected a surplus of about \$100,000.

Tom Rubenstein reported on **Conference Site Selection**. It is hoped to receive a proposal for Fall 2005 from Dallas.

George McClure discussed an **Exhibitor Proposal** put forth by Horizon House. Horizon House proposed running exhibits at VTC in return for a share of the gross revenue, which results in no loss to the Society should the exhibits not make a profit. They have worked successfully with other IEEE societies. It was agreed to arrange with Horizon House to have exhibit booths at VTC2003-Fall in Orlando.

Tom Rubenstein discussed the possibility of **electronic elections**, and presented a proposal he had received from Intelliscan. Electronic voting would be significantly more expensive than the current paper ballots.

Robert French presented a report on **ITS**. Robert Barret is standing down as the second VTS representative to ITS. The President appoint Roger Madden as his replacement.

Eric Schimmel reported on **ITU** and **CCIP**. The World Administrative Radio Conference will take place in June.

IEEE-USA has produced a policy statement on **hybrid electric vehicles** and electric transportation. Mark Ehsani was appointed as liaison to IEEE-USA regarding hybrid electric vehicles and electric transportation.

A **Constitutional By-laws Committee** was formed, consisting of Dennis Bodson, Tom Rubenstein, and Roger Madden.

A canvas of attendees determined that a quorum, plus some margin, will be in attendance at VTC2003-Spring in Jeju, South Korea, so future meeting dates were agreed as follows:

Jeju, South Korea Thursday, 24 April 2003

Orlando, FL, Wednesday, 8 October 2003

Genoa, Italy Thursday, 13 May 2004

Another meeting will be held towards the beginning of February.

Call for Papers

2004 ASME/IEEE Joint Rail Conference

Baltimore, MD – 6-8 April 2004

The increase in use of rail transportation has placed a high demand on improving railroad technology. The continuous threat of terrorism, and most recently the power blackout during this past summer, has caught the attention of the engineering community. The systems that are in place now, and those of the future, have to be practical, safe, and most importantly reliable. The annual ASME/IEEE Joint Rail Conference, sponsored by the Land Transportation Division of the IEEE Vehicular Technology Society and the ASME Rail Transportation Division offers a technical forum that explores engineering principles to advance railroad technology. Join the engineering community to share information, ideas, and experience at the 2004 Joint Rail Conference in Baltimore, MD during the month of April.

You are invited to submit papers for presentation and discussion at the conference. Papers are submitted from the supply industry, rail transportation corporations and agencies, consulting and engineering firms, and academia. **This year's theme is "RR – Stands for Ruggedness and Reliability"** - How are we designing and maintaining systems such as GPS, Remote Control for Locomotives, CBTC, etc. so as to be rugged and reliable in light of today's regional and world activities? Other papers of interest are also welcomed. 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, and light rail systems.
- ◆ 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 14, 2003 to:

Bih-Yuan Ku Papers Chair
National Taipei University of Technology
No. 1, Sec. 3 Chung-Hsiao E. Rd.
Taipei 106, Taiwan, R.O.C
Phone: 886-2-27712171 ext. 2192
Fax: 886-2-27317187
E-mail: ku@ee.ntut.edu.tw

- ◆ Electronic mail submissions are preferred. If submitted by mail or fax, please forward a diskette/CD copy of your abstract, if possible, using WordPerfect or Microsoft Word format.
- ◆ Notification of paper acceptance will be made by December 28, 2003. Selected papers must be submitted in an acceptable electronic format, as instructed by January 14, 2004 for publication in the Conference Proceedings (CD format).
- ◆ Lead author Advanced Registration for the Conference will be required.



IEEE



Call for Papers

IV'04



IEEE Intelligent Vehicles Symposium Parma, Italy, June 14-17, 2004

The Intelligent Vehicles Symposium (IV'04) is an annual forum sponsored by the IEEE Intelligent Transportation Systems (ITS) Council. It gathers researchers from industry and universities to discuss research and applications for Intelligent Vehicles and Intelligent Infrastructures. Three days of the symposium will be allocated for technical presentations and one day will be dedicated to live vehicle demonstrations. The technical presentations are characterized by a single session format so that all attendees remain in a single room for multilateral communications in an informal atmosphere. Papers dealing with all aspects of vehicle-related intelligent systems and cooperation between vehicles and infrastructures are solicited for IV'04.

Program Topics Include the Following Technical Categories

- Driver Assistance Systems
- Automated Vehicles
- Active and Passive Safety
- Integrated Safety Systems
- Vehicle Environment Perception
- System Architecture
- Smart Infrastructure
- Impact on Traffic Flows
- AHS
- IVI
- Sensors
- Image, Radar, Lidar Signal Processing
- Information Fusion
- Vehicle Control
- Decision and Expert Systems
- Communications and Networks
- Human Factors
- Human Machine Interaction
- Others

Special Session Organization is encouraged. Organizers should contact Dr. Niehsen at Wolfgang.Niehsen@de.bosch.com

Paper Submission

Prospective authors are requested to send an extended summary through the conference website no later than **Dec. 1, 2003**. The summary must be a **pdf file** in **IEEE two column format**. A LaTeX style file and a Microsoft Word template are available at the website. The extended summary must be 4 pages including figures with sufficient detail for review for technical merits and appropriateness. A separate page should include (1) the title of the paper, (2) the name of the authors, (3) the name, mailing address, telephone and fax number, and email address of the corresponding author, (4) the technical categories.

Please refer to the following websites for the most up-to-date information:

IEEE IV'04 <http://www.ieeeiv.org>
IEEE ITS Council <http://www.ieee.org/itsc>

Important Dates

Organized session proposal deadline	Nov. 1, 2003
Extended summary submission	Dec. 1, 2003
Notification of acceptance	Feb. 1, 2004
Camera-ready manuscript due for proceedings	Mar. 15, 2004

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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	
7-10 September 2003	PIMRC 2003	Beijing, China	http://www.pimrc2003.org	
17-19 September 2003	MC-SS 2003	Oberpfaffenhofen, Germany	http://www.dlr.de/kn/kn-s/mcss2003	
24-25 September 2003	8 th Int OFDM Workshop	Hamburg, Germany	http://ofdm.tu-harburg.de/	
4-9 October 2003	VTC 2003-Fall	Lake Buena Vista, FL	http://www.vtc2003.org	
12-15 October 2003	ITSC03	Shanghai, China		
19-22 October 2003	WPMC'03	Yokosuka, Japan	http://www1.ilcc.com/WPMC/	
22-24 October 2003	Wireless Networking Symposium	Austin, TX	http://www.cce.utexas.edu/wncg/events/symposium2003/symposium2003.php	
13 November 2003	SCVT 2003	Eindhoven, The Netherlands	http://tte.ele.tue.nl/scvt2003.htm	
1-5 December 2003	Globecom 2003	San Francisco, CA	http://www.globecom2003.com	
24-27 February 2004	European Wireless 2004	Barcelona, Spain	http://research.ac.upc.es/EW2004/	✓
2-4 March 2004	Int Symp on Advanced Radio Technologies	Boulder, CO	http://www.its.bldrdoc.gov/meetings/art/	
21-25 March 2004	WCNC2004	Atlanta, GA	http://www.wcnc.org/2004/	✓
23-24 March 2004	Workshop in Intelligent Transportation 2004	Hamburg, Germany	http://wit.tu-harburg.de/	✓
6-8 April 2004	ASME/IEEE Joint Rail Conference	Baltimore, MD	See page 42	✓
11-14 May 2004	VTC 2004-Spring	Genoa, Italy	http://www.vtc2004spring.com/	✓
14-17 June 2004	IEEE Intelligent Vehicles Symp	Parma, Italy	http://www.iccciv.org/	✓
20-24 June 2004	ICC 2004	Paris, France	http://www.icc2004.org	✓
27-30 June 2004	IST2004	Lyon, France	http://www.mobilesummit2004.org	✓
30 August - 2 September 2004	IEEE Int. Symp on Spread Spectrum Techniques & Applications	Sydney, Australia	http://www.isssta2004.org/	✓
September 2004	PIMRC2004	Barcelona, Spain	http://www.pimrc2004.org	✓
20-22 September 2004	ISWC '04	Mauritius	http://www.uom.ac.mu/events/iswcs04.htm	✓
26-29 September 2004	VTC 2004-Fall	Los Angeles, CA	http://www.vtc2004fall.org	
3-5 October 2004	ITSC04	Shanghai, China	http://www.ewh.ieee.org/tc/its/conf.html	
29 May - 1 June 2005	VTC 2005-Spring	Stockholm, Sweden	http://www.vtc2005.org	
Q2 2006	VTC-2006 Spring	Melbourne, Australia	mailto:fzheng@iecc.org	

Conferences marked '✓' have open calls for papers as of 15 August 2003. 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.