IEEE VTS NEWS

Connecting the Mobile World

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FORWARD

James Irvine, Editor

Happy New Millennium!

Those of us counting from one can now join the computer scientists of this world who insist on starting at zero and agree that we have, on the Gregorian calendar, reached the third millennium.

The cloud to this particular silver lining is that the time has now past for my venerable *Chambers 20th Century Dictionary*, although to be fair to Chambers, they had more foresight than some software developers and changed the name to *Chambers English Dictionary* in 1988.

The relevance of this fact to the *VTS News* is the fact that this particular book is what I refer to when checking my Ps and Qs. While I hope that we all agree that the *VTS News* is published in English, the interesting question is 'which one?' This was brought home to me by a comment to one of our Senior Editors, Frank Lord, that he had made a mistake in his spelling. In fact, Frank faxes his articles to me rather than sending them electronically, and when I rekey them I use British spelling. If you would like to blame anyone, it should be me.

Most columns are submitted electronically, and are only edited for format. Most features do require editing, especially since we are averaging more than one non-native English speaking feature writer per issue. Most of them use International English rather than American English. Other material – this foreword, news items, some reports – are written or rewritten from submitted material. Editing is done in Scotland, and copy submitted to Piscataway for laying out and printing.

The IEEE Professional Communication Society recently discussed this dilemma (Ron Blicq, 'Guidelines for English Language International Technical Documentation?', *IEEE PCS Newsletter*, Sep/Oct 2000), but found little consensus. Although most respondents wanted a standard, 36% wanted it based on British English, 26% on American English, and the best part of half, 40%, were undecided. On a sample of 5 words, on one (caulk), Americans favoured the British spelling (to a larger extent than the Europeans, including British, themselves) and on another, (spelt/spelled), the majority everywhere favoured the American spelling. Other words split down country lines, with Canadians and Australasians voting with the Europeans.

One of the key features of the *VTS News* is its timeliness. Columns discussing recent technical developments are in your hands between six and eight weeks from being written. In the light of this, and the fact that there is no real consensus, it is not really practical to re-edit 33000 words to standardise on one specific spelling convention. Therefore, while every effort will be made to ensure that spelling is consistent within an individual article, articles will use the convention – American or International – that is most appropriate. I hope that this is an acceptable compromise between readability and speed.

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For inquiries and orders, see telephone numbers above.

MOBILE COMMUNICATIONS DEVELOPMENT IN CENTRAL AND EASTERN EUROPEAN COUNTRIES

Arturas Medeisis, Head of Section, SRFS Lithuania

Introduction

Central and Eastern European (CEE) countries (see Figure 1) today present an interesting example of social, economic and technical developments. For a long time developing behind the "iron curtain" of communist era, many CEE countries achieved significant levels of welfare in many sectors. Unfortunately, after the liberalisation from the communist rule a decade ago, CEE countries realised that their prior development was based on the wrong economic principles, so they were trapped in a corner with no further way up.

Thus CEE countries were thrown back in their socio-economic development and had to struggle in a new direction to liberal market economies, while faced with many transitional difficulties. All these processes also had a great impact on the technology, because many systems and technologies had to be replaced or renovated to comply with western standards.

However, for the telecommunications sector this provided a significant boost, because establishment of proper communications systems was perceived as a primary goal, before any other economic developments could really start. In particular mobile systems, thanks to their quick deployment capabilities and advanced services, were first to this then unexplored market place.

Common market features

After the first years of despair and obscurity, caused by a collapse of previous long-lasting economic systems, most CEE countries quickly re-oriented their efforts towards development of liberalised market economies. Although this

Country	Population, million	GNP per capita, 1999, US$	Teledensity, end '98, %
Albania	3.4	870	3.1
Belarus	10.2	2630	24
Bosnia-Herzegovina	3.8	n.a.	9.1
Bulgaria	8.2	1380	32.9
Croatia	4.5	4580	34.8
Czech Republic	10.3	5060	36.4
Estonia	1.4	3480	34.3
Hungary	10.1	4650	33.6
Latvia	2.4	2470	30.2
Lithuania	3.7	2620	30.6
Macedonia	2.0	1690	n.a.
Moldova	4.3	370	15
Poland	38.7	3960	22.8
Romania	22.5	1520	16.2
Russian Federation	146.5	2270	19.7
Slovakia	5.4	3600	28.6
Slovenia	2.0	9890	37.5
Ukraine	50.0	750	19.1
Yugoslavia	10.6	n.a.	21.8
Total:	**340.0**		
Average:		**3046**	**25.0**
WB's middle income grade:		**2000**	
Average EU Monetary Union:		**21680**	

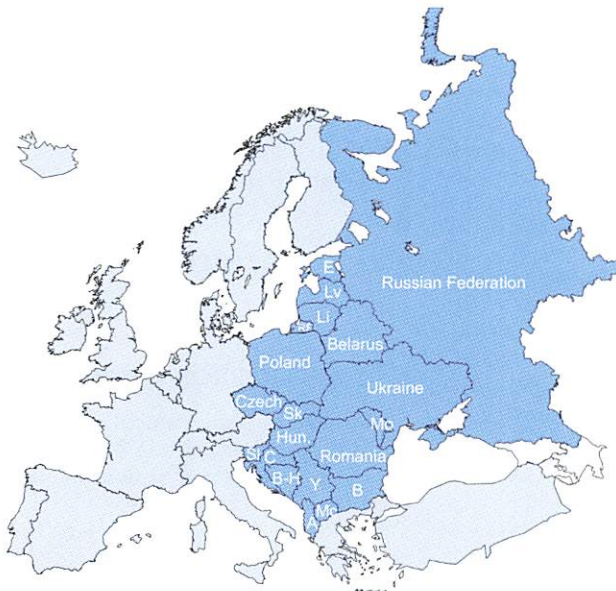**Figure 1** Central and Eastern European region (A:Albania, B-H:Bosnia-Herzegovina, B:Bulgaria, C:Croatia, Czech:Czech Republic, E:Estonia, Lv:Latvia, Li:Lithuania, Mc:Macedonia, Mo:Moldova, RF: Russian Federation, Sk:Slovakia, Sl:Slovenia, Y:Yugoslavia)

Table 1 Major economic and telecom indicators for CEE countries (source: 1999 - World Development Indicators database; GNP data based on the World Bank's Atlas method)

process is not easy and may not be finally completed for some years to come, even today one could see significant changes and developments.

Today most of CEE economies are growing and have impressive figures of annual GDP increase, ranging from 3% to 10%. However, the accumulated capital is not yet sufficient to create significant purchasing powers within the countries that would be comparable with that of our Western European neighbours (see Table 1).

This means that when making technology choices, much too often countries and people have to opt for cheaper solutions, and this sometimes slows down the overall pace of technological developments and the penetration of new innovative services, such as mobile communication systems.

Mobile communications of the communist age

A common feature of mobile communications in CEE countries prior to liberalisation was the fact that there were no mobile systems intended for public use. All mobile communications were considered to be an important part of strategic state infrastructure, so they were accessible only to military, governmental offices, emergency services and certain kinds of state owned companies, like railways, utilities, etc.

On the technology side, there were some bright pictures. One notable example could be the mobile telephony system "Altaj". For the first time developed in late fifties, it was gradually modified several times and was used in few hundred cities until recently (and is still used in some places today). "Altaj" is an excellent example of analogue trunked system for mobile telephony. It used configuration of a single urban macrocell with radial coverage, employing 36 channels in the 330 MHz band, and featured a fully automated central switch, allowing direct calling to/from the PSTN.

However, because the system was intended for limited governmental use, it was designed only to cope with limited subscriber capacities and had no such important functions as airtime accounting, all of which made later commercialisation of the system impossible.

On PMR[†] side, there were limited number of networks in place, used by emergency services, utility companies and alike, mostly concentrated in the 50 MHz and 160 MHz bands, and also in 450 MHz in some countries.

In the field of paging, no networks were known to exist at all. Although there were some reports of developing the "low bit-rate data transmission systems", such systems did not reach the production stage.

First steps of public mobile telephony

Abolishment of communist rule and subsequent liberalisation of CEE countries at the beginning of nineties opened all roads for development of communications. Mobile systems were seen as a competitor even to fixed networks because of relatively low teledensity in the CEE (between 5-30% in different CEE countries).

But early nineties were exactly the time when mobile technologies where moving in Europe from 1st to 2nd generation. So having to select something for the urgent deployment, most CEE countries had wisely chosen to install initially the 1G networks, which at that time were readily available, affordable and easily compatible with the analogue PSTN networks then prevailing in CEE countries.

In many CEE countries this turned out to be the Scandinavian NMT-450 system. As a complementary measure, some countries even installed few NMT-900 base stations in metropolitan areas to cater for roaming businessmen.

However those initial NMT-450 networks were not given a real chance to develop to a mature stage, because the GSM standard was quickly gaining wider and wider acceptance within all of Europe. Besides few exceptions (big countries, like Poland, Russia), in most other CEE countries NMT networks never had more than few tens of thousand of subscribers.

All this led to a situation, where the existing 1G networks were quickly overridden by the mighty 2G digital counterparts. However, most of those early NMT networks still exist and are operational, although serving largely the old customer base or those, which need services in remote areas, where the NMT-450 provides better coverage. In some cases, NMT-450 networks are being either dismantled or converted to serve different purposes, e.g. as WLL solution for fixed rural subscribers in remote areas.

Public mobile telephony systems today

Experience with the NMT networks taught CEE administrations one early lesson, which was that many advantages might be gained by allowing really trouble-free roaming between many neighbouring countries. So, in their selection of 2G technology, all CEE countries unanimously opted the GSM standard.

Installation of GSM networks in CEE started around the year 1995 and very soon GSM truly dominated the landscape of public mobile telephony.

An important element for successful development was early introduction of wide competition. Competition increased even further with the installation of the DCS-1800 systems (GSM modification for the 1800 MHz band).

In many countries licensing of DCS-1800 was arranged so, that the licences were given to existing GSM operators plus one or two new entrants. Table 2 shows the number of operators of either GSM or DCS-1800 or both in different CEE countries, together with their corresponding total mobile penetration.

Country	No of GSM/DCS-1800 operators	Mobile penetration % (Mid 2000)
Albania	1	<1
Bulgaria	1	6
Croatia	2	7
Czech Republic	3	27
Estonia	3	29
Hungary	3	22
Latvia	2	14
Lithuania	3	12
Poland	3	14
Romania	3	8
Russia	Regional licences	1.5
Slovakia	2	22
Slovenia	2	46
Ukraine	4	1

Table 2 Number of operators and mobile penetration in the CEE countries (Note: penetration numbers are collected from several diverging sources, so provide the rough estimates)

[†] Private or Professional Mobile Radio, also known as Specialist Mobile Radio (SMR)

Today many GSM/DCS-1800 operators strive to improve their networks and services further. This encompasses both the commercial aspects (new services, variety of tariff schemes, etc.) and technical elements (better QoS, coverage, etc.). However the most important developments in the 2G networks today concern the introduction of new communication protocols and platforms, allowing increase of transmission speed and new operation modes, thus paving the way towards 2.5G and 3G services.

Here the similarities stop, as different operators select different technologies, notably either HSCSD (High Speed Circuit Switched Data) or its packet switched rival GPRS. Although implementation of these technologies started by the end of 1999 – beginning of 2000, up to now (December 2000) there were no reports of significant commercial success so far.

On the contrary, there were some voices heard from operators, claiming that both HSCSD and GPRS appeared to be difficult to implement, even causing operational disruptions in the networks. Apparently, introduction of those new data transmission technologies would require major reconfiguring of the network and consequently much more time to start successful commercial use. However, probably the market itself seems being not yet ready to accommodate those new services, both in CEE and in the Western Europe.

3G developments in CEE

Fast development of GSM networks attracted much attention to the mobile telephony market in CEE. So now everyone appears to be confident that multimedia capabilities of 3G networks would bring even more benefits and further boost the mobile penetration as well as an overall IT market (see Table 3).

CEE countries have already confirmed their commitment to the implementation of the harmonised European standard for 3G, known as UMTS. However the way to award UMTS licences appears to be less clear to administrations of CEE countries and less harmonisation is likely to be achieved in this field.

Country	IT investments per capita, US$	PC penetration rate, %	Internet penetration, %
Slovenia	165	25.0	13.0
Czech Republic	152	10.7	8.0
Hungary	120	n.a.	11.0
Poland	61	13.7	6.0
Estonia	n.a.	6.9*	13.0
Latvia	n.a.	9.1	4.4
Lithuania	63	5.9	3.0
Slovakia	74	n.a.	4.0
Russia	17	n.a.	0.4
Bulgaria	22	3.7	2.5*
Romania	11	2.8	2.8
Western Europe	549	27.7	21 (UK only)

*Residential users only

Table 3 Investment and penetration statistics of IT market in CEE countries for year 1999 (Source: Prime Investment / IDC, 2000)

Up to very recently, most of CEE countries used to issue mobile licences by means of the so called "beauty contest" procedure. Only Slovakia and Slovenia have so far used forms of auctions to licence mobile spectrum. However this peaceful scenery was spoiled by the news of the famous UMTS auction in the United Kingdom, which raised over $30 billion, echoed by the successful German auction. This gave rise to a new way of thinking and many CEE finance ministers hooked on to the bright idea of how to improve the health of their state budgets.

As a result, today many CEE administrations are considering possibilities for selling 3G spectrum in their countries by means of auctions. One of the most interesting examples could be the initiative discussed between the three Baltic States (Estonia, Latvia and Lithuania) to issue UMTS licences in a combined regional auction, thus increasing the size of the potential market and provoking higher licence prices.

However all this money talk is beginning to fade away slowly as less optimistic news started to flood from all around, notable from the latest UMTS initiatives in Austria, Switzerland, and financial concerns over the mounting levels of debt held by the major mobile operators.

The latest news on 3G auctioning in CEE came from Poland just when this article was drafted in early December 2000. Poland expected to issue up to five UMTS licences by the end of 2000 in a combined beauty contest-auction arrangement. However by the prescribed deadline, only three existing Polish mobile operators had registered their interest. According to the latest report, the Polish administration is seriously re-considering whether to continue the licensing procedure given this situation.

PMR trends

Liberalisation brought also a lot of changes to the PMR market in CEE over the last decade. Now the numbers of PMR users are constantly increasing, as more and more not only large companies but also SMEs rush to use that cheap technology for their mobile communications needs.

However, the current market trend is mostly in the direction of an increase of number of small private PMR networks rather than towards PAMR. Most companies tend to have their own small privately owned network, with a base station typically installed just above the rooftop of a building where they reside.

Only comparatively few large establishments (oil, gas utilities, transport companies, police, emergency services, etc.) have installed larger analogue trunked networks, some of them nation-wide. The digital PMR trunked networks in CEE today may be counted on one's fingers, while PAMR solutions have not appeared at all. Although many CEE countries have licensed PAMR operators, no commercially successful systems are reported.

Such new digital technologies as TETRA or TETRAPOL also have not seen a success that far in CEE, with only a couple of such systems sold and few more undergoing trials. However, it may be noted that the latest European TETRA conference in Rome boasted some 900 participants, which points to further developments in this area.

Meanwhile, potential operators claim that the current lack of commercial interest in the new digital PMR technologies is being largely due to persistent high prices of equipment, as compared to the "good old" analogue FM simplex PMR equipment. Further incentives to use advanced technologies gradually disappear with the successful intrusion of GSM services into potential PAMR market segments.

For example, the use of VPN (Virtual Private Network) technology over the conventional GSM network solves many potential interests for corporate mobile communications of both large and small companies alike, and does it in

a very elegant manner, on a really wide scale, with minimum investment.

Most hopes today for the development of new digital PMR and PAMR services are related to the expected need for renovation of many existing soviet-built state owned emergency and governmental networks. However, the less than plentiful state coffers of CEE countries do not suggest that these hopes will materialise very soon.

Paging industry in the CEE

The paging industry is another example where developments were overtaken by the fast market seizure by the public mobile telephony systems. Some 10 years ago, the paging market in our region seemed very promising, because it was expected that cheap and unobtrusive services, that never existed in CEE before, may cut off the large portion of the public mobile communication needs.

At the beginning, POCSAG technology was used by operators to establish their networks. The fact that many licences were issued in most of CEE countries (usually 3-5) provided further incentives for competition. Many additional paging operators were licensed on a regional basis, sometimes using such complementary paging technologies as RDS (data transmission in the FM radio channel). Operators tried to get on more customers by offering the one-time little sign-up fee combined with CPP (Calling Party Pays) scheme and similar commercial approaches. Another step was the introduction of FLEX technology by interleaving their packets into the gaps of not very loaded POCSAG transmissions, which allowed increases of speed and introduction of new services.

However none of these attempts helped very much and paging networks slowly went into decline. The latest governmental moves to license ERMES, the new European digital paging technology, also were not successful in CEE as well as everywhere else in Europe.

So today only few paging networks remain in place, each usually serving only a few thousand faithful subscribers. New expectations were raised with talks of introducing some form of return channel, especially for use as telemetry and similar applications, and even appropriate harmonised frequencies were foreseen for such use on a pan-European scale. However nothing really happened in this area so far.

Radio spectrum issues

Radio spectrum considerations are an important issue for overall understanding of situation in CEE countries today. The major problem here is again related to the recent past, when the countries of socialist block decisively used different radio frequencies and standards than those used in Western Europe. So now, when CEE countries decided to tune their new developments to the harmonised European standards, unavailability of necessary spectrum often became a restrictive element.

Situation with the old military systems proved to be especially problematic, because of long lifetime of military equipment and difficulties to get sufficient funding for replacement expensive military equipment. At the same time, in many CEE countries military and governmental users were previously allocated much greater parts of the spectrum than civil users.

One notable example of such problems could be the situation in the 900 MHz band, which almost entirely was previously used throughout CEE for the aeronautical radio navigation system known as RSBN/PRMG. This system initially caused many problems because its frequencies coincide precisely with those of GSM-900. Smaller countries, which re-equipped their aircraft quickly, were able to assign the full necessary spectrum for GSM use. However bigger CEE countries, having large military air forces and being not able to overhaul them quickly, still face this problem today.

A similar problem is encountered in several CEE countries with regard to spectrum allocation for the UMTS services, where core bands identified by the ITU for IMT-2000 around 2 GHz still cannot be made fully available for UMTS use.

Russian scenario

Russian Federation is obviously a significant market on its own, so probably deserves a few separate words. Indeed, the situation in the mobile market in Russia today is very controversial and differs significantly from that in the majority of CEE countries.

Right after the liberalisation, Russia took a two-fold approach to standardisation of mobile technologies. On the one hand, some systems were given the status of federal standard, which allows their unlimited licensing and deployment anywhere in Russian territory. Such mobile federal standards include European standards NMT-450, GSM, DCS-1800.

On the other hand, Russian administration decided to allow into the country other standards, coming from different regions of the world, by giving them the status of regional standards. Among such mobile regional standards, such could be mentioned as AMPS, D-AMPS and even CDMA (IS-95). The conditions of their use are such that operators of AMPS/D-AMPS are given licences to operate their networks only in a particular region and no automatic interregional roaming is allowed.

CDMA systems are officially allowed to be installed on a regional basis, and only for provision of WLL services to fixed subscribers. However, because of inherent mobility features of their systems, CDMA operators reportedly allow mobile users into their systems, thus raising many heated debates over illegal competition. In any case, CDMA systems account for very small fraction of the Russian mobile market today, which was reported to hit 3 million subscribers by 1 December 2000 (Source: Sotovik).

Regardless of this mix-up with standards and many regional operating companies, the Russian mobile market shows constant growth (more than 100% over the last year) and also certain preference for the GSM technology, as around 65% of all mobile subscribers use GSM. The rest of mobile subscribers mostly use NMT-450, AMPS/D-AMPS. An important market statistic to mention is that the Moscow region alone accounts for around 60% of all mobile users in Russia.

In the PMR market, Russia followed a similar two-tiered approach, allowing both harmonised and regional standards. In the first category, a notable example is TETRA, for which the Russian administration recently opened the 410-430 MHz frequency band. A mixture of different trunked PMR standards was allowed to operate in the band 815-820/860-865 MHz.

Certain developments also concerned the aforementioned Altaj's 330 MHz band. Although "Altaj" was and still is used until now in many Russian cities (in Moscow serving around 30000 users with a base station installed on the Ostankino TV tower), the need for its replacement was obvious long ago. Finnish firm Nokia was first to jump into this niche market at the beginning of the nineties, offering their ACTIONET analogue trunked system (based on MPT-1327 specifications) adapted to the 300 MHz band.

However, on the market development side the pattern was similar to the rest of CEE. Although there were quite a few large PMR/PAMR networks installed in Russian Federation, apparently no one operator claimed a truly signifi-
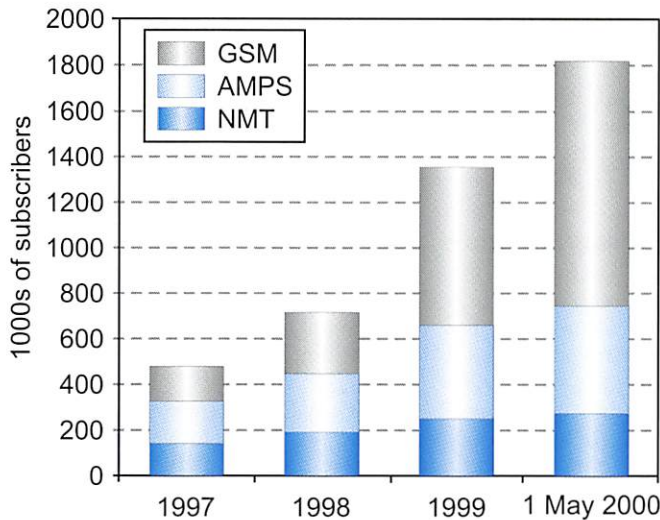
Figure 2 Split-up of Russian mobile market by different standards (source: Sotovik).

cant commercial success as growth of subscriber bases was rather limited.

The last September news came from St. Petersburg, where a new TETRA network started trial operations, but it appears that most hopes of the prospective operator again lie with the potential users from state authorities and municipal utility companies.

Paging developments in Russia pretty much followed the general line in other CEE countries. After initial introduction a decade ago, paging networks quickly lost competition battle to their mighty cellular mobile rivals, and now are seeing only very limited growth if any. At the beginning of the year 2000 there were some 450,000 paging subscribers in Russian Federation, of which 95% were served by the POCSAG networks.

There were reports that ERMES networks would appear in Russia by the summer 2000, but as time passed none appeared on the air.

Conclusions

The overall CEE market today is little known to the outsiders, probably because of inertia of its long lasted isolation and because of the current poor performance of national economies.

However this market has a significant potential, especially in technological areas, thanks to the well-developed education system, good record of past engineering achievements, skilled human resources, etc. This potential is likely to be released to the full sooner or later, as evidenced by the rapid developments of a whole ITC sector in CEE over the last decade.

Within the mobile communications, CEE countries took one good approach in general alignment of their recent developments with the harmonised European standards, which allowed the many difficulties of small fragmented markets to be overcome. So today mobile communications in the CEE countries are truly keeping abreast with the latest developments in Western Europe, including both success stories and downturns of some mobile industries.

However, many transitional problems still remain, and those related to incompatibility between the new and old (especially military) systems are some of the most difficult technological challenges.

But technological challenges are not the major concern for mobile communications professionals in Central and Eastern European. The biggest problem is that our economies are not able to change as quickly as we may change our networks.

To probe further

Unfortunately, most of the information today on mobile communications in CEE is largely fragmented and often available only in national languages.

One Internet site that may be recommended for English readers is the web site of the CEPT's European Radiocommunications Office, at http://www.ero.dk/.

It provides useful insight into many facets of radiocommunication developments within Europe, including CEE countries. In particular, ERO provides links to the web pages of many European national radio administrations, from where additional national information may be gathered.

Those few of you, who might be familiar with the Russian language would be delighted to try out the web site of Russian mobile providers at the http://sotovik.ru/, which is completely dedicated to mobile communications in Russia and ex-USSR countries and provides lots of both marketing and technical information.

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THE FUTURE OF RADIO IS CLEAR: SATELLITE RADIO

Michael J. Bergman, Sirius Satellite Radio, Inc.

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This paper gives an overview of Satellite Digital Audio Radio Service (SDARS), discusses some of the benefits and technical challenges, and introduces some next-generation features of SDARS.

Introduction

The SDARS category began to take off in 1997, when the FCC first auctioned off the spectrum for this application. Sirius Satellite Radio (then CD Radio) and XM Satellite Radio (then American Mobile Satellite Radio) won licenses to the spectrum for purposes of national broadcast by satellite, with supplemental coverage via terrestrial gap-filler networks. Now, three years later, this technology is about to become available to the public, first with the launch of the Sirius satellites. The XM satellites will follow some time later. The problem this technology addresses is that traditional commercial radio really doesn't serve the public very well. Interruptions due to driving too far from a city are very common. Multipath causes problems as well, as frequency selective fading causes dropouts. Moreover, the typical FM station has 18 minutes of commercials per hour—plus station hype.

Satellite Digital Audio Radio Service, or SDARS, dramatically improves this picture. For a small monthly fee, customers will receive 50 channels of music. XM will have a reduced advertising load, and Sirius will offer music that is entirely free of advertising. The signal will be broadcast nationwide, with modern digital transmission technology and digital music quality. And this is presented with virtually no interruptions of any kind. The technology of SDARS is what makes this choice possible.

Satellite Transmission

There are two types of satellite transmission being deployed by SDARS providers in the United States. The original concept, proposed in 1996 by Sirius, was to use two geostationary satellites at approximately 80° and 110° longitudes. These two satellites were intended to cover the Contiguous United States (CONUS) and to be supplemented with terrestrial transmitters. XM Radio subsequently adopted this approach as well, with orbits at 85° and 115° longitude.

Over time it became clear that the geostationary approach was best suited for stationary receivers. In the northern part of the CONUS, such as Maine or Washington,

the angle of elevation of these satellites is fairly low, typically only 25° to 35°. When the receiving antenna can be installed in a fixed location with a clear line of sight to such a low point in the sky, this is not a problem.

However, mobile receivers cannot count on an advantageous line of sight. While moving, they would suffer from blockages such as small buildings, trees and even trucks. In 1998, Sirius was the first to move to the current generation of SDARS technology by switching to a modified Tundra orbit. These inclined elliptical geosynchronous orbits put two satellites in view of North America at all times, but at a higher angle of elevation for the northern part of the country. Three satellites are used, evenly spaced over the 24 hour day. Each satellite spends 8 hours in an idle state below the equator, and 16 hours above the equator and transmitting. Each satellite is 47,102km above North America at apogee.

As a result, the angle of elevation for a mobile receiver in the northern part of the U.S. is dramatically improved. For Bangor, Maine, there is always at least one satellite above 60°. For Seattle, there is always one above 65°. This dramatic increase in angle of elevation—from 35°, to over 60°—leads to a much higher level of service availability in the north. This is another way of saying that there will be fewer interruptions, a key goal of SDARS.

A corollary result is a decrease in the number of terrestrial transmitters required. With the geostationary orbits, it was not possible to cover all locations reliably, so one must deploy as many terrestrial transmitters as is economically feasible. With the newer orbits, one can deploy perhaps a hundred or so and have excellent coverage.

Terrestrial Transmission

Both companies are using a terrestrial gap-filler strategy. The terrestrial band of each SDARS system is roughly one-third of the total bandwidth, centered in the middle of the total SDARS band.

The transmission system is based on COFDM modulation (Coded Orthogonal Frequency Division Multiplex). This is the modulation style used in Eureka-147 DAB, although there are technical differences in the implementations from this standard.

This technology is well known for its robust performance in fading channels. Sirius has been running a test network in San Francisco and has successfully demonstrated that it is a suitable solution at S-band.

Receiver Technology

The Sirius receiver chipset is being designed by Lucent Micro Electronics. Sirius' wireless link uses QPSK modulation with TDM as the channel multiplexing technique for the satellite path. It uses pi/4 D-QPSK COFDM modulation for the terrestrial path. Both paths use convolutional and Reed-Solomon encoding, bit and byte

interleaving, and audio decoder error concealment. The XM system is similar.

For Sirius, the foundation on which the wireless link is built is a patented approach that achieves time, space and frequency diversity. Of the three transmissions at any time, the terrestrial transmission and one of the satellite transmissions are delayed by 4 seconds. The second satellite transmission is sent in real time, but buffered by 4 seconds in the receiver.

Since the same data is sent on all three paths, the receiver can combine them for operation that is more robust. Specifically, the receiver uses a maximum ratio combiner technique to merge the soft symbols before the Viterbi decoder. This provides significant diversity gain. The other aspects of transmission diversity are frequency and space diversity. Since the three transmissions are spread over 12.5MHz, and the satellites and terrestrial transmitters are widely separated, Sirius achieves additional proof against blockage and errors.

What this means to the industry is a nearly seamless signal coverage from coast-to-coast. While complete signal loss is still possible, it will be much less common than for AM, FM or cellular technologies. A complete dropout would be characterized by an audio mute. But in the case of a complete signal blockage, such as driving under a bridge far from any terrestrial network coverage, the aforementioned 4-second buffer would provide music during the blockage. Thus, the driver would not perceive any blockage at all.

Next-Generation Features

So far, we have discussed the first generation SDARS technology, which uses geostationary orbits and a large terrestrial network; and the second generation of SDARS technology, which uses geosynchronous orbits and a much smaller terrestrial network.

The next generation of SDARS technology, like 3G cellular, will be characterized by an explosion of features. Some of the technologies expected from the SDARS providers include multichannel audio; support for extended telematics services such as multicasting; feature-rich receiver chipsets; and more antenna options.

Multichannel Audio

Steering for 5- or 7- channel audio can be combined with the SDARS music compression algorithm to permit a stereo transmission to be decoded into multiple channels at the receiver. Current systems do not encode this steering, but it is available. Demand from OEs and the aftermarket will drive implementation of this feature. However, SDARS systems use aggressive compression to fit many channels into a fixed amount of available bandwidth. Where there is an increase in the required bandwidth necessary, the tradeoff between a given number of stereo slots and a small number of fatter multichannel capable slots becomes a business decision.

Multicasting and Narrowcasting

The current generation of SDARS systems can transmit music and voice, but also arbitrary data packets. Arbitrary packets can contain application data from SDARS providers or from their partners, such as OEs. Multicasting is a networking term that is used to mean the transmission of a packet to a set of devices that share some common addressing characteristic. One scheme used in Ethernet is to mask off part of the address of the device. All devices whose addresses match the unmasked portion of the address receive the packet.

The equivalent business model for broadcasting is called narrowcasting. This is the process of sending messages to part of the subscriber base. In SDARS, narrowcasting can be used to send data to all of a certain class of customer, or make and model of car. One can imagine sending a promotional message to all Lincoln LS owners, for example.

New Receiver Features

The first receivers available will most likely be separate from the head unit. The current receiver chipsets are a little too large to fit into the space available in existing head units. Power consumption makes multichip module technology an unlikely candidate for size reduction, since heat dissipation in an MCM would be quite a problem with the anticipated watts of power these receiver chipsets require.

The next generation of receivers will be easier to integrate into head units for several reasons:

◆ Reduced chipset power will put less load on head unit power supply design and heat dissipation requirements
◆ Overall part count will be reduced due to up-integration
◆ New head-unit designs will anticipate SDARS chipset space requirements

Antenna Options

The antenna in the first year will be an active antenna mounted on the roof or the backlight. Of course, the preference is for hidden and integrated antennas. In the next generation, the systems will feature new antenna designs that make use of diversity to allow smaller, cheaper designs to be better integrated into the look of the vehicle. Antenna diversity implies multiple antennas and cables, but the gain may be that the antenna no longer must be mounted outside the cabin. This is a key feature that the industry requires.

SDARS providers are building the infrastructure for these features into the basic technology being introduced now, so that the industry can take advantage of them for new customers without alienating existing customers.

Conclusion

Satellite Digital Audio Radio will deliver a superior car audio experience to subscribers starting in 2001. It offers digital quality commercial-free music via a superior transmission system in a wide variety of formats. As the technology rolls out in the next year, new features and services are being planned for future generations of SDARS technology, to make this an exciting product for years to come.

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AIRPORTS AND TUNNELS GET WIRED FOR WIRELESS

Philip E. Deck, Vice President & Chief Technical Officer, Concourse Communications

In September 1997 a special purpose company named New York Telecom Partners obtained an exclusive Agreement with the Port Authority of New York and New Jersey to design, supply, install, commission, operate, maintain, and upgrade a neutral host, equal access, wireless communications network within Port Authority owned facilities. The network, known as the Telecommunications Network Access System, or TNAS, serves all licensed and unlicensed wireless service providers that wish to participate in the Public/Private Partnership wherein the Port Authority receives usage based revenue for the use of their wireless rights-of-way by the service providers. NYTP is the TNAS network developer and operator and does not provide services over the network. This article gives an overview of Phase I of the TNAS implementation (the [road] tunnels and the airports).

Introduction

In the fall of 1997, after over three years of effort, New York Telecom Partners, LLC. (NYTP) obtained an exclusive Telecommunications Network Access System (TNAS) Agreement with the Port Authority of NY & NJ (PANYNJ). That Agreement, with a term of 25 years, including options, defined a Public/Private Partnership and the terms and conditions that govern NYTP's design, supply, construction, commissioning, operation, maintenance, and upgrade of an equal access, technically neutral, multiple wireless service provider network within the venues owned by PANYNJ. The Agreement defines the wireless services to be included as both those requiring and not requiring an FCC license for operation in the radio frequency (RF) bands between 806 MHz and 40 GHz. As shown in Table 1, that could be a huge number of services to deal with, but the reality of the market is that there are currently 5 viable licensed commercial wireless service providers and a similar number operating in the bands that do not require a license. The venues owned by PANYNJ, include just about every type there is – road tunnels, rail tunnels, and buildings of all sizes including three airports and the World Trade Center. Each venue offers a distinctive set of characteristics including the physi-

cal attributes and the number of people that reside in, visit, or are transported through them, including their telecommunications habits. The wireless service providers (WSP) priorities for venues wherein they require coverage are based on the potential number of subscribers they can expect to capture and those priorities are reflected in the TNAS build-out schedule. That schedule began with the Lincoln and Holland tunnels where only the licensed wireless service providers have indicated a desire for their service distribution, followed by Newark (EWR), LaGuardia (LGA), and John F. Kennedy International (JFK) airports, where both licensed and unlicensed WSPs want coverage. In addition, under non-exclusive terms in the TNAS Agreement, an optical fiber network is being built, utilizing air-blown-fiber technology, throughout the office spaces in the two 110 story World Trade Center towers – One WTC and Two WTC. Later phases of TNAS build-out are anticipated to include the Port Authority Trans Hudson (PATH) metro, the Port Authority Bus Station, and selected public areas within the World Trade Center Complex. In order to carry out their comprehensive obligations under the terms of the TNAS Agreement, NYTP has teamed with companies whose expertise and experience were at the same time focused on specific TNAS areas as well as complimentary in the overall project scope. Those companies include Andrew Corporation, LGC Wireless, Criterion Wireless, RCC Consultants, ARINC, Aerocomm, and Intermec Technologies Corporation.

TNAS Legacies

There were a number of legacy wireless service distribution subsystems that NYTP had to integrate into the new TNAS without interrupting service. Principle among these was the existing radiating cable system within the Lincoln and Holland tunnels. Prior to the TNAS Agreement, the two Cellular carriers in the New York area had leased the Port Authority public safety radio distributed antenna system (based on Andrew's RadiaxTM brand radiating cable) for their use to inject cellular signals into the two tunnels. The radiating cable that the Port Authority had installed supported services operating at or below 900 MHz quite well but performed more like a rope at PCS frequencies (1,900 MHz range). The cellular providers had enjoyed for several years having their services distributed in these two major road tunnel points-of-entry to New York city without competition from the new kids on the block, the PCS operators, and that circumstance drove the priorities of the PCS providers to rectify that lack of competi-
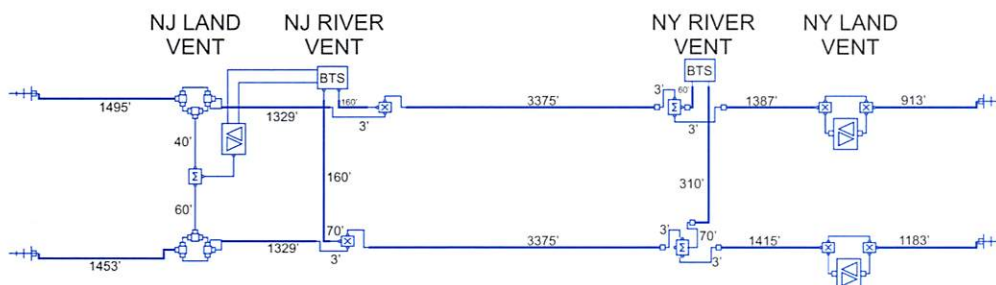

Figure 1 Holland Tunnel Schematic

Service Type	Service Band Description	Based on Service Standard	Multi Access Method	Uplink From MHz	Uplink To MHz	Extension From MHz	Extension To MHz	Downlink From MHz	Downlink To MHz	Extension From MHz	Extension To MHz	PANYNJ Area WSPs
Mobile Radio	Conventional	Inc. ESMR and SMRS	TDMA	806.0	809.8			851.0	854.8			
	Private Trunked			809.8	821.0			854.8	866.0			Nextel
	Public Safety			821.0	824.0			866.0	869.0			
	Aeronautical			849.0	851.0			894.0	896.0			
	Private Land			896.0	901.0			935.0	940.0			
Paging	Private							929.0	930.0			
	Private							929.0	930.0			
	Common Carrier							931.0	932.0			
Cellular Inc. CDPD	A Band	AMPS	FDMA	824.0	835.0	845.0	846.5	869.0	880.0	890.0	891.5	AT&T
		IS-54/-136	TDMA	824.0	835.0	845.0	846.5	869.0	880.0	890.0	891.5	AT&T
		IS-95	CDMA	824.0	835.0	845.0	846.5	869.0	880.0	890.0	891.5	
	B Band	AMPS	FDMA	835.0	845.0	846.5	849.0	880.0	890.0	891.5	894.0	BAM
		IS-54/-136	TDMA	835.0	845.0	846.5	849.0	880.0	890.0	891.5	894.0	
		IS-95	CDMA	835.0	845.0	846.5	849.0	880.0	890.0	891.5	894.0	BAM
ISM	Unlicensed	WLAN	FHSS	902					928			Metricom
PCS	A Block PCS 1900	GSM	TDMA	1850	1865			1930	1945			Omnipoint
	A Block PCS TDMA	IS-136	TDMA	1850	1865			1930	1945			
	A Block PCS CDMA	IS-95	CDMA	1850	1865			1930	1945			
	B Block PCS 1900	GSM	TDMA	1870	1885			1950	1965			
	B Block PCS TDMA	IS-136	TDMA	1870	1885			1950	1965			
	B Block PCS CDMA	IS-95	CDMA	1870	1885			1950	1965			Sprint
	C Block PCS 1900	GSM	TDMA	1895	1910			1975	1990			
	C Block PCS TDMA	IS-136	TDMA	1895	1910			1975	1990			
	C Block PCS CDMA	IS-95	CDMA	1895	1910			1975	1990			Nextwave†
	Unlic. Asynchronous	PWT Data	TDMA	1910					1920			Tenant
	Unlic. Isochronous	PWT Voice	TDMA	1920					1930			Services
	D Block PCS 1900	GSM	TDMA	1865	1870			1945	1950			Omnipoint
	D Block PCS TDMA	IS-136	TDMA	1865	1870			1945	1950			
	D Block PCS CDMA	IS-95	CDMA	1865	1870			1945	1950			
	E Block PCS 1900	GSM	TDMA	1885	1890			1965	1970			
	E Block PCS TDMA	IS-136	TDMA	1885	1890			1965	1970			AT&T
	E Block PCS CDMA	IS-95	CDMA	1885	1890			1965	1970			
	F Block PCS 1900	GSM	TDMA	1890	1895			1970	1975			No
	F Block PCS TDMA	IS-136	TDMA	1890	1895			1970	1975			Incumbent
	F Block PCS CDMA	IS-95	CDMA	1890	1895			1970	1975			
	W-CDMA		CDMA	1920	1980			2110	2170			Near Future
Data	Wireless LAN	IEEE 802.11b	DSSS	2400					2483			M†, Aerzone,
	Wireless LAN	IEEE 802.11b	DSSS	2400					2483			GDM, Wayort
	Wireless LAN	OpenAir	FHSS	2400					2483			M†
	WPAN (Bluetooth)	IEEE 802.15	FHSS	2400					2483			Cerulic
UNII	Nat. Info. Infrast.	Hiperlan2		5150					5850			Near Future
				GHz					GHz	Total		
FSS	FSS, MW & LMDS	Ka-Band		26.5					40.0			See Below
LMDS (Detail)	Block A	1.150 GHz		27.5					28.4	850 MHz		
	Local Multipoint	BW License		29.1					29.3	150 MHz		Winstar
	Distribution System	in 493 BTAs		31.1					31.2	150 MHz		
LMDS (Detail)	Block B	150 MHz BW		31.0					31.1	75 MHz		
	Local Multipoint	License per		31.2					31.3	75 MHz		
	Distribution System	BTA										

Table 1 Services in bands covered by TNAS. At the time of TNAS Agreement execution the above named wireless service providers offered services in the bands listed. Subsequently, through mergers, etc., Bell Atlantic Mobile (BAM) changed their name Verizon and Omnipoint changed their name to VoiceStream. Nextwave's C Block PSC licenses are in the process of being re-auctioned by the FCC.

tion at the earliest possible time. This combination of circumstances set the first TNAS implementation priority and created the first major technical challenge for NYTP in designing the TNAS.

Under the terms of the TNAS Agreement, the existing tunnel leases were bought by NYTP as a precursor to their eventual termination and inclusion in new leases. Resolution of the circumstance that the existing radiating cable would not support PCS service delivery into the Lincoln and Holland tunnels, however, required a little more creativity.

The Tunnel TNAS

The cellular carriers that originally had leases with the PA for the Lincoln and Holland tunnels were Nynex and Cellular One, which through various transactions became known as

Bell Atlantic Mobile (now Verizon) and AT & T Wireless by the time of the TNAS Agreement. In the 800 MHz region, in addition to the two Cellular operators, the TNAS Agreement mandated the inclusion of the Extended Specialized Mobile Radio (ESMR) operator, Nextel, along with the PA's new 800 MHz trunked radio. Furthermore, in the 1,900 MHz region, the TNAS Agreement mandated PCS operators Sprint and Omnipoint (now VoiceStream) service distribution within the two road tunnels. Nextel's licenses in the Land Mobile Radio band are in such close proximity to the Cellular band that unless the services could be somehow isolated from one another, an artificial "guard band" would have to be created to preclude undesirable interference. Typically, in other situations, Nextel had been willing to give up use of licenses in the top 3 MHz of their band for that purpose, and indicated a
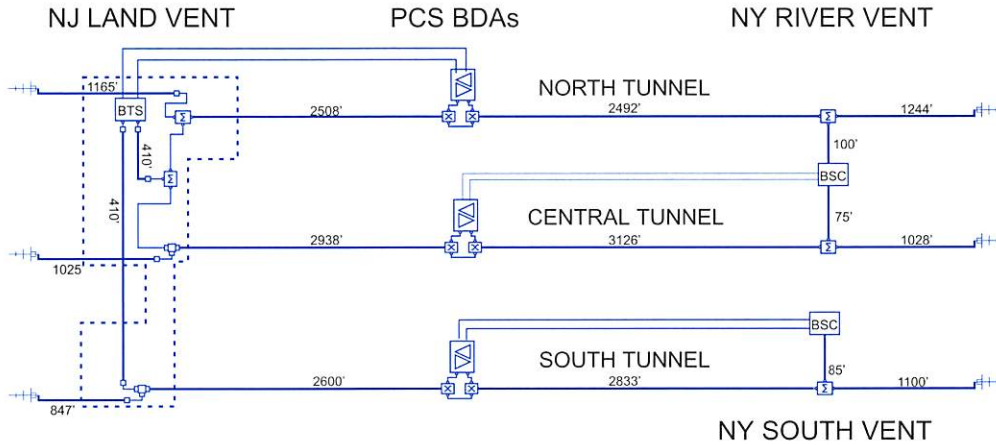
Figure 2 Lincoln Tunnel Schematic

willingness to do so in this case as well. However, NYTP strongly desired to not impose any artificial restrictions of licensed band usage on any of the users of the TNAS. Fortunately, through the use of a new radiating cable product from Andrew Corporation, a solution was developed, tested, implemented, and is now in operation that satisfied all the requirements without restriction. Beginning with a very brief description of how radiating cable works, that solution is described in the following paragraphs.

Radiating Cable for Tunnel Coverage

Radiating cable operates as two network elements combined in one – coaxial transmission line, and distributed antenna. Radiating cable offers some significant advantages in a tunnel environment where it operates as a continuously self-fed antenna that is always in close proximity to its target. Radiating cable is primarily characterized by two parameters – longitudinal loss (insertion loss) which is typically 2dB per hundred feet and coupling loss which is a measure of how the signal strength drops off as a mobile is moved away from the radiating cable operating as an antenna – coupling loss is typically on the order of 60 dB at a radial distance of 12 feet from the cable. In a two thousand foot long tunnel, a simple link could be created by installing a two thousand foot length of radiating cable on the tunnel wall. If a +40 dBm downlink signal were injected at the center, the signal at a vehicle 12 feet away from the tunnel wall would be (+40 dBm –60dB) or –20 dBm. As the vehicle moves toward either end of the tunnel, the signal would drop off in a linear fashion to the ends of the cable where the signal strength would be a further 20 dB lower because of the 2dB per 100 ft insertion loss i.e. –40 dBm. Thus, as a mobile 12 feet away traverses the tunnel, the signal strength seen at the mobile Rx goes from –40dBm at the entrance portal to –20 dBm at the center of the tunnel and back down to –40dBm at the exit portal. This sawtooth type performance is typical and for longer tunnels, amplifiers are periodically inserted to restore signal levels whenever they go below acceptable levels. The uplink performance is similar with the principle difference being the Tx power of a mobile being limited to on the order of +10 dBm. RF illumination of tunnels is also possible using conventional point source antennas distributed throughout the tunnel but the signals drop off much more rapidly that 2dB per 100 feet and the signals from a given antenna are partially blocked by vehicles between the mobile and the antenna. Although potentially more expensive to install, the radiating cable solution is preferred because it exhibits neither of these two disadvantages. Standard radiating

cable is broadband but it's longitudinal and coupling loss characteristics are frequency dependent with the useful upper frequency of operation determined by the requirement for and cost of bi-directional signal level restoration amplifiers.

Lincoln and Holland Tunnel Solution

The standard radiating cable installed by the Port Authority, originally for its 450 MHz and 150 MHz radio systems, was Andrew's RXL7 (1 5/8 inch diameter) Radiax, and has a useful upper operating frequency of about 900 MHz. While it was supporting the A and B Band Cellular operators satisfactorily and would support the frequencies of operation of the Port Authority's new 800 MHz trunked radio system and Nextel's ESMR iDEN service, it was clear that the introduction of PCS services in the vicinity of 1,900 MHz could not be done on the existing Radiax. Furthermore, the problem of Nextel's downlink frequencies being too close to the more sensitive Cellular uplinks needed to be addressed if possible so that Nextel would not be required to restrict their usage of frequencies for which they are licensed to operate.

The solution to this set of problems was to be found in a new dual band "tuned" radiating cable developed by Andrew Corporation as their model RCT7 Radiax. RCT 7 is tuned by the design of the slots in the cable outer conductor and the spacing of those slots. The performance bands that are enhanced are the 800 MHz and the 1900 MHz bands. RCT7 performs slightly better than RXL7 in the 800 MHz band and significantly better than RXL7 in the 1900 MHz PCS band . The solution, proposed by Andrew, accepted unanimously by the Port Authority, NYTP, and the commercial wireless service providers (AT&T Wireless, Bell Atlantic Mobile, Nextel, Sprint, and Omnipoint), and now implemented, was to install a second radiating cable in all bores (5) of the Lincoln and Holland tunnels and rearrange what portions of what services were on each cable. The second cable is the new dual band tuned cable RCT7. In simple terms, what was done was the following:

◆ The A and B Band Cellular, Nextel ESMR, and Port Authority 800 MHz trunked radio downlink signals and FM Rebroadcast signals remain on or are put onto the existing RXL7 cable, and
◆ The A and B Band Cellular, Nextel ESMR, and Port Authority 800 MHz trunked radio uplink signals are put onto the new RCT7 cable, and
◆ The PCS downlink and uplink signals are put onto the new RCT7 cable.

Sample schematics for the new radiating cable system are provided in Figures 1 and 2.

Note that 800 MHz service provider equipment has sufficient power output to drive the longer spans of radiating cable directly from the Base Station Combiners (BSC) whereas, for 1900 MHz PCS services, bi-directional in-tunnel amplifiers (BDAs), located in the tunnel air plenums above the roadway and fed from the BSCs over optical fiber, are required to drive the longer spans of radiating cable at higher frequencies.
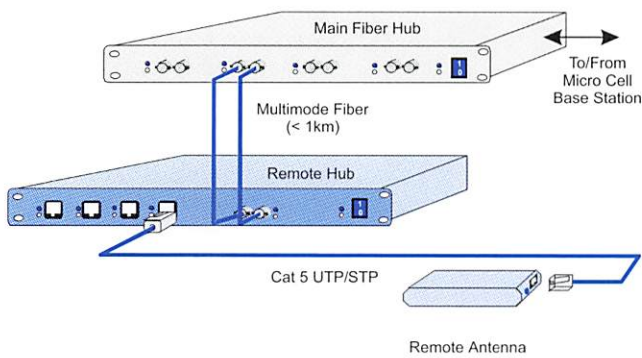
Figure 3 The Simplest LGCell

The Airport TNAS for Licensed WSPs

For the Port Authority's three airports, NYTP chose a distributed point source antenna in-building RF distribution technology known as the LGCell. The LGCell, provided by LGC Wireless, utilizes the industry Standard LAN cabling infrastructure for licensed wireless service distribution as described below:

The LGCell

At one location in each airport, referred to as the Point of Interface (POI), the licensed WSPs locate their BTS equipment. At the POI, at least one LGCell main fiber hub for each WSP, processes all that participating WSP's signals and distributes them over an optical fiber distribution network to "expansion" hubs. For each service band, the optical fiber network for each is comprised of two fibers, one for the downlink signals and one for the uplink signals. From the remote hubs, signals are connected, via Category 5 twisted pair cable, to antenna locations chosen

in number and placement to uniformly illuminate the interior public spaces of the covered airport. This combination of fiber and copper cabling is identical in concept to the "wired" Local Area Network and is implemented in conformance with EIA/TIA 568, the International Standard for High Speed Structured Cabling Systems. A pictorial of the simplest one antenna, one service, LG Cell subsystem is shown in Figure 3.

Each main hub can support four expansion hubs and each expansion hub can feed four remote antennas, for a total of 16 antennas per main hub. At least one main fiber hub (or more depending on capacity) is required for each service making them virtually independent except for the shared optical fiber routes and Cat 5 routes and the shared antennas, a feature that offers multidimensional scalability. That scalability allows each licensed wireless service provider's needs to be satisfied independently of others.

The licensed wireless in-building service TNAS at each airport is comprised of independent LGCell subsystems for each licensed wireless service band, with each subsystem comprised of main hubs, remote hubs, and remote antenna units (RAU) in sufficient quantity to deliver the capacity brought to the POI by the wireless service provider to all of the terminal areas where coverage is desired by that service provider. Excess capacity cabling infrastructure is installed and available at the initial installation so that the TNAS for licensed WSPs is scalable in terms of the number of service bands and service providers that can be supported (add main hubs), the coverage areas within each airport (locate remote hubs and RAUs appropriately), and delivered capacity (can be expanded by adding main hubs and or sectorized by reconnecting fiber).

A typical independent and scalable LGCell subsystem for a single licensed wireless service provider is shown in Figure 4. In the TNAS at the Port Authority airports, the BTS equipment, combiner network, fiber main hubs and ARM unit are located in a large equipment room and the expansion hubs are located in "Telco" closets distributed throughout the airports.

The multiple RF Carrier configuration consists of the required multiple of the above simply overlaid upon one another with all network elements collocated. Each participating RF Carrier provides their BTS equipment at the single POI location that serves the airport. The downlink and uplink signals for each RF Carrier are connected to the appropriate fiber main hubs as shown in Figure 4. The fiber main hubs are each 1U (1.75") high, 19" rack mount units and each unit is dedicated to a single RF Carrier. The fiber main hubs are stacked at the POI location. The Expansion hubs are the same size and are similarly stacked ate the remote Telco closets. Thus, for example, for 5 RF carriers, the physical space required at each location is 8.75" of 19" rack space.
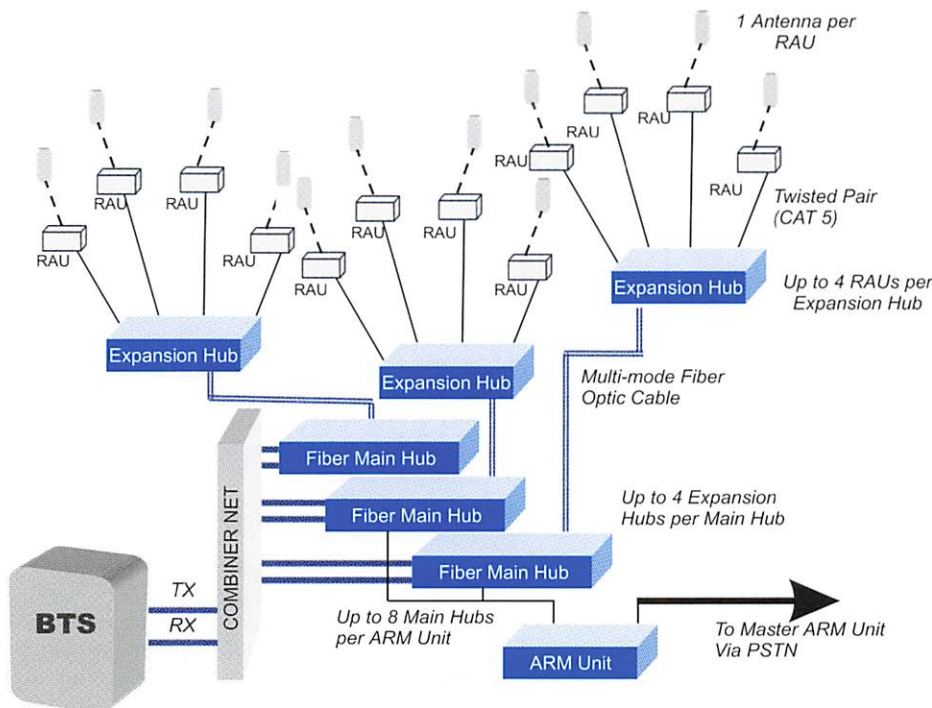

Figure 4 Typical Single RF Carrier Network

PANYNJ Airport TNAS for Licensed Wireless Services

Applying the LGCell technology to the three Port Authority airports, the preliminary design resulted in Table 2.

Airport	Covered Area Square Feet	Terminals	POI & Main Fiber Hub Locations	Expansion Hub Locations	Antenna Locations
Newark	1,241,626	3	1	17	50
LaGuardia	1,330,250	4	1	18	53
JFK	3,240,163	9	1	46	132

Table 2 Preliminary design for PANYNJ Airports

The Airport TNAS for Unlicensed WSPs

Once the technology choice for the cabling infrastructure required to support licensed WSPs in-building service distribution had been made and the industry standard wired LAN selected, the choice for unlicensed wireless service distribution was obvious. In fact, the LGCell design was originally developed to take advantage of the pervasive presence of wired LANs already installed in thousands of buildings throughout the world for use by IT departments to provide computer and data networks. Since the unlicensed wireless services being offered commercially in the PA airports are exclusively data services, the architecture of the wired LAN is ideally suitable as the backbone of the unlicensed wireless service delivery portion of the TNAS. That choice was made and the description of that portion of the TNAS is almost identical to that of the licensed wireless service delivery portion. The differences are that actual data versus radio frequency information (in either optical or electrical form) is transported over the wired LAN and in the names of the equipment connected to that LAN are different. The comparison is illustrated in Table 3.

The primary difference between the Licensed and Unlicensed portions of the TNAS is the fact that the radio spectrum is shared in the unlicensed bands. This creates an extraordinary situation in view of the intense competition for subscribers by the WSPs that utilize the TNAS. The primary arena for this intense competition is in the unlicensed band from 2.400 GHz to 2.483 GHz where the Wireless LAN (WLAN) service Standard is IEEE 802.11. Currently, four of the six unlicensed WSPs offer IEEE 802.11b Standard (DSSS) services in that band and must share the 83 MHz of available spectrum. One of those also offers OpenAir Standard FHSS services in that same band and, soon, unlicensed WSPs plan to introduce Bluetooth services in that same frequency band. Peaceful coexistence of OpenAir and IEEE 802.11b services has been demonstrated and the TNAS design includes the features that make that possible. However, although Bluetooth operation is governed by a different standard (IEEE 802.15), peaceful coexistence of Bluetooth services in that environment has not yet been demonstrated. The implementation of Bluetooth services within the TNAS will not take place until and unless degradation of other services within that band is demonstrated to be intrinsically less than specified limits (5%) or interference mitigation techniques can be shown to limit interference and degradation to those levels.

To minimize the interference potential in the unlicensed bands, the proposed TNAS design includes separate WLANs for each unlicensed band of service and for each technology within each of those bands. The result is illustrated by Table 4.

Each of these WLANs is independent in terms of the RF portion (Access Points) but share antennas and share the wired LAN backbone. The wired LAN backbone is initially a Fast Ethernet LAN but can be upgraded to Gigabit Ethernet capability when needed.

For the WLAN that is shared by more than one WSP, the WLAN design includes non-discriminatory equal access for all WSP subscribers and hardware and software at the POI that enables each WSP to enable Access to their subscribers, Authenticate that the subscriber is in fact their subscriber, and Administer the data transfer session, the so called AAA functions. In addition, the Settlement process that is the basis for billing subscribers for service delivery is enabled.

Antennas

Aesthetics is a key consideration in public spaces, especially in airports, and in NYTP's TNAS the only portion that is visible are the antennas. The antennas chosen are very small and unobtrusive to the extent that they usually must be pointed out for recognition of their presence. This fact is illustrated in Figure 5.

TNAS Design Summary

NYTP's TNAS design includes the application of two different radio frequency distribution technologies, each particularly well suited for the two different physical structures that serve the Port Authority of NY & NJ's traveling public – Road Tunnels and Airports. When the project is complete, both will truly be wired for wireless. The Lincoln and Holland tunnels are completed and the three airports will be complete within the year. The tunnel solution is radiating cable based and designed to serve all licensed wireless service providers by giving them access to their subscribers as they pass through the tunnels in their vehicles. The airport, in-building, solu-

Category	Licensed Name	Unlicensed Name
Primary WAN	PSTN	IP Network
Initial WAN Connectivity	T1/DS1	T1/DS1
WSP Equipment at the POI	BTS	Router
Media Conversion	Main Fiber Hub	Media Converter
Transport to Local Area	Optical Fiber	Optical Fiber
Local Hub	Expansion Hub	Ethernet Hub
Transport to Antenna Unit	Category 5 UTP	Category 5 UTP
Local Antenna Unit	RAU	Access Point
Transport to Antenna	Coaxial Jumper	Coaxial Jumper
Antenna (typical)	3dBi Omni	3dBi Omni

Table 3 Comparison between Licensed and Unlicensed Equipment

Service Band	Technology Standard	WLANS	WSPs
902 to 928 MHz	Ricochet (FHSS)	1	1
2.400 GHz to 2.483 GHz	IEEE 802.11b (DSSS)	1	4
2.400 GHz to 2.483 GHz	OpenAir (FHSS)	1	1
2.400 GHz to 2.483 GHz	IEEE 802.15 (Bluetooth FHSS)	1	1

Table 4 Different WLAN Technologies and Frequencies
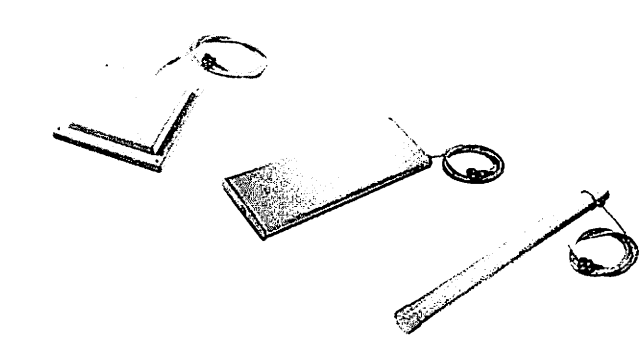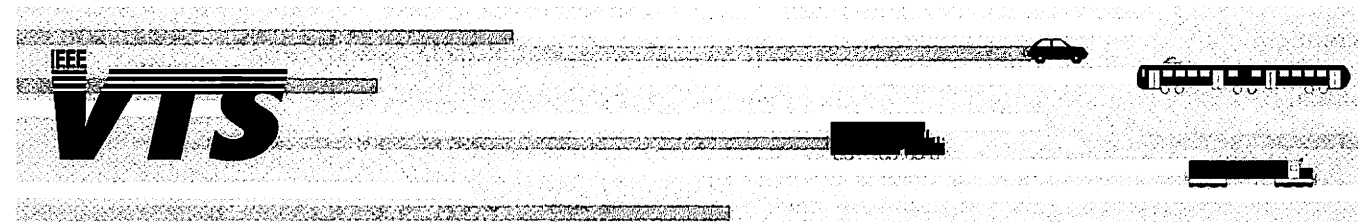

Figure 5 TNAS Antennas

tion is comprised of an overlay of wired LAN backbones, made wireless to support both the Licensed and Unlicensed Wireless Service Providers. The cabling is installed in accordance with Standard EIA/TIA 568 (the International Standard for High Speed Structured Cabling Systems) to support both current and future needs, and the visible antennas are aesthetically pleasing and unobtrusive. Tunnel travelers are in their vehicles and although subscribers in airport public spaces are not in their (aircraft) vehicles, it is only a matter of time before the TNAS will serve them there as well. It is therefore fitting that this article appears in the IEEE Vehicular Technology Society News.

Philip Deck (PDECK@concoursecommunications.com) is VP and Chief Technical Officer of Concourse Communications (www. concoursecommunications.com), and is responsible for technology and vendor selection and all technical aspects of design and installation of TNAS. Prior to joining three years ago as a founding employee, he worked for ten years at Andrew Distributed Communications Systems on a number of high technology wireless communications infrastructure projects. Mr. Deck has represented U.S. industry as a FCC delegate to the ITU work group engaged in revising the Spectrum Monitoring Handbook and holds a M.S., B.S.E.E., and B.A. Degrees from Rice University. He is a published author and holds several U.S. and Foreign Patents.

REPORT ON VTC2000-FALL

The IEEE VTS Vehicular Technology Conference returned to the United States of America after an absence of more than a year by way of Amsterdam and Tokyo for the 52nd conference, held in Boston from the 24th to the 28th of September 2000. The venue was the Seaport Hotel and World Trade Centre in South Boston, giving delegates an excellent view of the 'Big Dig' project to replace the central raised motorway in Boston with an underground highway. More than 1000 abstracts were submitted, and of these about 500 were accepted for oral presentation and a further 150 or so being presented as posters.

The Conference Committee, chaired by Stu Lipoff, took the opportunity to introduce a number of novel features. The first was making the paper submission and reviewing process completely electronic, with the exception of the signed copyright form (electronic signatures are not – yet – valid in the United States). This considerably reduced the amount of paperwork the committee had to organise. Printed proceedings must be provided for VTC since it is included in the IEEE 'All Publications' package for libraries, but wire binding was used allowing shorter print runs, eliminating waste.

Slightly less successful were innovations in the catering arrangements. Rather than providing hosted lunches, to allow more time in the programme and encourage networking, small lunch boxes with sandwiches, crisps, cake and soft drink could be purchased and eaten in the poster presentation area. Unfortunately the preferred option for delegates seemed to be to head for the Trade Centre's cafeteria where a much larger choice was available. Seating for the one hosted lunch, the Awards Luncheon was limited, so this was added as a cost option, but the traffic control was a little too effective with the result that the event was rather poorly attended.

The opening plenary was addressed by Michael P Lewis, Acting Project Director[†], Central Artery/Tunnel Project, "The Big Dig". This $14 billion dollar, 19 year project is centred on the construction of 7 1/2 miles of new motorway in central Boston, half of which is underground. The project is at its peak at the moment, and for the past two years has been spending at the rate of $100 million per month. This

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[†] Since the conference, Mr Lewis has been confirmed as permanent Project Director.

Figure 1 The southern section of 'The Big Dig' looking towards Logan Airport. This section links with the Ted Williams Tunnel, an earlier part of the project. The large building centre top is the Seaport hotel, with the World Trade Centre on the pier to its left.

rate of spend will continue for a further year. The project itself has been going for 15 years, and there are four years to go. It will form the most extensive underground tunnel system in the United States, with 161 lane miles in tunnel. The cost of new infrastructure is very high, which leads to the importance of better management. For example, a broken down car has a greater impact on traffic volume, and so has to be dealt with more quickly. With regard to communications technology, there will be 1500 loop detectors and 400 CCTV cameras installed in the system. Responding to questions from the audience, Mr Lewis confirmed that it will be possible to use cell phones in the tunnel, and turnpike authorities are in discussions with cellular companies. 25 SMR channels will be available for emergency services and AM/FM broadcast radio will be rebroadcast in the tunnels.

The second opening speaker was Dale N. Hatfield, Chief of the Office of Engineering and Technology at the FCC (Federal Communications Commission). He discussed the scarcity of radio resource, noting that if we are to avoid spectrum drought and consequently growth grinding to a halt, we need help from the engineering community. He said that it was necessary that the scarcity of radio resource did not constrain competition, or limit productivity gains (from increased mobility of Internet applications), or to compromise public safety, or finally to compromise military use (and consequently national security).

He identified a number of solutions, including re farming, increased technical efficiency, increased sharing, and extending the upper range of usable frequencies. With regard to re farming, there were possibilities for voluntary reallocation by giving existing users greater freedom to use their spectrum. The $35 billion paid in the UK and $45 billion paid in Germany for spectrum licences shows the increased value of spectrum. There is therefore a considerable incentive for increased technical efficiency, because if you double the efficiency, you are literally gaining billions of dollars worth of value. Increased sharing is not a new concept, having already been used with microwave point-to-point and fixed satellite. There are two approaches — regulatory or market based. The regulatory approach is favoured by new operators, but not by existing ones, and so on is becoming a more political issue. The market based approach is based on the ability to lease or resell spectrum, encouraging more efficient use of the existing spectrum to allow "spare" spectrum to be made available. Increasing the upper range of usable frequencies depends on technological development. The upper limit for non experimental applications has been

Figure 2 Discussing the posters at a coffee break

raised from 40 GHz to 77 GHz, and a possibility of raising this to 90 GHz has been looked at.

Mr Hatfield noted that the FCC had received two petitions – one from mobile satellite and one from the CTIA to define a rule making procedure for the allocation of new spectrum for 3rd generation services. He also reported an allocation between 7.850 and 7.925 GHz for ITS applications. A number of questions were taken from the audience, in particular with regard to spectrum auctions, and the point was put that they may delay rapid rollout. Mr Hatfield said that he didn't believe that this is a case when compared to the alternatives. His personal view was that auctions were the best solution, and that he noted that the United States gives more freedom to licensees so that they can resell their spectrum to gain from efficiency savings. On using unlicensed bands for commercial services, Mr Hatfield warned that you get what you pay for, and that organisations would have to be very careful if they used these bands for commercial services because no guarantees were possible.

The awards presented at the Awards Luncheon were reported in the previous (November 2000) issue of the VTS News. The Awards Luncheon was addressed by Barry Goodstadt of C-quential Consulting with the talk entitled 'Myths and Challenges of the Wireless Web'. Mr Goodstadt noted that a lot of speculation had taken place with regard the prospects for wireless web access. One forecast was for 217 million users by 2005. However, Motorola had forecast one billion wireless web phones in place by that date compared to 260 million today. A straw poll of the audience showed only three people raising their hands in the affirmative to using their mobile phone to access the web. Mr Goodstadt pointed out the differences between accessing the web from a wired or wireless connection. A wired connection normally had a flat rate charge, compared to a perhaps unreliable connection which had to be paid for by the minute. He noted that we are also all speed freaks, like big screen TVs and 19 inch computer monitors. Things are changing – AT&T now offers free, unlimited web access, but only to three portals.

A survey of 1000 households in April 2000 showed that current web users were two or three times more likely to consider using wireless access to the web than people who only had mobile phones. They were likely to be aged between 18 and 35, have a fax and a pager, and therefore be technically sophisticated. A survey in the United Kingdom of companies showed that 59% felt that WAP brought no benefit to their business, and only 17% will migrate to GPRS. Based on this, that survey estimated that there will be 16 million active wireless web users by 2007 rather than one billion by 2005. E-commerce whilst walking was not really practical generally.

Barry Goodstadt argued that the killer application is not there. Wireless voice is not yet particular good, and wireless data access has slow speed. Converting large Web based pages to WAP is difficult. I-mode in Japan been a very great success, but this was in a different culture, and much of its traffic is with messaging type services rather than a replacement for wired web access. High-speed will come, but not in 2005 or 2007. He predicted that there will be wireless access to the Internet, but that will be access to existing services. It was not a case of whether – it would happen, that was certain – but rather when and how.

Continuing the novel culinary arrangements, there was no evening banquet but a 'Special Event' of a panel session accompanied by beer and pizza (soft drinks were also available). The Panel Session addressed 'Advanced Technologies for 3G and Beyond'.

The first speaker was Francis O'Brien of Lucent, who discussed standards development towards 3rd generation, noting that an industry had tried to come up with a single 3rd generation standard, but with the legacy of second generation systems, and five standards were required. He covered ongoing standards work, looking at updates to existing 3rd generation standards, the introduction of "all IP" (i.e. using IP throughout the radio access network), and looking beyond to what might be termed 3.5G. He noted the setting up of ITU-R WP8F which is trying to define what fourth generation is (see WP8F Chair Stephen Blust's article in the November 2000 VTS News for full details).

Chuck Weatley, Senior VP for Qualcomm, looked at wireless data for mobile users. He discussed market trends and the wireless technology road map noting the path from 9.6 kbps which has rare Internet use, for text only, 28.8 kbps in which allows graphics to be introduced, 56 kbps which allows for Web browsing, and 128 kbps which allows multimedia. When 2 Mbps is achieved, this allows access to the full Internet experience. Improved data access can be provided on a wide area basis by IMT-2000, on a local area basis by Wireless LAN (802.11) or Home RF, and on the person (i.e. personal area network) by Bluetooth. He then went on to discuss the transition road map for cdma2000, with 1x being available towards the end of the year 2000, and 1xEV in the last quarter 2001. cdma2000 1xEV phase 1 (or HDR) allows up to 2.4 Mbps to be delivered to mobiles on the downlink shared between the mobiles in a cell. It has achieved 1Mbps/1.25MHz/sector in mobile trials.

Mr Wheatley noted that with the diversity of standards and the difficulty in getting the standards to converge, it was easier to build mulit-mode terminals than to get the standards to fit.

Håken Eriksson, VP and General Manager of Ericsson Research, discussed the 3G roadmap towards 4G. He gave a demonstration of the type of live broadcast which would be possible on a mobile handset and which would require high data rate services. He felt that EDGE and cdma2000 1xEV would be used for existing spectrum, and WCDMA for new spectrum. He suggested that there would be two different parallel industries in the fixed and mobile Internet. Fixed would always have the advantage of broadband connections, but mobile had a possibility of always being with you, and allowing location dependent services. He also discussed the phases of computing compared to that of mobile phones and the difficulties faced by mobile access when compared to fixed, in terms of the handset (bandwidth, display, keyboard, memory, CPU) but also in the Internet Protocol header, when is not very efficient. Header compression is possible, but not trivial because errors are introduced in the mobile channel, but this was an area which is currently actively being researched.

Figure 3 Barry Goodstadt addresses the Awards Luncheon

Figure 4 Beer and pizza at the panel session

Figure 5 The Seaport Hotel was within reasonable walking distance from the centre of Boston, although a ferry was also available.

John Chatter, Director of Radio System Technology at Nortel looked at how advances in technology impact on the business case for 3G. He described the new network model, with its more converged approached with IP at the centre of a common network paradigm and mobile just another form of access. Base stations currently form 75% of the capital cost the network, but new technology, with ultra linear power amplifiers and wide band software based radio is reducing the amount of analogue circuitry and with it costs.

David Douglas, VP Network Experience, Sun Microsystems presented a talk entitled 'Fast Cars, Big Bandwidth and Java: is the Geek Heaven?", looking at the evolution of the motorcar from a means of transportation to

a telemetry and entertainment centre. He noted that there is a tension between the business model and its requirements for centralised control, and innovation, which needs a more distributed approach, but is more difficult to control, and therefore make a business case for.

An interesting observation to come out of the panel session was the different attitudes from different parts of the world, with North America being seen to be taking a more technically orientated approach, and Asia focusing more on services.

Attendance at VTC numbered a healthy 718, of which slightly over 200 were students. There were 223 attendees at the tutorials, a 50% increase in the number budgeted for. Unfortunately, the poster sessions suffered from a high number of cancellations, with about half being withdrawn in the last month before the conference. There is obviously a feeling that poster papers are somehow of less value than oral presentations, but this is not true. Both are printed equally in the proceedings, and the split between poster and oral presentation at VTC is often (and sometimes only) done of the basis of timetabling to maintain the theme of the tracks. Poster presentations have certain advantages – it is possible to have more interaction with a poster presenter than is possible with an oral presentation where questions are limited. In any case, author or observer, those who attended benefited not only from a technical programme of the highest standard but the chance to enjoy New England at a particularly pleasant time of year.

TRANSPORTATION SYSTEMS

Harvey Glickenstein, Senior Editor

Kowloon Canton Railway Corporation (KCRC) has shown a measurable increase in ridership on both the existing light rail and East Rail lines. For the first half of last year, the profit on both lines was up 9.7%.

Construction on West Rail is underway, with completion of Phase I scheduled for December 2003. Tenders were also invited for construction of the East Rail Extensions. A Northern Link, a Southern Link, and the Port Rail Line are being investigated for further extensions.

A consortium led by Bombardier Transit Corporation has signed a design build operate maintain (DBOM) contract for a driverless monorail system in Las Vegas. The system has been described as an urbanized version of the Mark IV monorail at Walt Disney World in Orlando. Bombardier will provide 36 Mark IV cars for the system. They will operate in trains of four cars each. Bombardier will also provide all of the electrical and mechanical systems. Granite Construction, the other member of the consortium, will provide all of the civil works.

The new monorail will link seven stations over four miles. The project includes reequipping the existing one-mile two-station monorail of the MGM-Grand Bally and integrating it into the new line. It will serve eight major resort properties and the Las Vegas Convention Center. The new monorail is expected to carry 19 million passengers in the first year.

Bombardier will operate and maintain the line for five years with an option for an additional ten years.

The total capital cost of the project is $354 million. The new portion of the line is scheduled to open in 2004.

The French National Railways (SNCF) has awarded a contract to a joint venture of Alstom and Bombardier for 22 TGV double deck high-speed trainsets. SNCF currently operates 30 TGV double deck trainsets in the Paris-Lyons service. An additional 12 TGV double deck trainsets are presently under construction. Delivery of the 22 new trainsets is scheduled to start in October 2002.

Istanbul opened its first heavy rail transit system late last year. The first five-mile segment of the line from Taksim to 4 Levent has four intermediate stations. The next 3.7-mile portion, which is under construction beneath the Golden Horn south to Yenikapi, will add another four stations and an interchange with the light rail system. An extension north to the Technical University is also planned.

Alstom provided eight 4-car trainsets for the first section of the line. The aluminum cars are designed to operate at speeds up to 50 mph. When the portion between Yenikapi and the Technical University is in service, the fleet will be expanded to 150 cars.

All of the stations were designed for eight-car trains. As traffic builds up in the future, Istanbul anticipates requiring the use of longer trainsets than the existing 4-car trainsets.

Florida passed a constitutional amendment requiring the state to build a high-speed rail system in the November election. Largely overlooked in the wake of the controversy over the presidential election in Florida, this constitutional amendment was a setback for Governor Jeb Bush, who cancelled the FOX high speed rail project soon after entering office.

The amendment requires the state to build a high speed rail or maglev line to connect the state's five largest urban areas. High speed service in the amendment is defined as a speed of at least 120 mph, substantially slower than the 200-mph FOX service between Miami and Orlando that was killed by Governor Bush.

The amendment, which was approved by 53% of the voters, requires construction to start by November 1, 2003.

The Ottawa-Carleton Regional Transportation Commission (OC Transpo) broke ground for their first light rail line last year. Until now OC Transpo relied solely on bus rapid transit as its only high-density transit operation.

Figure 1 Artist impression of cars for the Ottawa-Carleton light rail

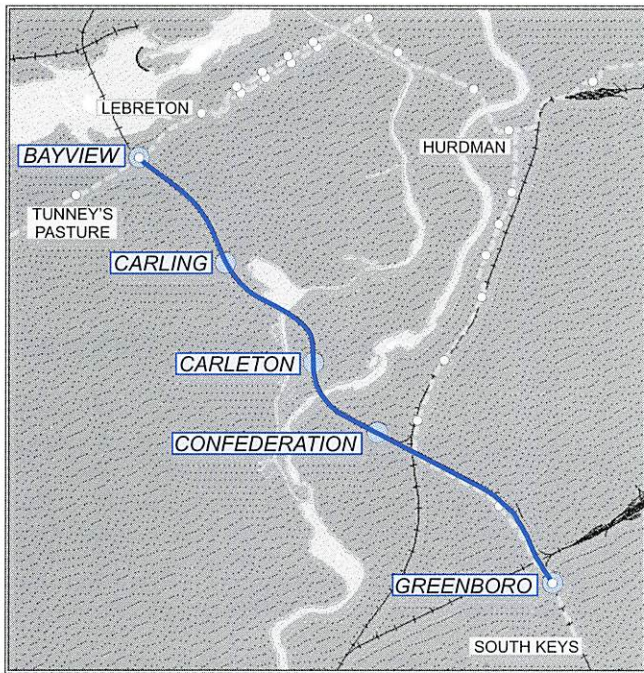**Figure 3** Docklands Light Railway cars

Figure 2 Bayview-Greenboro route

The light rail system now under construction is a 5-mile diesel light rail line that will connect with the existing bus rapid transit system. It will have five stations and will be operated on existing Canadian Pacific Railway track between Greenboro and Bayview, Ontario. Ridership is projected at 6400 riders per day.

Bombardier will provide three 3-car trains for the service. Each train will have a powered vehicle at each end and a trailer car in the middle. The cars are low floor to allow accessibility for wheelchairs. Each train will be able to accommodate 135 seated passengers and 150 standees.

The system is scheduled to go into revenue operation in August 2001.

Docklands Light Railway (DLR) has ordered 12 additional cars. The fully automated light rail system presently has 70 cars in service. DLR ordered an additional 12 cars in January of last year and have recently executed an option for an additional 12 cars.

Delivery of these cars from Bombardier's Belgian factory is expected to be completed by March 2002.

Salt Lake County and two adjacent counties in Utah approved a 0.25-cent sales tax increase for public transit. This increase will fund additional service on the Trax north-south light rail line between Salt Lake City and Sandy and help pay the operating costs on the new 2.5-mile west-east line to the University as well as other transit improvements.

Similar tax increases in other counties in the Salt Lake City area did not pass.

The Tri-County Metropolitan Transportation Authority (Tri-Met) has purchased 17 new low floor vehicles. Like the previous order of low floor vehicles from Siemens, these cars have a low floor section extending through 70% of the vehicle. The four doors on each side are located in the low floor section. They are equipped with a passenger-activated bridge plate to accommodate wheelchairs. Seating capacity is 72 passengers.

The propulsion system is ac with IGBT control. There are four motors per car. Top speed is 55 mph.

New York City Transit (NYCT) has restructured its Division A Automatic Train Supervision (ATS) Project. The project will provide a centralized control center for Division A, the former IRT Division, of the transit system. Because the project was running behind schedule, NYCT directed Union Switch & Signal (US&S), the former prime contractor for the project, to restructure the team working on the project. The new team is a joint venture of US&S, Siemens Transportation Systems, and RWKS Comstock. Siemens will be responsible for the ATS Control Center, including the hardware and software. US&S will be responsible for the wayside design and the field code units. RWKS Comstock will be responsible for the installation.
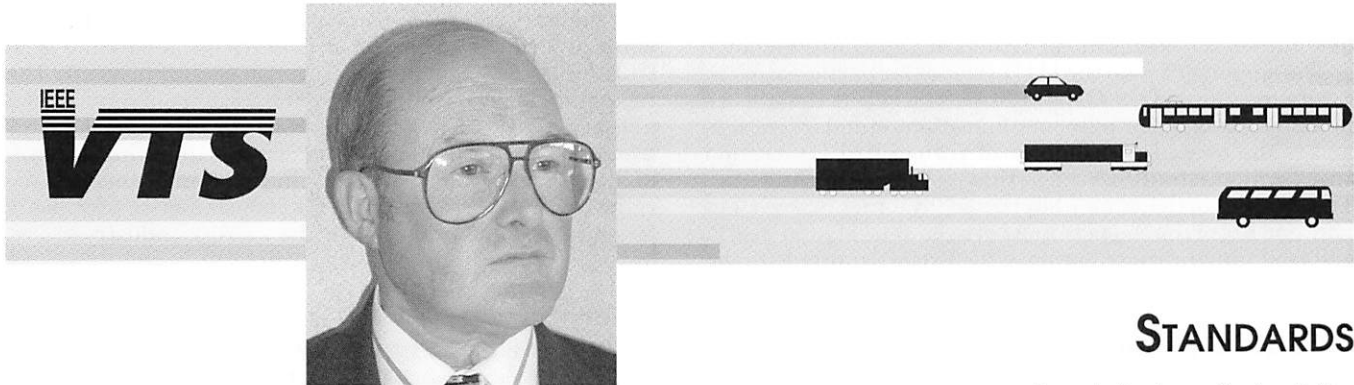
STANDARDS

Dennis Bodson, Senior Editor

IEEE Standards Board Action Relating to the Vehicle Technology Society at their December 7, 2000 meeting:

The IEEE Standards Board conditionally approved a new standard P1478/D9.0 (VT), Standard for Environmental Conditions for Transit Rail Car Electronic Equipment. The reason for the conditional approval is based upon the sponsor resolving any copyright issues to the satisfaction of the IEEE Standards staff prior to February 9, 2001.

IEEE Standards Association (IEEE-SA) Board of Governors

Dennis Bodson has been elected by the IEEE-SA membership for Profile 7 for the period January 1, 2001 thru December 31, 2002. Profile 7 includes the Vehicular Technology Society.

ITU Streamlines Standardization Process

A wholesale streamlining of procedures operated by the International Telecommunication Union (ITU), with a view to agreeing standards for new equipment and services within two months, has been agreed by the World Telecommunication Standardization Assembly, in Montreal, Canada.

Delegates approved the holding of a "virtual" meetings between experts, using electronic communications, and a new fast-track approval procedure for technical international standards. The adoption "of a standard could take as little as two months" said an ITU statement.

The aim of the move, it was added, was to "streamline working methods so as to further reduce time-to-market delivery of standards needed to meet the fast changing needs of the industry and of the market while improving the efficiency of the sector."

CTIA, WDF Agree to Merge

The Cellular Telecommunications Industry Association (CTIA) agreed to acquire its sister organization in the Wireless Data Forum (WDF). The formal transition is expected to be completed by December 31, 2000.

According to WDF Chairman David Sutcliffe, this new partnership with CTIA is the next leap forward. WDF evolved three years ago from a development group for cellular digital packet data to a technology-neutral forum designed to spread the word about wireless data.

CTIA Changes Add Internet to Name

The Cellular Telecommunications Industry Association (CTIA) board has voted to change its name to the Cellular Telecommunications and Internet Association. The name change must be put before the entire membership, but the question will be accompanied by a recommendation from the board that it be approved, said CTIA President Thomas E. Wheeler.

TIA to Integrate MMTA

The Telecommunications Industry Association (TIA) announced it would fully integrate its subsidiary, MultiMedia Telecommunications Association (MMTA), and continue to offer the combined 1000 members the benefits of both associations.

Matthew J. Flanigan, TIA's president said of the moves that "Together, the two organizations can create a forum to serve as the industry incubator for emerging technologies and new market launches. With TIA's strength in technical expertise and MMTA's strength in market conditioning and education, the opportunity exists to integrate the two organizations to leverage the strength of both".

ITU Hosts First Regulatory Convention

The International Telecommunication Union (ITU) held the first world telecom regulators, with the aim of establishing a worldwide regulatory information exchange for industry.

The development is intended to encourage independent regulatory authorities throughout the world to share their experience of dealing with problems common to all liberalizing telecoms markets, such as resolving interconnect disputes. For its next meeting early in 2001, the ITU hopes to recruit operators and equipment manufacturers.

"The telecoms market today is global, which is why regulation must take on this dimension if it is not to be ill-adapted," said Jean-Michel Hubert, president of the Autorite de Regulation des Telecommunications (ART) in Paris, who opened the debate at the ITU symposium.

The first meeting of the Development Symposium for Regulators in Geneva gathered representatives from 80 of the world's regulators, including William Kennard, chairman of the Federal Communications Commission, of the United States.

3rd Generation Partnership Project Expands its Membership

The 3rd Generation Partnership Project (3GPP), an alliance of standards bodies and industry consortia from around the world which produces specifications for a 3rd Generation mobile communications technology, has taken a number of steps towards the specification of tomorrow's global mobile systems.

Meeting in November 2000 in San Francisco, California, the Project's Organizational Partners (OP) and Project Co-ordination Group (PCG) agreed to new working relationships with the International Telecommunication Union (ITU) and the Internet Engineering Task Force (IETF). They also approved the Project's budget for 2001, appointed a new

Chairman for the PCG and confirmed the acceptance of two new Market Representation Partners at a special ceremony.

The agreement with the ITU provides for participation in future meetings of the OP and PCG. The ITU is the world's pre-eminent body for telecommunications standardization, and is the overall co-ordinator of various 3rd Generation specification activities, such as that performed by the 3GPP. The direct participation, supported by other agreed enhancements of the co-operation between the ITU and 3GPP, will facilitate the contribution of the Project's outputs to the ITU for adoption as global standards.

### CTIA Releases the Latest Edition of the Wireless Industry Indices Report

CTIA has officially released the latest edition of the Wireless Industry Indices report-an in-depth analysis of the mid-year 2000 semi-annual data survey results. CTIA has conducted the data survey since January 1985.

With 113 tables and charts, the 231-page Wireless indices report provides a comprehensive review of the survey results over time, and a detailed series of benchmarks for industry performance and productivity. The latest issue of the Wireless Industry Indices report updates comparisons between wireless services and selected data from the wireline local (ILEC and CLEC) and interexchange service markets. The report also includes sections on wireless prepaid services and toll service revenues. Among current and historical industry trends analyzed are subscriber usage, capital investment, digital vs analog subscribership, and subscriber-to-employee ratios. CTIA's Wireless Industry indices report provides a broad range of benchmarks for the wireless industry.

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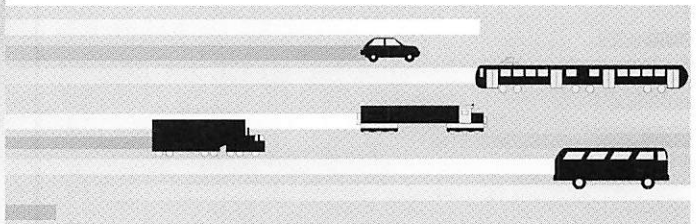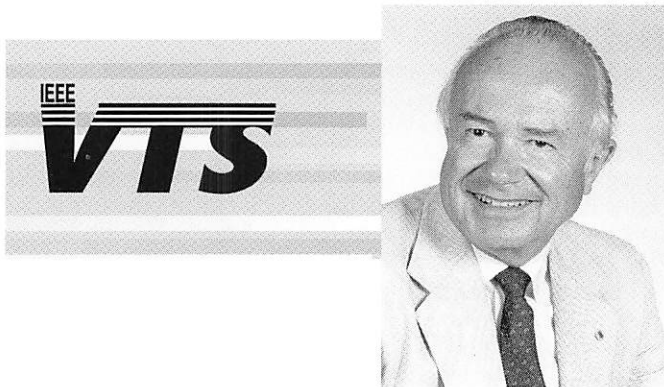
PROFESSIONAL ACTIVITIES

Frank Lord, Senior Editor

If recent events in Florida have done anything, they have brought home forcefully the fact that in a democracy, every vote does indeed count. Whichever side of the debate you happen to be on, the difference was never more than a few hundred votes, a very small proportion of a population of over 260 million, or even of Florida's 14 million.

However, events in Florida have to a certain extent overshadowed what has been going on in the rest of the United States, and one such was the defeat of Republican Senator Spencer Abraham from Michigan by Democrat Debbie Stabenow.

Senator Abraham is of particular interest to readers of this column as sponsor of the 'American Competitiveness in the 21st Century Act of 2000' (S.2045), one of the acts discussed in my August 2000 column [1] which proposed significant increases in the number of temporary workers allowed in to the country with H-1B visas. The act proposed a doubling of the ceiling for H-1B visas over the next three years, coming on top of a previous doubling proposed by the senator two years ago.

At first sight, there is a conflict of interest between IEEE-USA, which opposes these increases, and the wishes of IEEE members in the rest of the world who would like to work in the USA. However, IEEE-USA is not arguing against immigration, but rather that better use of the Green Card scheme would be more appropriate than raising the limits for H-1B visas.

Holders of H-1B visas are guest workers employed for a specific job. Unlike Green Card holders, who can change jobs and are on the road to becoming a US citizen, H-1B holders risk deportation if they quit for a better job. This has serious consequences not only for the worker concerned but also for the employment market in general as an influx of workers tied to specific jobs depresses wage rates. Indeed, IEEE salary surveys show wage increases only slightly more than inflation, after a long period when they lagged behind inflation, which does not suggest a serious shortage of skilled labour which could not be dealt with through the natural process of supply and demand. Distorting this process may be one of the reasons that the USA has a comparatively poor record of persuading its own high school graduates to pursue careers in engineering.

Another serious issue is that holders of H-1B have limited prospects for staying long term in the USA. As reported in [1], an IEEE-USA sponsored study by Georgetown University's Institute for the Study of International Immigration shows that with the Act's ceiling of 195,000 workers per year, the permanent immigration system will absorb only about 25,000 workers and their families per year, so the majority of guest workers will not be able to use the programme to start a new life in the USA. IEEE-USA makes a strong case that it is to the advantage of all parties to make better use of the Green Card system.

IEEE-USA campaigns on these issues, but ultimately what matters to politicians is votes, and that is where individual members come in. In West Michigan, IEEE member Ronald Fredricks has done just that. Active in the West Michigan IEEE Section, Dr Fredricks has written numerous letters to Senator Abraham and other senators, as well as to local and national newspapers on this issue, based on

his experience and others. In my August 2000 column, I listed 7 actions individual members could take to support IEEE-USA action. Of course, there are many issues in this election other than H-1B, but that brings us back to Florida. Every vote does count.

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AUTOMOTIVE ELECTRONICS

Bill Fleming, Senior Editor

2001 Model Year New Electronics Features

1 **Communiport** — available on Cadillac Seville, and supplied by Delphi-Delco Electronics. This is one of the first telematics products to come as factory installed equipment. It puts a portal to email, Internet and navigation information in the vehicle's IP (Instrument Panel). It's configured to act as an extension of one's personal computer and personal digital assistant (PDA), and it also piggybacks on the embedded cellular telephone in the vehicle that ties it into the OnStar service. Communiport includes a port for FlashMedia cards (which contain digital music files) as well as an infrared port to exchange data with devices such as the Palm PDA. Voice recognition enables the driver to activate features, or respond to emails, without having to take his or her hands off the steering wheel — see p.73 of [1].

2 **Peltier-Effect Cooled Seats** — available on Lexus LS430, and supplied by Amerigon. Beyond simply embedding a fan in a seat to circulate air, electric Peltier-effect bimetal elements are placed in the front seats. When dc electric current is applied, depending on which direction the current flows, the surface of the seat becomes cooler or hotter. Seat surface temperature can be regulated over the range of 30°C to 39°C (86°F to 102°F) — see p.75 of [1].

3 **Radar Adaptive Cruise Control (ACC)** — available on Lexus LS430 (with laser radar supplied by Denso), and on Mercedes-Benz S-Class CL Coupe (with millimeter-wave radar supplied by Temic/Tyco). Radar is used to automatically maintain distance between vehicles. If the front vehicle slows, the ACC system automatically reduces throttle and applies brakes to regain the driver's pre-set interval distance between vehicles. If vehicles get too close, a warning is sounded; but drivers must manually brake in order to bring their vehicle to a complete stop — see p.75 of [1].

4 **Minivan Power Lift Gate and Power Sliding Door** — available on Dodge/Chrysler minivans, supplied by Magna International. With the push of a button on a RKE (Remote Keyless Entry) key fob, electric motors raise or lower the rear liftgate, or open or close the two sliding doors. Before the liftgate opens or closes, the van's lights flash and a warning beeper sounds — see p.77 of [1].

5 **Top-Mounted Navigation Unit** — available on Volvo XC Cross Country vehicles, supplied by Mitsubishi. Rather than mounting the navigational display down below in the stack of the center console, Volvo's display is mounted atop the IP. Using control buttons mounted on the backside of the steering wheel, the driver can signal an electric actuator to raise the display (where it's more in the right-side field of view of the driver) or retract the display back into the IP — see p.77 of [1].

In a related development, Denso Corporation announced a navigation system that offers complete digital map coverage of the United States. This was accomplished by merging two databases (GDT Geographic Data Technology, and NavTech Navigation Technologies) into a single new map database that covers all U.S. highways in both urban and rural areas. The new database is offered to customers whose cars are equipped with Denso's DVD (Digital Versatile Disk) navigation system which is available on Lexus LS400, Jaguar S-Type, Cadillac DeVille, and Cadillac Seville [2].

6 **Vehicle Entertainment System** — available on several SUV (Sport Utility Vehicle) models (such as Chevrolet Express, GMC Savanna, DaimlerChrysler, Ford, Nissan, and Toyota); and supplied by Johnson Controls, Visteon, and Audiovox. These are second-generation systems, with larger screens, mounted overhead on the headliner, sometimes with two separate display monitors, each operating on different channels. Connecting wires to headphones have been replaced by wireless infrared transmission — see p.77 of [1].

7 **Multi-Electronic-Function Rearview Mirror** — available on the Pontiac Grand Prix, supplied by Donnelly. Beyond the usual electronic auto-dimming function, this mirror includes a 32K ROM microprocessor on a two-sided board, which provides: (a) compass and temperature digital readouts, (b) cell phone microphone and hang-up functions, and

(c) OnStar engage button and 911 (emergency) operator call button. In the future, Donnelly expects to add to the rearview mirror the following new features: rain sensors, garage door openers, thermal/motion occupant position/intruder detection sensors, and a GPS receiver [3].

Trends in Automotive Electrical Wiring

A Frost & Sullivan study identified the following trends (or lack of trends) in electrical wire harnesses and connectors [4]:

1 **Multiplexing** is today a feasible technology — it reduces weight, adds capability, and simplifies vehicle harness assembly; but it adds cost, and is therefore probably beyond a five-year time span of widespread use; i.e., beyond 2005 before it significantly penetrates the automotive marketplace.

2 **Fiber optic** lines have many times the signal-carrying capacity of copper wire, and would reduce weight and complexity; but would also likely increase total system cost due to the additional components required to convert electrical signals to light pulses and back into electrical signals. Fiber optic lines are likewise, therefore, unlikely to find widespread use in the near term.

3 **Flexible printed circuit boards** are making minor inroads into automotive applications, but the technology so far has had limited function. At this point it's really only replacing the jumper harness that connects to a main harness. Significant use isn't forecast until at least 2009.

Against All Odds — Electronics Drives Future Innovation

"Electronics will drive 90-percent of all future innovation in the automobile; and by 2010, and automotive electronic systems will account for about a third of vehicle cost, a jump of about 50% compared to today" — as forecasted by Roland Rechsteiner, International Automotive Competence Center, Munich, Germany [4].

But, "while electronics has gone a long way, carmakers haven't yet come close to realizing the full potential of electronics in the vehicle. Suppliers can only do so much. The gap between the promise of automotive electronics and actual application must be closed by the automakers themselves [5]." In Ref. [5], Hansen cites three major problems:

1. Top automotive management doesn't understand electronics and its promise. Electronics isn't considered a core function — body engineering is core.

2. Therefore, auto company organizations aren't set up to implement electronics in ways that allow fundamental/beneficial changes in vehicle design.

3. There aren't enough engineers at carmakers to get the job done — i.e., carmakers aren't providing the resources to bring about the full potential of electronics.

Examples were given. At BMW, another 400-to-500 electrical engineers were needed over the next three years, but no hiring requisitions were made because there was a legacy of preferentially keeping mechanical engineers. Unofficial studies have shown that although 15%-to-20% of today's vehicle is comprised of electrical/electronics parts, only 10% of engineers at Mercedes (including DaimlerChrysler's technical center in the U.S.), and even lower percentages at VW and BMW, were electrical engineers [5].

42-Volt Electrical Systems

Automakers will adopt 42-V electrical systems because they'll pay for themselves due to substantial savings in fuel cost and reduced emissions [6]. These benefits will result from: alternator efficiency improvements, electromechanical engine valve operation, electric power steering, engine start/stop operation, electric water pump, and a pre-heated catalytic converter [7]. Table 1 summarizes features associated with 42-V operation.

42-V Feature	Anticipated Electrical Power Loads [a]		Fuel Economy Efficiency Improvement [b]
	Peak	Average	
alternator	–	–	15 %
camless electromechanically actuated engine valves	2400 W	800 W	12 %, fuel economy, and also emissions control [c]
electric power steering	1000	100	8 % [d]
engine start/stop	–	–	4 %, fuel economy, and also emissions control [e]
electric water pump	300	80	3 % [d]
electrically actuated brakes	–	–	–
electric engine cooling fan	800	300	–
heated windshield	2500	200	–
pre-heated catalytic converter	3000	60	emissions control
active suspension	12 000	360	–
entertainment/information electronics	100	100	–
TOTAL	N.A. [f]	2000 W	10 % overall [g]

Items denoted by, " – ", either have no data provided, or aren't applicable.

[a] Anticipated electrical power loads are taken from Table 1 of Ref. [8].

[b] Fuel economy efficiency improvement estimates are taken from Ref. [7].

[c] Adaptive valve timing/lift, made possible by electromechanically actuated valves, allows best engine operation under both low and high output operating conditions; along with enhanced stratification of the air-fuel mixture for improved fuel economy and reduced emissions.

[d] Improvements come from elimination of continuous, parasitic, hydraulic power-accessory pumping losses.

[e] Engine startup (initiation of fuel injection) is delayed until the starter brings the engine to full running speed (e.g., 1200+ rpm), thereby providing fuel economy and emissions control benefits.

[f] Because peak loads do not simultaneously occur, a peak-load total is not applicable (N.A.).

[g] Based on a study by Standard & Poor's, an overall fuel-consumption savings of 10% is forecast [6]. (This is less than the sum of this column because the bottom-listed features consume, not save, energy).

Table 1 Features Associated With 42-V Operation [6-8]

In 2002, French automaker PSA will likely be the first to adopt 42-volt technology. It plans to utilize an integrated starter/alternator (ISA) in its 2002 Citroen Xsara.

However, despite the many compelling reasons for adopting 42-V systems; there still is concern that investments for full implementation of 42-V systems can't be justified in the short term. For example, electromechanically actuated engine valves will probably not be fully developed until at least 2005 or beyond. And, moreover, suppliers of necessary parts such as 42-V fuses, relays and switches are balking at funding development of this technology because the market remains uncertain [9].

Future Automotive Electronics Functions

Here are some further out future automotive electronics functions that you might not have seen yet.

1 **Telematics Speed Control** — When in-vehicle navigation components (GPS, autonomous navigation, and map matching) are combined with roadway information regarding local traffic signs and speed limits; precise speed limits and traffic stop information can be continuously provided to a running vehicle. This information can: (a) be shown on in-car IP display to provide an over speed warning, (b) be used to take over vehicle speed control from the driver to prevent speeding, or (c) be used for braking intervention if stops are required (e.g., if a stop sign is obscured or isn't seen). This system was called "Brake-by-GPS" and was proposed at the Convergence 2000 Conference [10].

(Editor's note: Come to think about it, assuming that a marriage of today's real-time navigation systems with vehicle adaptive cruise control will likely occur, it isn't that improbable that cars will someday become remotely controlled. Cars could then be speed-limited to the match the local roadway speed limit, or at the very least they would provide the driver with an alert/signal whenever he or she is going faster than the local speed limit allows. This combination of technology — which might conceivably be called "Remote Speed Control-by-Wireless GPS" — could foretell something that the public could construe as a "Big Brother" type of government vehicle control, which I hope doesn't happen).

2 **Audio Spotlight** — Thanks to a collaborative effort between DaimlerChrysler and the Media Lab at Massachusetts Institute of Technology (MIT), the days of fighting over who gets to choose the music during family trips may soon be over. Audio Spotlight directs a narrow beam of sound so that only the person that the sound beam is "shined" on can hear it. Each occupant can listen to something different without interfering with each other. And in today's telematics-equipped vehicle, it doesn't have to be just music — the telematics-equipped vehicle includes voice-enabled navigation, email, cell phone conversations, video games, and in-car movies. The speakers used in this system control the location of sound and how its dis-

tributed around the listener. These are special speakers that consist of a thin circular transducer array, a special signal processor, and an amplifier. The array transmits short millimeter-long ultrasonic wavelengths, which form a narrow beam of sound that becomes audible as it travels through the air [11].

3 **Seat Belt Microphone** — Paragon announced a seat belt-integrated microphone for in-vehicle telematics applications that takes advantage of the superior signal-to-noise performance of the (near field) location of the shoulder belt. The seat belt microphone improves voice recognition by as much as 98% compared to microphones mounted in or near the rearview mirror [12]. Paragon's website —Ref. [12] — showed that a microphone is clipped onto the shoulder belt, and from a stowed position (when the belt is unbuckled and stowed on the vehicle's D-ring) the microphone is manually slid/moved into position in proximity with the driver's mouth. The microphone is wireless and sends its voice signals via infrared transmission.

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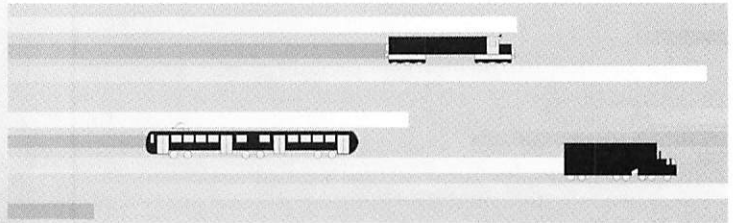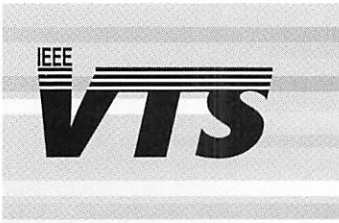
MOBILE RADIO

Javier Gozalvez, Senior Editor

TETRA

ETSI has approved further enhancements of the TETRA standard to position TETRA in the 3G market place. TETRA Release 2 will incorporate additional features in according with the following requirements:

+ evolution to high speed packet data at approximately 10 times that available in existing TETRA
+ selection and standardisation of an additional speech codec to enhance voice quality and provide intercommunication between TETRA and other 3G networks without transcoding
+ enhancements of the radio interface to increase spectrum efficiency, capacity, etc
+ production of standards to provide improved interworking and roaming between TETRA and public mobile networks
+ evolution of the TETRA SIM with the aim of convergence with the Universal SIM (USIM)
+ extension of the range of TETRA
+ ensure full backward compatibility and integration of the new services with the existing TETRA standards

Nokia introduced the first TETRA WAP browser for professional use. The browser will operate on a PC or laptop PC giving quick access to customer or technical databases. Professional WAP service supports TETRA short data SDS and TETRA IP packet data services. Nokia also introduced in the PT/Expo Comm China 2000 exhibition the TETRA 800MHz system.

Dolphin Telecom has chosen the Cadtrak GPS vehicle tracking system for its European TETRA network. The system combines vehicle location with fleet text messaging and work schedule management.

M-commerce

ETSI has started its "ETSI Project M-Commerce", which will address the specific technology and regulatory aspects of telecom banking standards (GSM/EMV) and WAP/SIM Toolkit issues. Among its main considerations will be Public Key Infrastructure (PKI) and security, digital identities, and interoperability requirements.

Motorola teamed with e-commerce specialist Entrust Technologies to develop and market integrated m-commerce solutions for mobile phones and other devices like 2-way radios, pagers, communicators and smart phones. Motorola's devices will use Entrust's PKI Infrastructure for secure transactions and communications. Motorola also teamed up with Baltimore Technologies for secure m-commerce. Motorola devices will use Baltimore Telepathy wireless e-security products and services. An early product of this alliance is the support by Baltimore's Wireless Certificate Service for Motorola's WAP server platform.

SmarTrust (from the Finish Sonera) and Compaq won a deal with Eurogiro Network A/S, a money transfer company, to enable secure payments over mobile phones across 30 countries. SmartTrust also launched a product for the prepaid market allowing users to top up their phone account via a secure SMS.

i3Mobile Inc launched a pilot program with the Canadian Imperial Bank of Commerce providing customers and CIBC employees with wireless information services on their wireless devices. The alerts can be customised to include services such as banking tips, closing stock quotes, market indices, sport news, headlines and weather forecasts. MobileQ Inc also participates in the program providing its XMLEdge software platform to power the transactional components of the offering.

Mobile location based services

Nokia, Ericsson and Motorola established a new organisation to boost location based service development. The forum, named Location Interoperability Forum (LIF), will be dedicated to develop global interoperability between mobile positioning systems. The first applications based on LIF's recommendations are expected to be available in 2001. A spokesman from Nokia said that location technology will evolve from simple-cell ID, available today but accurate only to 100m-20km, to methods based on triangulation. These methods use the time difference from handsets to various points around the network and should be available next year. These technologies include Enhanced Observed Time Difference (E-OTD) in GSM networks and Advanced Forward Link Trilateration (AFLT) in CDMA networks. The GPS standard could then be combined to improve accuracy to one meter.

BT Cellnet launched the UK's first service that allows its customers to obtain information about their location when using mobile phones. The voice-based locator service, Findme, uses cell and sector matching technology to locate the user. The method is accurate to within 15km in rural areas and 100m in urban areas.

Lucent Technologies and MapInfo have teamed to develop location-based services initially for WAP phones over GSM networks. MapInfo will provide Java software that identifies geographical locations together with geographical data. The companies will first use cell-ID for location and GPS when it becomes available.

Phone.Com signed an agreement with SnapTrack, a subsidiary of Qualcomm, to offer mobile operators a complete location solution. Both companies will jointly develop SnapTrack's SnapSmart location server software and Phone.Com's Mobile Location Server (MLS) platform. SnapTrack's products are

based on combined information from GPS satellites and wireless networks and Qualcomm's gpsOne technology.

Ericsson has licensed Cambridge Positioning System's Cursor technology, based on the E-OTD standard, to include it in its mobile location solution. Ericsson will use the technology as the intellectual property blocks of the E-OTD part of its next Mobile Positioning System product, which will also include GPS and cell-ID.

Sprint's wireless division unveiled plans to install GPS locator chips in its mobile phones by mid-2001, in response to a US government mandate for the location of emergency calls made through mobile phones.

Forums activities

A group of wireless operators and manufacturers have formed the Mobile Data Initiative Next Generation (MDI-ng). This initiative represents an extension of the Mobile Data Initiative (MDI) but with a focus on packet switched technologies. Its aim is to identify and eliminate technical and market barriers limiting wireless connectivity and performance. The initiative will address standards compatibility, interoperability, security, reliability and scalability between devices.

The Wireless Multimedia Forum released portions of its Application Requirements Document (ARD) and the Recommended Technical Framework Document (RTFD), which represent a technical framework for delivering multimedia content seamlessly across wired and wireless networks. ARD discusses end-to-end system requirements (such as billing-accounting, security capabilities, Quality of Service, logical system model for content providers, operating system support requirements and host environment requirements) for carriers and content providers. RTFD focuses on end-to-end delivery of streaming multimedia applications.

Cisco Systems, Bell Labs Lucent Technologies, Siemens, Intel and American Online joined the SyncML initiative. The initiative, that already has 500 supporter companies, focuses on the development of open standards for universal data synchronisation across multiple networks, platforms and mobile devices. The initiative also launched its 1.0 specification, which represents the world's first protocol for universal remote data synchronisation. The protocol will enable end users to benefit from immediate synchronisation of email and other office applications via mobile devices.

GSM Europe, a group of the GSM Association, announced plans to develop a code of conduct for European operators in order to clarify the international roaming price information for consumers.

Japan's mobile market

NTT DoCoMo announced it reached 15,5million subscribers to its service i-mode at the beginning of December 2000. DoCoMo is expecting to repeat the success around the world after a series of alliances. The operator signed a deal with American Online to jointly develop and market mobile Internet services. More recently, the company bought 16% of AT&T Wireless for $9.9billion. AT&T should then introduce i-mode in the US and GSM into its TDMA network in order to migrate later to WCDMA without altering its plans with EDGE. Java-enabled i-mode phones, allowing more advances services and security, have been delayed until beginning of 2001. DoCoMo also plans to launch an i-mode-linked service to help people with chronic diseases by March 2001. NTT is planning to expand the success of i-mode to fixed line phones with the launch of L-mode providing content based on compact HTML to fixed phones. Concerning its plans for WCDMA, DoCoMo said it will launch them by the end of May 2001, with data rates of 384kbps in the downlink and 64kbps for the uplink. DoCoMo is also planning to distribute music via a Personal Handyphone System in co-operation with Matsushita and Sony.

J-Phone (from Japan Telecom) will introduce its handsets using Java software by June 2001 and 3G services, using WCDMA technology, by December 2001. The company expects to use its partnership with Vodafone and BT to establish roaming agreements with WCDMA networks.

KDDI (third Japanese mobile operator) awarded Motorola a contract for a cdma2000 1X network covering the Tokyo, Tokai and Kansai regions. The service, that will offer data rates of 144kbps, is expected to start in the fall of 2001.

ITU TELECOM ASIA 2000

The ITU Exhibition and Forum for the Asia-Pacific region was held in December 2000 at Hong Kong. The Forum had 500 exhibitors from 29 countries and was attended by 51056 participants. The focus of the event was on the dual boom in the Asia-Pacific region in mobile communications and internet-based services. By the beginning of the year 2000, there were more than 170million subscribers with China and Japan being the second and third largest cellular market in the world. More information about the event can be found at: http://www.itu.int/ASIA2000/

During the event, the ITU presented a report presenting Asia-Pacific Telecommunications indicators. According to this report, by 2010 more than 50% of all mobile phone users in the world will be in the Asia-Pacific region, up from a 35% share in 2000. Unfortunately, the wireless and Internet booms are being confined to the most developed Asian countries.

The ITU Telecom Even Middle East and Arab States 2001 event will take place in Cairo from 7 to 10 May 2001.

FCC & US spectrum licensing news

According to the Federal Communications Commission (FCC), AT&T Wireless, VoiceStream, Sprint and 84 other applicants qualified to participate in the December 12 auction of 422 licenses in the C and F block Broadband PCS spectrum. The auction is predicted to raise approximately $18.5billion. 25 applicants, including Cingular Wireless and Triton PCS, failed to qualify to participate in the auction. Before the auction starts some wireless operators have been exchanging spectrum in order to fill out gaps in their network coverage. The exchanges were done between Cingular Wireless and VoiceStream, and between AT&T Wireless and Sprint PCS. The FCC released an interim report on a Spectrum Study of the 2500-2690MHz band for 3G systems, identified by the WRC2000 conference as candidate spectrum for 3G (along with the 806-960MHz and 1710-1885MHz bands). The report examines technical characteristics of 3G systems, the ability for 3G to share spectrum with incumbent services, and possible options for segmenting these bands to provide spectrum for 3G systems. The report is a companion to a study done by the National Telecommunications and Information Administration on the 1775-1850MHz band.

The FCC allocated for commercial wireless services (both fixed and mobile) 50MHz of spectrum, located in the 3650-3700 MHz band, transferred from Government to non-Government use. The FCC also adopted a Notice of Proposed Rulemaking that proposes to reallocate 27MHz of spectrum from Federal Government use for non-Government use. The spectrum is in the following bands: 216-220MHz, 1390-1395MHz, 1427-1429MHz, 1429-1432MHz, 1432-1435MHz, 1670-1675MHz and 2385-2390MHz bands.

The FCC's 700MHz Guard Band auction ended raising a total of $519million. The winners represent a new type of FCC license, named "Guard Band Managers", which will be engaged in the business of subdividing the spectrum they won and leasing it to third parties for both commercial

and private users. The FCC also released a Policy Statement and Notice of Proposed Rulemaking setting forth a framework to promote the development of more robust secondary markets in radio spectrum, which will encourage licensees to freely trade or lease their unused or unneeded spectrum capacity.

The FCC revealed a First Report and Order to permit Non-Geostationary Satellite Orbit (NGSO) Fixed-Satellite Service (FSS) providers to operate in various segments of the Ku-band, and adopted rules and policies to govern these operations.

The FCC released a Notice of Proposed Rule Making on Authorisation and Use of Software Defined Radios (SDR). The document, accessible at www.fcc.gov, proposes to define SDR as a new class of equipment with equipment authorisation rules that reflect the additional flexibility incorporated into SDRs. It also proposes to allow manufacturers to make changes in the frequency, power and modulation of SDR without the need to file a new equipment authorisation application with the commission.

Satellite mobile communications

A US bankruptcy court accepted a bid from Iridium Satellite LLC to buy the assets of the mobile satellite services company Iridium LLC. Other satellite investors in the US have accused Motorola and former executives of Iridium LLC of denying them a reasonable chance to acquire the 66-satellite system. Also, immediately after Iridium Satellite LLC received court approval for its take-over bid, the company withdrew its plan to get the Iridium system operational within 60 days. The US Department of Defence confirmed beginning of December 2000 that it has awarded a two-year contract worth US$72 million to Iridium Satellite LLC. The non-exclusive deal will give up to 20,000 government employees unlimited airtime over Iridium's satellites for a $3 million per month fee. The contract could be later extended to 2007, the date estimated to be the longest the Iridium satellites could remain in orbit. The Department of Defence chose Iridium because the company can offer encrypted, global wireless services.

The latest batch of the Geostationary Mobile Radio (GMR) specifications, jointly developed by ETSI and TIA committee TR-34.1, has been approved. The GMR Mobile Radio Interface is used for Mobile Satellite Services (MSS) utilising geostationary satellite(s). GMR is derived from GSM and supports access to GSM core networks. The GMR-1 system is designed to provide mobile services via a single geostationary satellite.

Globalstar do Brasil and South American transportation company Itapemirim have teamed up to install mobile phones on 43 inner-city buses in South America. Users will be able to make calls using prepaid smart cards.

Qualcomm has become a shareholder of SkyBridge, a low-earth orbit satellite operator. The deal will allow the satellite operator to have access to important Qualcomm's intellectual property. According to Skybridge's president and CEO, "SkyBridge's industrial partners will be able to enter into licenses with Qualcomm for its CDMA technology for use in both user terminals and gateways".

As a result of the merger of Teledesic LLC and ICO, Teledesic and Motorola ended their agreement, although Motorola remains an investor, in which Motorola was going to serve as prime contractor of the Teledesic system.

A new online trading floor for satellite bandwidth was opened by the London Satellite Exchange Limited. According to its chief executive, buyers are coming from the ISP world, broadcasters, corporate networks and launch customers. Deals done in the exchange might save customers

10-15% of the final price. A second exchange is due to be opened in Amsterdam.

Technology news

The Japanese government stated its plans to back a single global protocol for future 4G systems. The Ministry of Posts and Telecommunications is supposed to be compiling a blueprint for the development of 4G services that should be released in spring 2001. NTT DoCoMo R&D labs have already started research on 4G and are developing network-control software and various applications for 4G.

Ericsson also revealed it has started plans for 4G systems expecting them to be operational around 2011, according to Hakan Eriksson, head of research at Ericsson. Ericsson will also sponsor research at University of California in CDMA evolution and 4G mobile technology. The sponsorship will be done in conjunction with the State of California. Among the areas of joint research by Ericsson and the University of California are: CDMA wireless access technology, advanced antenna systems, next generation mobile Internet, Quality of Service, power amplifier technology and wireless access networks.

Engineers participating in the 3GPP are looking to create an enhanced version of the 3G WCDMA radio interface that will boost data rates to 8Mbps in certain areas such as indoors. The enhanced-WCDMA should come before 4G systems expected to be available around 2010. Mr Hakan Eriksson, head of Research at Ericsson, said that they are looking towards the use of a different modulation scheme providing more efficient encoding within the WCDMA carrier frequency. According to Mr Eriksson, this enhanced-WCDMA could be introduced in the second half of the decade. According to Ericsson's officials, enhanced-WCDMA might be used as a wireless local loop system connecting a base station in a carrier's network to a residential base station that would then support multiple mobile terminals around the home or office through Bluetooth wireless connections.

AT&T Corp demonstrated an asymmetric network it called 4G Access, combining EDGE technology for an uplink with wideband OFDM for the downlink. AT&T believes multicarrier OFDM will provide wireless downlink access up to 10Mbps for stationary systems and more than 384kbps at 800MHz in a high mobility environment. AT&T has started a two-phase upgrade of its network towards 4G Access. The first upgrade involves only software at BTSs while the second phase (in approximately two years) involves hardware of smart antenna technology.

The OFDM Forum has submitted three proposed standards to the US Federal Communications Commission (FCC) and IEEE rule making bodies to try to unify various broadband industries around a single OFDM standard. The targeted industries are: fixed wireless, Wireless LAN and the wireless road access. The Forum's Fixed Wireless Access Working Group submitted a physical layer proposal, below 11GHz, based on OFDM to the IEEE 802.16.3 subcommittee. The Forum's Wireless LAN Working Group announced its support to Motorola and Radiata's proposal on OFDM-based HiperPANs for the IEEE's 5GHz 802.15.3 standard. The Forum's Fixed Wireless Access Group submitted an OFDM proposal to the Dedicated Short Range Communications committee, asking the FCC to expand the wireless roadside access spectrum from between 5.8 and 5.9GHz to 5.7 and 5.9GHz.

BulletIN.net, a company developing and supplying wireless Internet solutions, won patents in the US and New Zealand for a single-button reply process for Short Message Service email. According to BulletIN.net's chief technology officer, this patent is analogous to Amazon.com's patent for one-click purchasing online. The company is planning a series of patents

aimed at improving the user interface for services and applications over SMS and enhancing WAP capabilities.

NTT DoCoMo has created a wristband mobile phone that allows users to hear calls by sticking a finger in their ear. The band houses a tiny microphone, plus a device that converts audio signals into vibrations. The caller's voice is converted to vibrations, which travel through the user's hand, the finger and into the ear. The user talks back via the wristband microphone. To answer an incoming call, the user just needs to tap their thumb and index finger together. Tapping the fingers in various rhythms could also perform multiple commands. The inventor, Dr Fukumoto from NTT DoCoMo's Media Computing Lab, expects the phone, called Whisper, to appear in the market by 2005.

The Chinese Ministry of Information Industry gave validation to the LAS-CDMA technology from LinkAir Communications (US). As part of the testing, LinkAir successfully completed its first outdoor call with LAS-CDMA outside Beijing.

Nokia opened a 3G Interoperability Testing Laboratory in Paris concentrating on network integration and interoperability testing between Nokia's network elements and other vendors elements. The tests will be carried out for core and IP backbone networks, 3G BTS and terminals, and 3G radio access.

Parthus Technologies (Ireland) announced InfoStream, a mobile Internet platform on a single chip. The platform, co-developed with Psion, will run on an ARM9 core under the Symbian EPOC32 operating system. However, the system is compatible with the operating systems from Microsoft, PocketPC, 3Com, Palm, and Linux. The technology has already been licensed to Psion for their next generation PDAs and to Motorola for their next generation smartphones.

Argogroup, a UK wireless internet software firm, claims to have produced a software solution that will enable operators and content providers to deliver content to any handset without having to change their mobile sites. The software ensures that content rendered in one mark-up language can be viewed in devices that use a different mark-up language without requiring extra work from content providers.

Sun Microsystems and its partners released the Mobile Information Device (MID) profile, which defines how software applications are designed to interface with wireless phones, pagers and PDAs. The MID profile is based on the Java 2 Platform Micro Edition J2ME.

Mobile phone health risks

The UK's Department of Health has ordered new research into the potential harmful effects produced by the radiation coming from mobile phones. The project, jointly funded by UK government and industry, follows the recommendations of Sir William Stewart's report published in May. The UK Government had also to withdraw earlier advice suggesting "hands-free" headsets should be used to reduce exposure to the brain as recent studies found contradictory evidence on whether headsets cut radiation. The research from the Consumer's Association, and conducted by electromagnetics consultants ERA Technology, showed that these kits can reduce radiation to the skull but they can also increase it by more than three times, and that users should not rely on "hands-free" kits to reduce radiation. However, the organisation acknowledged that it is unclear whether the radiation emitted by mobile phones is harmful for the brain.

China's mobile market

China Unicom, China's number two mobile phone company, confirmed it plans to build a mobile phone network based on narrow-band CDMA technology. However, China Unicom did not release the size and timing of the roll-out. The move came under some surprise as China Unicom abandoned earlier this year its plans to build the CDMA network in favour of GSM, the technology actually used in China Unicom's mobile network. The company plans, with this new CDMA network, to supplement its Great Wall Network, which previously belonged to the military forces and that operates a trial CDMA network. The company also has plans to upgrade the network to cdma2000 1X offering Internet access at 144kbps. A couple of months later (beginning of December), China's Ministry of Information Industry (MII) signed a memorandum of understanding with Qualcomm confirming MII's support for Qualcomm's "Framework agreement" with China Unicom. That agreement provided the guidelines for the licensing of Qualcomm's intellectual property for the manufacturing and sale of CDMA equipment by Chinese companies. Previously, the vice-minister of the MII said that the Chinese government will let mobile phone companies decide for themselves which technologies they use to provide future-generation wireless services and will not impose a unified standard.

China Unicom, Qualcomm and Chinese phone maker Zhongxing Telecom Equipment (ZTE) unveiled the ZTE802, a mobile phone that uses CDMA and GSM. It is the first CDMA phone in China that let users switch handsets, remove SIM cards, and keep their phone number and service provider.

Nortel Networks Corp and Motorola Inc announced that they joined four Chinese companies and Siemens AG in a consortium to promote world-wide use of the standard TD-SCDMA (developed by Chinese government researchers and Siemens). Beside the foreign companies, the consortium includes China Mobile, China Telecom and Chinese equipment makers Datang Telecom and Huawei Technologies Co.

China and South Korea announced an agreement to strengthen co-operation in CDMA. Korea will then have a chance to take part in China's CDMA projects. Both countries will also co-operate closely on the IMT2000 system.

According to an official with the Ministry of Information Industry, China will become the No. 1 telephone market in the world in five years. The number of fixed-line and mobile phone users is estimated to exceed 600million in 2005. China has actually around 120million fixed-line phone users and 60million mobile phone subscribers. However, there are actually only 14.7 phones per 100 Chinese people and 4.7 mobile phones for every 100 Chinese people.

AT&T Corp signed a deal to launch the first foreign telecoms joint venture in China since the country pledged to open the sector under the World Trade Organisation rules. The joint venture, between Shanghai Telecom (a subsidiary of China Telecom), AT&T and Shanghai Information Investment, is know as Shanghai Symphony Telecommunications and will be restricted to Pudong. The venture will provide broadband telecom services but is not allowed to provide voice services. A few months earlier, Vodafone established a strategic alliance with China Mobile (Hong Kong) by paying $2.5billion to the Chinese company. The agreement gives Vodafone exclusive licensing rights for technologies relating to mobile voice and data communications and foresees co-operation on subscriber management and branding. China Mobile is also planning to buy seven provincial mobile networks from China Mobile Communications Corp.

Mobile communications market forecasts

A report by Arthur Andersen and JP Morgan states that the European wireless data market will be worth $82.4 billion annually by 2010. The report also places Sonera (Fin-

land), British Telecom and Telecom Italia Mobile in the best positions to exploit this market, with Germany being the market offering the biggest revenue opportunity. According to the report, wireless data revenues in 2006 will exceed those of the 1999 voice market. The revenues coming from wireless data applications are expected to represent 53% by 2010.

Cahner's In-State Group forecasts in the report "The Infrastructure Revolution Five Year World-wide Cellular/PCS BTS Semiconductor forecast", a 25% compound annual growth rate for wireless Base Stations from 2000-2004 due to the continuous growing of the wireless subscriber base and the migration to 3G systems. According to their predictions, wireless BTS semiconductor revenues will pass from $5.6 billion in 1999 to almost $9billion in 2004.

A study published by Herschel Shosteck Associates, "Wireless Internet Devices: From Phones to the Future", predicted that the Wireless Internet market will not be controlled in the future by manufacturers as it is today. Internet services will not be primarily delivered to mobile phones but secondary Internet devices will connect users to the Internet using mobile phones as "gateways".

The "Mobile Cellular Communications 2000-2005" report, by Web-Feet Research, predicts a revenue of $480 billion for mobile telephony. The subscriber base will rise to 1.8billion compared to 480million in 1999. The traffic volume will reach 2,074billion minutes despite mobile phone calls are expected to still be approximately three times more expensive than fixed calls. The report also expects the 2.5G market to attract 500million subscribers to wireless data services by 2005. The sales of 2.5G handsets will reach 550million units or 45% of the total. By 2005, the sales of 3G handsets will reach 170million (14% of the total). Bluetooth is said to be important in the wireless market with 1.05billion units generated by 2005 compared to 45million in 2001.

Some analysis are predicting a market of $750 million for wireless advertising by 2005. In a study done by the Kelsey Group (New Jersey), it was reported that almost 50% of wireless users said they would opt for an advertising-supported model over a monthly or per-use fee-based model.

Spectrum licenses

After the huge amounts paid for 3G licenses in UK and Germany, things have calmed down financially but the controversy continues. The European Commission (EC) is said to be under increasing pressure to speed legislation that lets 3G license holders sub-lease spectrum, which will help operators to recuperate some of the high cost of 3G licenses. A new EC framework includes a provision to remove obstacles to subleasing spectrum by 2002-2003. In Italy, five licenses were awarded to Omnitel, Ipse, Wind, Antala and TIM for around US$11.5billion, much less than was expected. The auction finished just 2 days after its start as Blu (holding a GSM license and participated by BT) withdrew. The "Antitrust" authority launched then an investigation to see whether there was an agreement within the participants to fix the outcome. Allegations of collusion also reached the Dutch UMTS auction as investigators raided the offices of Versatel and Telfort to try to find evidence of previous talks between the companies concerning the auction. Austrian's UMTS auction ended rapidly raising just 11.44billion schillings, again far less than expected, for six licenses (twelve paired blocks). Similar outcome was reached in Switzerland as the auction of four UMTS licenses only raised US$120million. The auction was initially postponed as the number of bidders was reduced from 10 to 4. In Poland, only the three GSM operators entered bids for five UMTS licenses after all foreign bidders withdrew due to aspects of the tender's terms. Poland decided then to annul the tender and award the licenses to the incumbent operators through a 650million Euro extension of their GSM licenses. The Spanish government decided to raise the annual levy for the four UMTS licenses, it previously awarded through a "beauty contest", from 5million Euro to 150million Euro. The move came due to pressure for the low amount raised in the contest in comparison with other European countries. The license holders are seeking compensation due to the alteration of the initial terms of the contest. The Spanish government also decided later to tender two more GSM licenses to increase mobile competition. Norway awarded four UMTS licenses, for US$11.2million each, via a "beauty contest". Ireland revealed plans to award four UMTS licenses in May via "beauty contest". One license would require the winner to cover 80% of the population by the end of 2005 while the other three only 53%. In Bulgaria, the tender of a second GSM license, with a minimum price of $40million, attracted five bidders.

The South Korean Government has decided to adopt both WCDMA and cdma2000 for its 3G licenses despite the fact that the three present carriers have already said they will go for WCDMA. The government will award three licenses by the end of 2000. The three incumbent operators (SK Telecom, Korea Telecom and LG Telecom) and Hanaro Telecom have entered the competition. Malaysia is expected to license 3G spectrum via "beauty contest" and recommends the adoption of WCDMA. The Communications and Multimedia Commission has also proposed that telecom companies wishing to offer 3G services share a common network while continuing to offer services under their own brand. Hong Kong has proposed to award four 3G licenses in 2001 through a two-stage hybrid of a beauty contest and an auction. The successful bidders would be required to open part of their 3G network to service providers in order to increase competition. Singapore has decided to award four 3G licenses through auction to be carried in February 2001. The successful bidders must fulfil 100% island-wide coverage and rollout by 2003. Macau, a special administrative region of China, awarded two mobile licenses to Hutchinson and SmartTone Telecommunications through a "beauty contest". The Australian application process for 3G licenses has started and will finish on 12 February 2001. A trial auction will commence on 26 February and the auction will begin some time in March. There is not a fixed number of licenses, instead blocks of spectrum will be auctioned.

Six companies are qualified to bid in an upcoming Canadian auction, to start by January 15, for high-speed wireless licenses. The companies will bid on 40MHz of additional spectrum in the 2GHz band. Honduras is planning to sell a PCS license via an auction. The Namibian government has launched a tender for the country's second mobile license. The bidders are required to be at least 51% owned by Namibian investors. Brazil is planning to auction nine new PCS licenses in the 1.8GHz band, through three auctions said to start on January 20, February 20 and March 13. Brazil wants the bidders to pay at least $3.4billion in total for the nine licenses.

Greece has awarded six Fixed Wireless Access (FWA) licenses to five companies at an auction raising $41million. Greece was auctioning three licenses in the 3.5GHz band and four in the 25GHz. Venezuela is planning to auction a license using Wireless Local Loop technology as soon as the monopoly of national telephone company CANTV ends later in 2000. Ireland announced plans to award two more broadband wireless access licenses (in the 28GHz band) and an additional narrowband wireless access license (in the 10.5GHz spectrum range). The auction of Broadband FWA ended in UK only raising £38.16million compared with

pre-auction forecasts of £1billion. Only 16 licenses in 8 regions were sold from a total of 42 in 14 regions. Australia ended the auction of spectrum in the 3.4GHz band for Wireless Local Loop raising A$112.2million.

WAP news

Ericsson announced an embedded WAP server to be used in an implemented Bluetooth environment. The server enables Original Equipment Manufacturer's to add both WAP and Bluetooth connectivity to products such as TVs, VCRs, DVDs, cars, locks for homes, etc. All the software needed for Bluetooth Wireless technology, WAP and the application are executed by a single component, e.g. the Ericsson Bluetooth module.

Columbitech, a Swedish software company, has made a version of its WAP server available for free download from its web site. It is then possible to establish an access point for WAP terminals without having to pay for the necessary software. According to Columbitech's CEO, "What we are seeing is the death of the WAP gateway. In the future it won't be possible to charge for WAP".

A report from BMRB International, a market research company, highlights that fewer than one in 50 adults in the UK access Internet services using mobile phones. However, BMRB estimated the number of UK Internet bank account holders had doubled to 3million in the past 12 months.

According to figures from Hewlett-Packard, by 2002 there will be in the region of one billion mobile phones, of which roughly 50% will be WAP enabled. Ovum, a market analysis company, is a bit more conservative as it expects 1.5 billion mobile phones by 2006 with 684 million being WAP enabled.

Bluetooth news

Ericsson and Intel signed a licensing agreement covering the supply of Ericsson Intellectual Property of Bluetooth wireless technology to Intel. The Bluetooth IP comprises both hardware and software for the Bluetooth Core Product from Ericsson and software for the Bluetooth HOST Stack.

Qualcomm has joined the Bluetooth 1.2 Special Interest Group as an associate member, giving the company access to Bluetooth specifications. Qualcomm said it plans to join its CDMA Technologies division with Bluetooth's Technical Working Group, Expert Group and Marketing Group.

Microsoft announced that Bluetooth will be embedded in the full release of the next generation Windows operating system, named Whistler, and in future releases of Windows 2000.

Axis Communications (Sweden) released a printing development platform based on Bluetooth wireless technology. The Printing Platform is based on a Wireless AXIS Printing server that allows virtually any device that utilise Bluetooth technology to print virtually to any printer. The server also provides direct connectivity to almost any network allowing printers to be shared even in multi-protocol environments. Texas Instrument and TROY XCD are also collaborating to offer wireless printing capabilities in mobile phones using TROY's Bluetooth printing software and TI's Bluetooth chipset solution.

Agilent Technologies introduced a set of testing devices for the Bluetooth wireless technology. The set includes a stand-alone Bluetooth communication test set, a spectrum analyser customised for Bluetooth testing and new generator capabilities. The test set was developed in co-operation with RTX Telecom of Denmark.

Widcomm (California) unveiled, at the Bluetooth Developer's conference, two new software products and two new developer's kit. The Bluetooth Protocol Software Suite has been developed for Embedded systems (BTE) and Windows (BTW) and allows Bluetooth technology to be added to any embedded system, desktop and notebook computers. The developer's kits have been developed for Windows and Handspring Visor. The kits will allow Window OS and Palm OS developers to create Bluetooth-based software applications for desktop/notebook computers and Handspring Visor product family respectively.

At the same conference, Parthus Technologies PLC demonstrated a Bluetooth-enabled MP3 platform that allows wireless devices peer-to-peer and peer-to-multi-peer sharing of music and sound files between handheld devices. Philips Semiconductors also introduced a Bluetooth baseband controller chip called Blueberry. The Blueberry IC, that uses as link controller the Ericsson Bluetooth IP Core, integrates an ARM/RISC processor, multiple I/O interfaces and an A/D voice band codec.

NewLogic (Austria) introduced a Bluetooth transceiver core, called Boost Radio, that integrates a CMOS 2.4GHz radio front-end. The company claims the core is suitable for embedding a Bluetooth radio transceiver in an ASIC or System-on-Chip design.

Other news

Qualcomm announced it would invest $500million, through a new company Qualcomm Ventures, in start-up companies over the next four years in order to promote its CDMA technology. The selected start-ups will have access to Qualcomm's R&D and engineering resources, its business relationships and other portfolio companies. Qualcomm also created a licensing program for these start-ups that would replace up-front license fees with equity. Qualcomm wants to make it easier for start-ups to use its CDMA technology

SK Telecom claimed a world first with the first commercial launch of cdma2000 1X, a 2.5G technology allowing speeds up to 144kbps. Nortel Networks has signed a design transfer agreement with Qualcomm for 1xEV technology allowing the Canadian manufacturer to develop, manufacture and deploy 1xEV network solutions.

A joint project between Palm Technology, SK Telecom and Seoul National University developed the "first embedded-Linux smart phone". The IMT2000 smart-phone, named Palmi, has multimedia functionality, including MP3, video, Bluetooth capabilities, and Voice over IP.

Samsung and Sprint also presented a wireless phone capable of downloading MP3 music to the handset. Samsung is also planning to develop a dual GPRS/UMTS handset in its UK R&D facilities. The Korean company also has plans to launch a MPEG4 streaming video cell phone after the company got a license from the Geo Interactive Media Group for its Emblaze A2 video ASIC.

A Japanese University claimed to be the first to use internet-capable mobile phones to increase communication between students and professors. The system uses DoCoMo's i-mode and allows students to ask questions, catch up on missed classwork and check lecture cancellations.

Lucent pledged $10million to academy and industry researchers to try to develop a business model that would make 3G networks more profitable. The grant will be distributed among the School of Management at Boston, French INSEAD business school and the London Business School.

MobileOne (Singapore) carried out a study, which indicated that 3G services will require 70% more base stations than GSM1800 networks.

According to the chairman of the African section of the GSM Association, pre-paid services are driving the growth of GSM on the continent, with more than half of the GSM subscribers in Africa being pre-paid.

Al Gross 1918-2000

Al Gross, wireless communications pioneer, IEEE VTS Fellow and member of the VTS Distinguished Speaker Programme died at his home in Sun City, Arizona, on the 21 December 2000.

Interested in radio from the age of nine, by fifteen he was building his own radio chassis before miniaturising the system to produce a hand-held device he christened the "walkie talkie" which he patented in 1938. It was the first of many fundamental contributions to the wireless technology we use today. His work attracted the interest of the military and he worked for the US Office of Strategic Services (OSS) throughout World War II. He developed a system of ground to air communications which was very difficult to monitor and was only declassified in 1976, being described by the US Joint Chiefs of Staff as one of the most successful wireless intelligence gathering methods ever employed.

After the war, Al Gross formed his own company to develop hand held radio technology, and continued to innovate, patenting in 1949 a means of paging individual receivers which forms the heart of a mobile telephone system. More patents followed in the 1950s and 60s, before he started to work for larger corporations specialising in microwave communications. Never one for retirement, from 1990 until the time of his death he worked as a senior engineer for Orbital Sciences Corporation.

As is often the case with people who come up with revolutionary ideas, Al Gross was ahead of his time. He intended his pager to be used by doctors, but when demonstrated at a medical convention in Philadelphia there were concerns from the doctors that a beeping device would upset patients. During the 1950s, US telephone companies were not interested in taking up the technology. As he himself said, if his patents had not run out in 1971, he'd have been a millionaire several times over by now. He was quoted as saying "If you have a cordless telephone or a cellular telephone or a walkie talkie or beeper, you've got one of my patents."

This is not to say that Al Gross lacked recognition for his pioneering work. Some of his many awards were a Commendation from President Reagan (1981), the IEEE's Century of Honors Medal (1984), the Marconi Gold Medal (1995), the 1999 IEEE Edwin Howard Armstrong Achievement Award, and just last year the Lemelson-MIT Lifetime Achievement Award for invention and innovation and for playing a major role in the wireless personal communications field.

As those who have had the pleasure of hearing him speak can testify, Al Gross had a rare ability to pass on not only his considerable knowledge but also his enthusiasm. He will be missed.

Transactions Changing to Electronic Peer Review System

As of January 1, 2001, all new submissions to the Transactions are being processed electronically.

Papers will be submitted electronically, using one of several standard formats, and reviews will be provided electronically as well. The process is web-based, using a tool that was developed in coordination with the IEEE. The submission of papers involves creating an individual account and prospective authors and reviewers are encouraged to go ahead and create their personal account. The tool can be accessed at http://tvt-ieee.manuscriptcentral.com/index.html.

This transition will require the assistance of both authors and reviewers, which is greatly appreciated. This effort will ensure that the Transactions continues to provide timely publication of work that is of interest to our readers.

VTS Awards Presented at Convergence

Two presentations of awards reported in the last issue were made at Convergence 2000 in October.

Convergence founder Trevor Jones receives a Millennium medal

Kent Johnson presents the 2000-1 Convergence Fellowship to Jean Yves Routes

Membership Matters

Society membership declined by 1% between November 1999 and November 2000, and currently stands at 5422. The following VTS members have recently been elected Senior Members by the Admission and Advancement Panel at its last two meetings: **Shlomi Arnon**, Israel Section, **Robert J Bultitude**, Ottawa Section, **Hossam H Hmimy**, Dallas Section, **Min Huei Kim**, Taegu Section, **Chan Kyung Park**, Oregon Section, **Robert S Roman**, New Jersey Coast Section, **Dan Keun Sung**, Daejeon Section and **Kenneth E Vought**, Westchester Subsection.
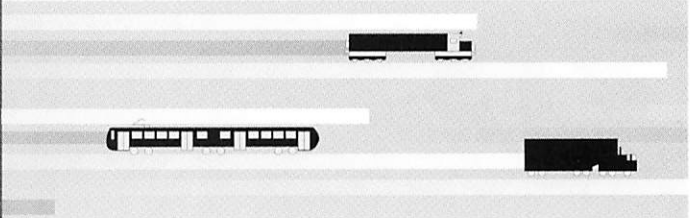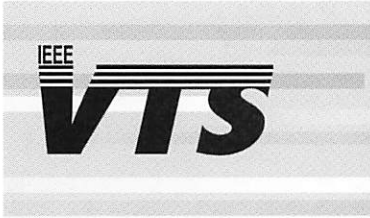
CHAPTER NEWS & MEETINGS

Gaspar Messina, Senior Editor

New York Section

The New York City VTS and ComSoc Chapters co-sponsored a rail signal systems technology sharing forum on October 18, 2000. Lead panelists explained, and answered questions on the Communications Based Train Control (CBTC) system that is being developed for the Southeastern Pennsylvania Transportation Authority (SEPTA), and the new train control system being developed for the Southern New Jersey Light Rail Transit System (SNJLRTS), which has a shared right-of-way for freight service.

Lead panelists were John LaForce and John Sutton. Mr. LaForce is an IEEE Member, Voting Member on the IEEE CBTC Standards Committee, and Deputy Chief Engineer - Operations for SEPTA. Mr. Sutton is Director, SNJLRTS-New Rail Construction. Co-presenters with Mr. Sutton were Ms. Olga Cataldi and Mr. Rajee Alexander, both from the Booz-Allen & Hamilton consulting firm. Systems engineers, suppliers, installers, and operators were present and shared their insights.

Thirty-three paid admission fees and thirteen IEEE NYC Section VTS Chapter invited speakers and honored guests raised the total attendees to forty-six. The total includes thirty-six IEEE Members, including one student IEEE Member. Prior to the formal program, NYC VTS Chapter Officers were elected and immediately commenced serving. The new officers are:

- ✦ Chairman: Kenneth E. Vought, P.E. (SM)
- ✦ Vice Chairman: David E. Weiss (SM)
- ✦ Treasurer: Bradley P. Craig, P.E. (M)
- ✦ Secretary: David K. Horn (M)

The NYC VTS Chapter has scheduled two forums in 2001. In April, the VTS forum will focus on propulsion, control and signage innovations incorporated into the latest rapid transit rail cars ordered by New York City Transit, the R-143 cars manufactured by Kawasaki Rail Car. The October 2001 VTS forum will review fiber optic communications systems being applied for rail vehicle control.

Nortel Networks has graciously offered to host both of these IEEE NYC Section VTS Chapter forums in 2001.

Rail Rapid Transit Vehicle Innovations Forum

The IEEE New York Section Vehicular Technology Chapter will sponsor a technology-sharing forum on **New York City Transit's R-143 Rail Car propulsion, control, and signage systems.** Rail Rapid Transit Vehicle Innovations Forum, hosted by Nortel Networks, will take place on April 24, 2001, 6:00 to 8:00 PM at 320 Park Avenue, (50th ST) New York City. The lead panelist, **Mr. Erwin Schaeffer**, New York City Transit's project manager on the R-143 procurement, will explain and answer questions on these new technology, Rapid Transit vehicles.

Systems engineers, suppliers, installers, and operators are invited to share insights. Future IEEE NY Section, VTS Technology Sharing forums are being planned for:

- ✦ Fiber Optic Communication networks for Rail Vehicle control,
- ✦ Automatic Bus Location and Control Systems, and
- ✦ Wayside and Railcar PA and Customer Information Systems

There is a $35.00 charge for the forum and refreshments commencing 5:30 PM.

Advance registration is required for admission. IEEE Members and non-members may register for the April 24, 2001 forum by sending $35.00 checks payable to IEEE NY Section to Brad Craig, Louis T. Klauder and Associates, 317 Madison Avenue, Suite 1621, New York, New York 10017. If you are an IEEE member, please provide your membership number and indicate if you are interested in participating in one or more of the planned forums.

Additional information regarding program specifics can be obtained by contacting Mr. David Horn of Fluor Daniel Infrastructure, at (212) 947-7110, or by e-mail at david.horn@fluor.com.

Greece

As of 17 July 2000, the Vehicular Technology Chapter of the Greece Section has changed its status to include the Aerospace and Electronic Systems Society.

3rd Generation Infrastructure and Services

The chapter is sponsoring an International Symposium on 3rd Generation Infrastructure and Services from 2-3 July 2001 in Athens, Greece. Discounts are available for advance registration before the 1st of May, and those registering after this date will receive the proceedings on CD only rather than on hard copy as well. For further details, contact Mrs. Penelope Koutroubi (email: piko@egnatia.ee.auth.gr) or see their web site: http://newton.ee.auth.gr/3GIS/

Philadelphia, Pennsylvania

This chapter held a meeting on November 8, 2000. Mr. Brandon Swartley from Stone & Webster, presented a paper on Richmond Static Frequency Converter (SFC) Project Update. A total of 15 people attended the meeting including 7 guests.

Note to VTS Chapters

VTS Chapters world-wide are eligible to receive $100.00 U.S. at the end of the calendar year for submitting L-31 Meeting Attendance Forms reflecting their Chapter's periodic meeting to VTS Chapter Activities Chairman.
Gaspar Messina,
9800 Marquette Drive,
Bethesda, Maryland 20817, U.S.A.

The 2001 Joint Rail Conference, sponsored by the Land Transportation Division of the VTS and the Rail Transportation Division of the ASME will take place in Toronto, Canada from April 17th to 19th 2001. In this issue we reproduce the abstracts of the 15 papers accepted from the IEEE in order to give you a flavour of the conference. There will also be papers at the conference from the ASME. If this encourages you make the trip to Toronto, a registration form is also included in this issue.

Engineering the CBTC Interface with MTA-NYCT's R143 Vehicle

Edwin A. Mortlock, C.Eng., Principal Systems Engineer, Parsons Transportation Group, and Erwin H. Schaefer, P.E., Project Manager R143, Division of Car Equipment, MTA-New York City Transit

New York City Transit (NYCT) has embarked on an extensive upgrade that includes the introduction of new technology in many areas. Transit cars will employ AC drives and multiple microprocessor controlled systems instead of contactors, resistors, and relays. A new technology signal system is also being introduced for long term deployment over the complete subway system. Microprocessors will replace traditional track circuits and wayside color light signals and tripstops. Signal equipment will now be installed onboard the cars, responsibility for the signal system will now be spread between two NYCT Divisions.

In December 1998, NYCT signed a contract with Kawasaki Rail Car Inc. (KRC) for R143 B- Division transit cars. The contract is fast tracked, with the first 8 cars to be delivered in early 2001. Provisions were made for space, cables and wiring, and system functions to make the cars Communications-Based Train Control (CBTC) ready. The cars will enter passenger service for a period before the CBTC equipment is delivered, and the latter is intended to be "plugged-in" to the R143's as simply as possible.

The process was complex and initially a common set of interfaces was developed with 3 shortlisted Proposers' systems. Upon award of the CBTC contract in December 1999, the interface was finalized. The concept of developing detailed mechanical, electrical, and functional interfaces prior to the completion of the preliminary design of the CBTC was a challenge at best. Coupled with the tight R143 delivery schedule, there was extreme pressure to make detailed engineering decisions at a very early stage of CBTC system design.

The cars are now under assembly, and the CBTC Contractor is proceeding with design. Frequent technical exchanges and use of Working Groups to get all parties together to discuss and resolve technical difficulties contributed significantly to the successful process.

ITS Standards for The Rail Industry
Thomas J. McGean, P.E., TJMPE

It has long been common practice at rail transit properties throughout the US to mix cars made by different suppliers within a single train, and to operate trains over signaling territory installed by different signaling suppliers. This level of interoperability could easily be lost as we move into the intelligent world of microprocessor based signaling systems and train local area networks. New Communications-Based Train Control (CBTC) systems will not necessarily be compatible, and even when cars have the same communications protocol, they will not interoperate unless data elements and objects have also been standardized.

Welcome to the world of intelligent transportation system (ITS) standards for rail vehicles! In recognition of this very problem, the IEEE Rail Transit Vehicle Interface Standards Committee has been working since 1996 to develop rail standards with the goal of preserving, and if possible extending, the interoperability options which rail transit properties now enjoy, while enabling them to take advantage of the immense cost and performance advantages offered by intelligent systems.

This paper summarizes the status of these ongoing efforts to develop a comprehensive set of ITS standards for the rail industry. IEEE Standard 1473-1999 has established a uniform communications protocol, and other ongoing standards activities are providing standard data elements and objects, while uniform CBTC performance requirements and central display standards have been developed for the new communications based signaling systems. These standards are being integrated where necessary to also operate seamlessly with NTCIP and TCIP ITS standards now being developed for automobile and bus use on highways. Such interfaces occur at grade crossings, with signal priority systems, and with central transit management systems. The paper discusses these efforts and also efforts in the areas of maintenance and diagnostics, verification of software based vital functions, and software documentation which together provide a complete set of ITS standards tools for rail transit as it moves into the 21st century.

Development of A Next Generation ATP System
Kazutoshi Sato, Senior Researcher, and Hideki Arai, Researcher, Signalling and Telecommunications Technology Division, Railway Technical Research Institute

An Automatic Train Protection (ATP) system, which is called the Automatic Train Stop (ATS) in Japan, is introduced in almost all narrow-gauge lines of Japan Railway (JR) companies. The ATS system consists of on-board equipment and beacons, and intermittently transmits a resonance frequency signal from the beacon to the on-board equipment, after a train passes an alarm point of a stop signal regardless of the train speed. In this case, the emergency

brake is activated by the ATS to halt the train only when the driver fails to execute confirmation within five seconds after the alarm goes off. However, this system essentially has a problem that the above function is disabled after the driver properly executes confirmation. So each JR is considering that a safer ATP system should be introduced in the major narrow-gauge lines.

Hence we are developing a new ATS system with a function to overlay digital codes having information about the distance to the stop signal on the resonance frequency signal transmitted from beacons. In response to this distance information, the on-board equipment generates a speed reference pattern. When the train speed exceeds the reference speed, emergency brake is automatically activated. Due to this additional function, the safety of the ATS system is maintained even after the driver properly executes confirmation. This new ATS system is compatible with the conventional ATS system, and enables inexpensive and convenient system change because the distance information is transmitted from the beacons to the on-board equipment through the existing ATS equipment. This paper reports the construction and function of this new ATS system and the results of field test.

Train Control for Shared Traffic on A Light Rail System

Rajee P. Alexander, Senior Consultant, and Olga K. Cataldi, Associate, Booz-Allen & Hamilton, Inc.

Light rail is rapidly gaining acceptance in various communities around North America. In areas where there is public demand for transportation while minimizing additional infrastructure, light rail has become a popular option for many transit agencies. In New Jersey, a light rail system will be installed along the Delaware River between the cities of Camden and Trenton. Light rail trains will be running on existing tracks used by Conrail for freight, which will be retained through 85% of the alignment.

The project is unique in many characteristics: One of the few in North America to have shared traffic of freight and light rail; 1st diesel light rail vehicle to be used in North America; 2nd project to be awarded by New Jersey Transit (NJT) as a design, build, operate, and maintain (DBOM) project.

In formulating the design requirements, traffic intensity, vehicle type, and track configuration were factors in determining the train control system. To allow for a safe operation of the transit system, the emphasis on safe train separation for all traffic is required. Significant differences in operating characteristics of LRT and freight trains, such as maximum allowed speed, length of consist, and brake rate, constitute technical problems that require unique solutions to assure effective and safe traffic for both types of vehicles.

The SNJLRTS will employ a relatively simple signaling system comprised of 3 aspect automatic block signaling and automatic trip stops at the signals with red aspects. No speed enforcement for LRT or freight vehicles will be employed. The system will utilize passing sidings to ensure schedule adherence.

The need to account for all these factors while assuring required headway for LRT makes the rules for conventional block signal design not applicable (or only partially applicable) for SNJLRTS. Therefore the block signal design must be unique to comply with internal NJT practices and at the same time with common FRA rules.

Other integration issues such as central control and highway rail intersections have been critical to the project. Train movements will be centrally monitored. The system has numerous grade crossings that require different treatment for mixed traffic.

This paper will describe the technical solutions that were found to reconcile the LRT and freight train operational differences while designing the train control system for SNJLRTS.

Development of Tracking Train Detection Device (Combat) by Using Wireless Communication

Noriyuki Nishibori and Tatsuya Sasaki, Railway Technical Research Institute; Osamu Kawai and Hirofumi Ogushi, West Japan Railway Company; and Takayuki Kasai and Akihisa Toyoda, Nippon Signal Co., Ltd.

As for the detection of the train in the railway signaling, the track circuit is generally used. But failure of detection is possible by rusty rail, etc. Moreover, it has some problems in maintenance.

For such reasons, the train detection device by using microwave balises (COMBAT : Computer and Microwave Balise Aided Train detection) was developed. This device's feature is non-contact to the rail and tracking train detection. The safety and the reliability of train detection by using this device improve greatly, because the train equipped ID-balises and this device individually detect the train by the ID-balise while existing track circuits detect only the "existence (0)" or "non-existence (1)" of the train.

This device is point detection method, but we realized sure tracking of trains because we established the state transition logic that this device could detect the direction of train even if it retreated while detecting. So the train control system can be constructed with a simple device composition and high safety by the function of this device. Moreover, this system can be constructed low-cost because a logical device is not needed in the car-borne equipment. The developed device executed a long-term test run in a Japan Railway line and it was confirmed that this device has an excellent performance.

Therefore, we are designing for practical use. This paper shows the system configuration of this device, the concept of fail safe securing and the concept of train detection logic, and reports the test results.

Broadband Networks for Transit Applications

Rafael L. Ruffo, P.E., Design Manager, MTA-New York City Transit

In the past, New York City Transit (NYCT) had a heavy reliance on copper cable runs and copper networks that were supplemented in some areas by a proprietary fiber network. In particular, the proliferation of copper to support the communication needs of NYCT was not supportable due to the increasing communication needs and respective bandwidth requirements. In recognition of these difficulties, NYCT has embarked on a consolidation of these networks onto a SONET/ATM fiber network.

By leveraging our existing fiber plant, each of our 468 passenger stations will have direct access to our fiber network. By doing so, and relying less on our copper plant, improved EMI/RFI protection in our electrically "noisy" transit environment will be achieved. Thus, having direct access to fiber connectivity will assure that mission critical applications such as ATS, PA/CIS and CBTC can be transmitted reliably and without degradation.

This SONET/ATM network will eventually provide the transport of voice, video and data traffic generated from 468 passenger stations plus other locations, such as PBX locations, bus depots, train yards and data centers. It will be de-

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LOCATION
The Hotel is located in the heart of the city within minutes walk of major attractions such as the CN Tower, the Harbor front, the SkyDome, the Entertainment District, and underground shopping and walkway network

TECHNICAL TOUR
On Tuesday afternoon we plan to visit the TTC Shops or the GO Transit Facilities. Final details will appear in the advance program

PROGRAM
An advance program will be mailed to members in February 2001.

ployed in 2 stages. In the first stage, 187 passenger stations plus PBX locations, and data centers will be equipped with ATM switches and 24 locations (stations, PBX locations, data centers) will be receiving SONET equipment. The SONET network will be capable of handling traffic generated from all 468 passenger stations, PBX locations and data centers. Under a second stage, the remaining 281 passenger stations will be equipped with ATM switches.

This broadband architecture is based on using SONET rings and ATM sub-tended rings. The SONET network will consist of 2 dual OC-48 BLSR core rings, and 4 OC-48 UPSR edge rings. The ATM network will consist of OC-12 line connections with interconnections to SONET network elements.

This project will allow NYCT to introduce data, voice and video applications from each of our passenger stations directly onto the fiber network. NYCT is also in the planning and design stages of other contracts that will migrate all existing traffic/applications onto this new SONET/ATM network.

Use of i-Mode Cellular Phones For Facility Management System
Makoto Kikuchi, Senior Researcher; Yusaku Yagi, Senior Researcher Laboratory Head; and Mikio Tanaka, Dr.Eng., General Manager, Transport Information Technology Division, Railway Technical Research Institute

For Japanese railroad companies, the management of facilities in the fields of signal, communication and track maintenance is important. We have developed and are now using a facility management system that has the functions of ledger management for facilities and automatic drawing. Although we have proposed to use portable terminals for this system as a means to collect inspection data at the inspection site of the railroad, presently they are not used as expected due to the difficulties of operation and portability. Therefore, we paid attention to i-mode cellular phones, which are now a topic in the limelight, and studied the possibility to use them in place of the existing portable terminals for the facility management system, especially for on-the-spot inspection data collection. This paper discusses the advantages and disadvantages of i-mode cellular phone, addresses problems to be solved, searches solutions, proposes to use it as an effective means for data collection in the field of the railroad and reports a result of the trial development.

Reliability Centered Maintenance for Improved Rail System Operating Efficiency and Safety
John P. Cullen, President, Rail Science, Inc.

Information technology is revolutionizing many aspects of rail system management, but is widely underutilized as a tool for instituting or improving reliability and maintainability programs. The efficiency and safety of rail operations can be improved through well-designed reliability programs and exploiting recent developments in portable PC hardware and software. The author describes the practical application of a reliability centered maintenance program that makes use of modern data collection tools. Specific, tangible improvements in rail operations are identified to assess the operating and cost benefits of such a program.

A pilot program is presented which employs the use of commercial, handheld PDAs (personal digital assistants) with custom software to gather and organize data. The time and effort expended in gathering raw information for reliability analysis is more than offset by the time savings of reducing paperwork, reporting errors, and administrative work for current reporting requirements. Key reliability principles and analysis methods are shown as powerful

tools for establishing an understanding of hidden system inefficiencies not apparent otherwise. Further applications include identifying and assessing possible future failures before they occur so that the sources of failure can be mitigated. Finally, the practical employment of a tailored reliability program to make use of the lessons learned is described. Measurable results are identified to make the case for the cost effectiveness of the program through increased system availability, reduced maintenance costs, and optimized spare equipment inventory.

The Use of GPS (Global Positioning System) for Synchronizing NYC Transit Frequency Converters
John Dellas, P.E., Principal Engineer, Electrical; Morris Schwartz, P.E., Chief Communications Engineer; Stanley Karoly, P.E., Chief Electrical Engineer; Stanley Fox, P.E., Principal Engineer, Electrical; Louis Ciarallo, P.E., Principal Engineer, Electrical; and Mysore L. Nagaraja, P.E., Senior Vice President and Chief Engineer, Department of Capital Program Management, MTA-New York City Transit

Portions of the existing NYC Transit railway signaling system utilize 25Hz power. Originally, the distribution of this 25Hz power to the signal system consisted of 3 25Hz electric generating power plants (2 in Manhattan and 1 in Brooklyn) synchronized to each other. The 25 Hz power was distributed to various power substations throughout Brooklyn, Manhattan, Queens and the Bronx via an extensive power cable and duct system. From these substations, the 25Hz power was stepped down to lower voltages and distributed to the main signal power feeders.

Recently, the utility company retired the 3 25Hz power plants, which were over 90 years old. In the place of these power plants, solid state frequency converters were installed at 17 NYCT substation sites throughout the 4 Boroughs. These frequency converters provide the required 25Hz signal power from readily available 60 Hz low-tension utility service.

Due to the nature of the signaling system, the 25Hz power supplied at these 17 substation locations is required to be continuously synchronized. To accomplish this synchronization, a novel application of the satellite global positioning system (GPS) will be utilized to provide the necessary timing signals to the 17 remote sites.

Each substation will be provided with a GPS antenna and receiver. Signals containing timing information will be retrieved from the satellites at each site and converted to the correct format for use by the frequency converter's internal synching system. Should the GPS signal be momentarily lost at one of the sites, a highly stable clock will be provided at each site to provide hold over until the satellite signal is re-established.

Analysis of Stray Current, Track-To-Earth Potentials and Substation Negative Grounding In Dc Traction Electrification System
Kinh D. Pham, P.E., Elcon Associates, Inc., Ralph S. Thomas, P.E., and Walt E. Stinger, P.E., LTK Engineering Services, Inc.

We will first look at a stray current model under the ideal conditions with uniformly distributed track-to-earth resistances and develop the track-to-earth potentials and stray current relationships within a segment of track. We then will expand the model to include buried metallic structures in the vicinity of the track using field theory to calcu-

late the potential gradients generated due to flow of rail current and show that a potential difference experienced by a crossing or paralleling underground structure that traverses these gradient could cause stray current corrosion. We will discuss the limitations of these models with the actual conditions such as non-uniform track-to-earth resistance and non-uniform soil resistivity. Our next step is to model the system when there are inadvertent breakdowns in the track insulation. The points of rail insulation breakdown may be approximated using the spherical ground electrode model and equipotential lines to illustrate the flow of stray current. Various approaches of substation negative grounding in limiting the track-to-earth potentials, enabling faster ground fault detection and lowering stray current levels will be examined and discussed in-depth.

Tunnel Lighting and Station Emergency Lighting

Melvin Sussman, P.E., Principal Engineer, Electrical;
Gabriel Reves, P.E., Principal Engineer, Electrical;
Stanley Karoly, P.E., Chief Electrical Engineer;
Harry Tom, P.E., Principal Engineer, Electrical;
Joseph Esposito, P.E., Principal Engineer, Electrical; and
Mysore L. Nagaraja, P.E., Senior Vice President and Chief Engineer, Department of Capital Program Management, MTA-New York City Transit

After traction power, the next largest use for electrical energy is lighting power. Lighting is used within the transit system for both station lighting and tunnel lighting. It should be noted that prior to their development neither a compact fluorescent lamp nor 600-volt DC ballast, capable of operation in a harsh and environmentally unfriendly subway environment, existed.

Lighting sources for station illumination utilize energy efficient fluorescent lamps for normal lighting. However, until recently, station emergency lighting used a 5-lamp incandescent bulb fixture powered from the 600 volt dc traction power rail (3rd rail). Recently, a fluorescent ballast has been developed which, while still using the 600-volt 3rd rail power source, allows the use of an energy efficient fluorescent lamp in lieu of the incandescent lamps. This resulted in an energy reduction factor of 5 for the same light output.

Lighting sources for tunnel lighting have evolved from incandescent lamps to mercury vapor lamps. However, while long lasting, mercury lamps are not energy efficient when compared to fluorescent lamps. A compact fluorescent lamp was developed to replace the mercury vapor lamp and reduce the energy used by a factor of 4. A 20-watt compact fluorescent lamp was developed and accepted as the new standard replacing the previous 50-watt mercury lamp standard.

When all 415 miles of subway track have compact fluorescent lamps installed a savings of $2,645,000 per year will be realized. This saving takes into account the life difference between the mercury and compact fluorescent lamps (24,000 hrs. vs. 12,000 hrs) and additional replacement labor costs.

Septa's M-4 Transit Car Door Experience

Daniel J. Gibbone, Senior Project Engineer, James W. Malloy, Engineer II, Southeastern Pennsylvania Transportation Authority (SEPTA); and Norman Vutz, Senior Engineer, LTK Engineering Services, Inc.

Shortly after introducing new M-4 cars into service, SEPTA found 2 modifications to the transit car door system to be necessary. The decision background for these modifications, SEPTA's interim actions, and the final implementation are described. One modification involves the addition of sensors on the cars and the mounting of targets at station platforms to enable door operation. This change resolves issues arising from converting to 1-person train operation on a line with mixed side and island platforms. A second modification involves a total change-out of the door actuation hardware and its associated controls to resolve in-service reliability issues. This modification also provides the benefits of contemporary microprocessor control hardware for obstruction sensing and for maintenance diagnostics.

Long Range Rolling Stock Planning Using Computer Simulation Models

Rongfang (Rachel) Liu, P.E., Ph.D., AICP, Project Manager/Professional Associate, PB Transit & Rail Systems, Inc.

Transportation executives, when considering the decision to invest in a major transportation capital project, wish to be confident that it will operate efficiently and will meet the requirements of their particular situation. One viable tool to achieve this comfort level before making significant funding commitments is to undertake a computer simulation of the proposed system.

A team of modelers and engineers has utilized state of the art computer simulation models to evaluate the train performance characteristics of a wide range of equipment to assist service providers develop a long-range rolling stock management philosophy. Rolling stock has a limited life span during which it can provide efficient service, therefore all operators will face this question, sooner or later: What is the most suitable equipment for the particular service?

PB has conducted a Fleet Configuration Study for the Connecticut Department of Transportation's consideration regarding the replacement and enhancement of MTA-Metro North Railroad's New Haven Line service. This study took advantage of the computer simulation applications, which have been utilized by other transportation properties including Amtrak, MTA-Long Island Railroad, New Jersey Transit, North Carolina Railroad, etc. After reviewing available programs, PB engineers selected the optimum program for this study and used the simulation model to develop a virtual railroad service. Actual characteristics of Metro North Railroad were represented by railroad profiles, station and interlocking locations, as well as dwell and operating schedules. It also incorporated speed limits imposed by physical and operational characteristics. A series of existing operating scenarios were successfully replicated to validate the simulation model.

Modelers utilized the validated simulation network and operating schedule to test a number of proposed equipment options ranging from Electric Multiple Unit (EMU) to High Speed Electric Power Locomotive (HSEPL) hauled coaches. The simulation assisted in the development of an ultimate specification for the potential locomotive design by applying the operational requirement of the New Haven Line service and the simulated performance characteristics of tested equipment.

This paper will provide a detailed comparison among a number of prevailing simulation software programs used by different transit and railroad operators. The presentation also covers frequently encountered problems during a simulation process and solutions for each.

Vehicle Technology Assessment for Downtown Baltimore East-West Transit Connector

Alain J. Kouassi, Senior Consultant, Booz-Allen & Hamilton, Inc.

To help relieve traffic congestion and improve mobility, cities throughout the US are considering the implementa-

tion of key transit initiatives. The City of Baltimore is studying a cross-town transit connector to foster continued development and improve mobility in its busy downtown business district. While not intended to be a full compendium of existing transit systems and applications, this paper presents key factors to consider in selecting the best transit vehicle system options.

The City of Baltimore is studying several vehicle options, including bus transit, heavy and light rail transit, automated guideway transit, monorail, personal rapid transit, and water transit. The paper presents an overview of selected transit vehicle options, along with the locations where they are operating. It also examines the East-West Transit Connector right-of-way requirements, and assesses the primary characteristics of each potential vehicle technology.

First, functions and travel markets that the transit system intends to capture are presented. Second, the physical constraints of the corridor, including the degree of freedom from surface traffic interference, and the stations spacing are discussed. Third, capacity of the potential transit technology, its impact on the urban environment, traffic circulation, and development patterns are also highlighted. Fourth, vehicle systems characteristics, including speed, crashworthiness, and performance, are discussed. Finally, capital and operations and maintenance cost requirements are addressed.

Railroad Ride Quality Assurance Assessment
Richard Shockley, Communications Systems Manager, Southern California Regional Rail Authority

With an accurate location assignment for all railroad structures, more refined assessments can be made of the issues affecting the quality of ride. The coupling of precise location related information for track and vehicles, with a methodical assessment of all ride related engineering factors, can provide data from which improvements could be made.

Four evaluation platforms are considered: Hi-Rail Inspection Vehicles, Engine Based, Passenger Car, and Wayside Based.

Hi-Rail Inspection Vehicles can be a valuable inspection platform because the speed of inspection can be regulated and reversed as needs arise. Inspections may include human and instrumented processes.

Locomotive engines will apply stress to the track structure that will not occur from vehicles of lesser weight. Evaluations from locomotive engines will provide information regarding the quality of the composite railroad factors under weight stress. This platform may also be used to evaluate train-handling factors that would affect the quality of the ride for the service target.

Passenger car ride quality evaluations will provide data directly affecting the service delivery target. Compartment environment quality should be determined by the ride quality. Other factors that require regular inspection and evaluation include the ambient noise levels of normal passenger vehicle operation including sounds transmitted into the passenger compartment from the roadbed through the suspension and any other operational noises such as air-conditioning.

Wayside quality assessments can focus on various sites of engineering quality enhancement ambitions. The quality of the interaction of the rail vehicle wheels with the rail could be determined through an evaluation of the audio products they produce. Directional broadband microphones can be focused, with proven off the shelf directional technology, to evaluate several individual metallic surfaces at an inspection site. A data baseline of acceptable audio imprints could be created for each operational location and application. Problems detected by the test equipment package could be reported immediately. Freight traffic with particularly dramatic flat spots on their wheels could be alerted or charged for their exceptionally demanding maintenance impact.

27TH September 2000 VTS Board of Governors Meeting Report

The VTS Board of Governors' Meeting was held at VTC 2000-Fall in Boston. President Kent Johnson was in the chair, with Board Members Charles Backof, Dennis Bodson, J. R. Cruz, Bob Fenton, Bob French, John Gilsenan, Anil Kripalani, Bob Mazzola, George McClure, Tom Rubinstein, Ray Trott, Jim Worsham, Vice Presidents Harvey Glickenstein and Eric Schimmel and Secretary Essam Sourour. Also present during the meeting were Vijay Barghava, Linda Sue Boehmer, Art Greenberg, James Irvine, Kumar Krishen, Jae Hong Lee, Roger Madden, Tadashi Matsumoto, Reuvan Meidan, and Evan Richards. Mel Lewis sent his apologies.

Treasurer Charles Backof reported that the net worth of the society had grown by $420,000 over the last year. It was agreed to move $200,000 dollars to long-term investment account, which leaves $1 million in the long-term investment account, and $400,000 in cash. The budget proposal shows a surplus of about $67,000 dollars on a budget of about $1 million. As of the first of July the society had 5180 members, 720 of them student members.

Art Greenberg, Chair of VTC2001-Fall reported on plans for that conference which will be held from the 7-11 of October in the Sheraton Convention Hotel and Atlantic City Conference Centre. He pointed out that this is not a casino hotel and that no

gambling takes place. All 400 rooms have been booked and they are looking at other hotels. They have a 22 member committee, and all the chairs are in place. Tutorials will be held on the Sunday, with eight tracks in the technical sessions from Monday to Wednesday. There will be a workshop on Thursday. The web site is up and running (www.fallvtc2001.org) and a Call for Papers had been distributed. There are expecting some sponsorship income in February or March 2001, but requested some additional seed money. A motion to allow a total of $20,000 seed money was agreed. The Conference Centre is next to the railway station, with a good service from Philadelphia and connections to the north-east corridor. Air access is to Atlantic City International, or to Philadelphia airport, which is about 1 1/2 hours away.

Tadashi Matsumoto, Secretary of VTC2000-Spring reported on the outcome of the Tokyo conference. In a 550 papers had been excepted, of which 165 had been posters. Registrations totalled 930, with 493 delegates attending tutorials. Due to large number of a attendees, the conference made a large surplus and the order of 17 million Japanese yen. Tad made two specific proposals. He noted that some considerable effort had been spent designing the logo. Each conference having a different logo meant that this effort had to be repeated, and there was no common branding for VTC.

Figure 1 Attendees at the Board Meeting. From left, Anil Kripalani, Bob Mazzola, J. R. Cruz, Roger Madden, Tom Rubinstein, Reuvan Meidan, John Gilsenan, Harvey Glickenstein, Linda Sue Boehmer, Kent Johnson, Essam Sourour, Jim Worsham, George McClure, Ray Trott, Bob Fenton, Charles Backof, Dennis Bodson, Bob French, Roger Madden (at wall on left) and Eric Schimmel (at wall on right).

He therefore suggested that the same format be used for conferences in the future (where no logo had yet been decided), since the VTC2000-Spring logo could be quite easily changed so that the globe could be centred on the location of the conference, the city name replaced, and the slogan replaced with the appropriate slogan (see Figure 3). The second proposal was that since the conference surplus was much larger than expected, the proportion going to the Japanese chapter was also very much larger than expected, and he proposed using some of this money to set up a fund for Japan chapter award. These proposals were favourably received, and it was agreed to form a committee to bring forward proposals on the award to the next meeting.

Reuvan Meidan reported that everything was in place for **VTC2001-Spring**. 220 submissions had been received by three days before the board meeting. This was in line with the total received at that point by Tokyo, where a total of 805 papers were submitted. Acceptances are expected to be sent out in mid December, with full papers being required February. The registration rate will depend a number of submissions, but is expected to be in the order of $450 dollars for members pre-registering.

Jae Hong Lee reported on plans for a **VTC2003** in Korea. The meeting will be held on the same venue has the ASEN (Asian European) meeting and the venue organisers had been concentrating on that. They will negotiate after this meeting. The venue is close to a subway station to allow easy access to other parts of the city and the use of alternative hotels if required.

Vijay Barghava reported on plans for **VTC 2002-Fall** in Vancouver. Along with Kent Johnson, he had examined the Hyatt Regency Hotel at the IEEE board meeting in June. They have a fixed rate of $155 a night for 2002, which is a very good deal considering that people are currently paying more this year. $20,000 seed money was approved. The call for papers will be available at the Tel Aviv conference. Lunches will not be unbundled as the total cost will still be less than the Boston conference considering the favourable exchange rates with Canada.

Kumar Krishen reported on **VTC'99-Spring** in Houston. The conference was technically good in terms of papers and financially a success in that it made a surplus (about $72k), but attendance was less than had been

hoped for, due to the fact that that was first year in which two conferences had been held per year. The conference is not yet closed out, although all the money had been dispersed. It cannot be closed until the paperwork is complete, in particular an audit.

Stu Lipoff reported 630 advance registrations for **VTC2000-Fall**, and on-site registrations by that day the total was up to 713. He was expecting 800 people to register the end of the conference, which was within the budget. It noted that all paper processing except for copyright form been done electronically. It had not impossible to process that electronically, and these forms had caused 50% of the administrative work load. 150 posters had accepted, but about half of those cancelled in last month. The printed conference proceedings used a wire binding process to allow shorter print run with no wastage.

On other conference business, it was suggested that an web cast of a conference session or plenary be investigated to allow non-attending members to benefit.

Ray Trott, Awards Chariman reported on the awards which would be presented at VTC2000-Fall. His column appeared in the last (November 2000) issue. The meeting also agreed to make an Outstanding Service Award to Tadashi Matsumoto.

Kent Johnson, President, gave his report. The five-year society review was due in November 2000. He had met with Eric Schimmel, Linda Sue Boehmer and George McClure the previous day in order to prepare a response. The Technical Activities Board had rejected the new financial model so the old one still applies. The society reserves will be reduced to pay for the deficit. About 6% of reserves, which in the case of the Vehicular Technology Society amounted to $1.4 million dollars, will go to pay the deficit, and projection for next year's charge is 10%.

Another output from the Technical Activities Board was that after 2002, all conferences would have to produce fully electronical conference proceedings, although hard (printed) copies will be required as well. VTS already complies with this requirement.

Figure 2 Tadashi Matsumoto reports on VTC2000-Spring

J. R. Cruz reported that **transactions** will have caught up with the backlog by the year end. There be working for the past nine months on setting up by Manuscript Central and customise it for the VT transactions. This removes paper from the refereeing process, allowing the work to be done electronically with resultant cost savings. Hopefully testing will begin at the beginning of this October, with the system up and running by later this year. The July Transactions on Vehicular Technology had only recently been mailed due to staff changes at the IEEE. This may affect the September issue.

Wireless activities with the IEEE: A telephone conference call had occurred to discuss wireless activities within the IEEE. The working group of suggested that the Transactions on Vehicular Technology be renamed to include the term wireless.

George McClure, Publicity Committee Chairman presented a report on chapter development. Gaspar Messina, VTS Chapters Co-ordinator, has attended the IEEE Chapter Coordinators Retreat held in New Orleans in February 2000 where a number of ideas for chapter development had been proposed. George presented a ten point plan for development of VTS chapters including better information exchange, a VTS chapter handbook, enhanced grants for chapter activities and to support guest speakers and encouragement to set up chapters in locations not currently served. This plan was approved.

Harvey Glickenstein, VP Transportation, reported that the books for the Joint Rail Conference 1999 will be closed within a month, and JRC2000 should be closed within two months.

Jim Worsham, who is responsible for past conferences, reported on the close out of conferences. A financial report had been prepared by the VTC'99-Spring organisers but there was some questions as to whether its form would be acceptable to the IEEE. The report had been delayed due to awaiting documentation from the IEEE, and it was agreed to seek a delay in the financial penalties imposed by the IEEE for the late close out of conferences due to this.

Jim also reported that there were problems closing out VTC'99-Fall in Amsterdam. The organisers had used a company to process registrations, which has caused difficulties since the auditors are not in a position to verify the original documents held by that company. A second difficulty was the fact that the conference was held with WPMC99 and some transactions had not been separated. It was agreed to seek further details from the conference organisers.

Eric Schimmel report on elections. The successful candidates for the five Board of Governors positions for the term 2001 to 2003 inclusive were Robert L. French, Robert A. Mazzola, George F. McClure, Raymond C. Trott and Gordon L. Stüber, the first four of whom are existing members of the Board of Governors. Kent Johnson, having served two terms as President, is not longer eligible for the position. J. R. Cruz was nominated for the post of President, and Dennis Bodson for the post of Executive Vice President, with the other executive members – Bob Mazzola, Harvey Glickenstein, Eric Schimmel, Essam Sourour and Charles Backof – being nominated for their existing positions. These candidates were duly elected. Greg Bottomley, currently Associate Editor of the Transactions on Vehicular Technology, will

Conference name (date) and place amended as appropriate

Rotate the globe so that the VTC hosting country is centered

Change the slogan to the slogan of the conference

Shaping History Through Mobile Technologies

Figure 3 Proposal for a common VTC logo

take over from J. R. Cruz when he becomes President on 1 January 2001.

Bob Fenton, Convergence Representative, reported that Mr Jean Yves Routex, a French student currently studying at Texas A&M University, is the awardee for the 2000-1 Convergence Fellowship.

Bob Mazzola, VP Motor Vehicles, reported that Society President Kent Johnson would present a Millenium Medal to Trevor Jones, Convergence founder, at Convergence 2000. The Convergence Transportation Electronics Association has voted to invite IEEE and SAE Vice Presents for Education to be ex-officio members of the organization to better and co-ordinate education programme sponsorship among the three organisations.

ITS Representative Bob French reported that the ITS Conference (ITSC) would be held in Dearborn on 1-3 October 2000, with the Intelligent Vehicles Symposium (IV) on the 4th and 5th of October. The ITS Council will meet on the 1st of October, also in Dearborn. That will be its only meeting this year. The ITS Council newsletter can be found at www.ieee.org/its, with the latest (September 2000) issue posted on the 7th of September. ITSC2001 will be in Oakland from 25-29 August 2001. IV2001 will be held in Tokyo on the 5th and 6th of June 2001.

Tom Rubinstein, Conference Site Selection and New Member Liaison reported that discussions on holding VTC2003-Fall in Florida had been productive and it was agreed to go ahead with this contingent on the approval of the local section. He also reported that enquiries had been received in New Zealand, Budapest and Genoa. Of these Genoa was a most advanced. It was noted that there may be transportation difficulties, and suggested Milan be investigated as an alternative. It was agreed to purchase a copy of Adobe Acrobat to produce documents in PDF, and proceed with the new member survey.

James Irvine, Newsletter Editor reported that the first issue of a new format of the VTS News had been produced, and extra had been printed and distributed to delegates at the Boston conference. Copy for the November issue is complete, but the newsletter coordinator had moved positions within the IEEE and a replacement has not yet been appointed, which may cause some delays.

Dennis Bodson, Standards Committee Chairman reported that there was an IEEE Standards Board meeting that day and the next, and that the next meeting would be on the 13th and 14th of November 2000. He also reported that the mobile book reprint project is going ahead, and is a response was awaited from the IEEE. The VTS had been asked if it would like to be represented on an R&D Policy Committee meeting in Washington. John Gilsenan was nominated.

The next meeting will be held on the 9th of February 2001 in San Diego.

VTC2001-Spring
6-9 May 2000
Rodos Palace Hotel and Conference Center, Rhodes, Greece

VTC2001-Spring Relocates to Rhodes

After careful consideration of the situation in Israel regarding the unrest in the West Bank and Gaza, the VTS conference committee and the local VTC committee in Israel have decided to relocate the Tel Aviv conference to Rhodes Island, Greece.

The May 6-9 dates and conference schedule stay the same, but the hotel location is no longer the David Intercontinental, Tel Aviv. The new location is the Rodos Palace Hotel and Conference Center, Rhodes, Rhodes Island, Greece.

For information about the hotel please look up the VTC2001-Spring conference web site at

http://www.congress.co.il/ieee_new/index1.html

Rhodes Island is one of the most frequently visited of the Greek islands, located in Eastern Mediterranean close to coast of Turkey. In early May, daytime temperatures of between 20 and 25°C can be expected. The Rodos Palace is a large conference center in the suburbs of the city of Rhodes, which is the main town on the island.

The island has a long history, being a staging port during the Crusades, and was for more than two hundred years the home to the Knights of St. John of Jerusalem (Knights Hospitallers), who converted Rhodes into an almost impenetrable fortress. It then came under Turkish and Italian rule before becoming part of Greece in 1947. Its population of 90,000 swells considerably during the summer as visitors come to see Rhodes Town, a World Heritage city with its medieval city walls, or to relax on the various beaches around the island. We are confident you will enjoy the island during your leisure time, as well as having a pleasant meeting environment for the conference. We hope to be able to get back to Israel when things settle, through one of the future VTCs.

The conference is still being run by the very capable committee in Israel, chaired by Reuven Meidan, with the support of Dan Knassim, a conference organizing company. Almost 1000 paper abstracts were submitted, so this promises to be a very comprehensive conference.

Mel Lewis, VTS Conference Coordinator
Reuven Meidan, VTC2001-Spring General Chair

Lindos, on the east of the island on a rocky outcrop surrounded by beaches boasts a 14th century BC Temple to Athena, and a 2nd century Acropolis.
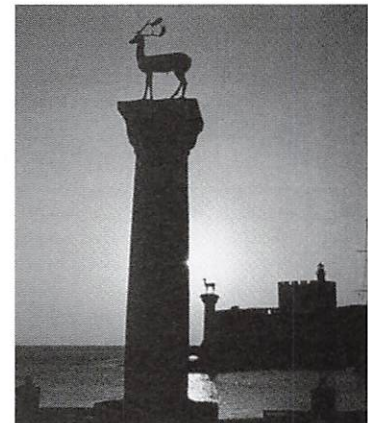
The entrance to Mandraki harbour, Rhodes.

FIRST CALL FOR PAPERS

FOURTH INTERNATIONAL SYMPOSIUM ON WIRELESS PERSONAL MULTIMEDIA COMMUNICATIONS (WPMC'01)

YRP Telecom summit / **WPMC'01**

WPMC'01 General chair:
Professor Ramjee Prasad, Aalborg University, Denmark
WPMC'01 Technical Programme Chair:
Professor Jørgen Bach Andersen (Aalborg University, Denmark)
WPMC'01 Technical Programme Co-chairs:
European, Middle east and Africa Co-chair: Dr. Marc Engels (IMEC, Belgium);
North & South America Co-chair: Dr. Uma Jha (Morphix, USA); Asia & Pacific Co-chair: Dr. Shinsuke Hara (Osaka University, Japan)
WPMC Steering Board:
Co-Chairs:
Professor Hideki Imai (The University of Tokyo, Japan), Professor Ramjee Prasad (Aalborg University, Denmark) Dr. Shingo Ohmori (Communications Research Laboratory, Japan).
Board Members:
Dr. Fumiyuki Adachi (Tohoku University, Japan), Professor Vijay K. Bhargava (University of Victoria, Canada), Dr. Ki Chul Han (ETRI, Korea), Professor Gordon L. Stuber (Georgia Institute of Technology, USA), Dr. Kouichi Honma (Panasonic, Japan), Dr. Heikki Huomo (Nokia, Finland), Dr. Toshiho Ihara (Communications Research Laboratory, Japan), Prof. Ryuji Kohno (Yokohama National University, Japan), Dr. Magnus Madfors (Ericsson Radio Systems AB, Sweden), Dr. Werner Mohr (Siemens AG, Germany), Dr. Nobuo Nakajima (NTT DoCoMo, Japan), Professor Norihiko Morinaga (Osaka University,Japan).
WPMC Advisory Board:
Chair: Professor Mitsutoshi Hatori, President YRP R&D Committee.
Board Members:
Dr. Kazi M. Ahmed (Asian Institute of Technology, Thailand), Professor Paul W. Baier (Universität Kaiserslautern, Germany), Professor Ezio Biglieri (Politechnico di Torino, Italy), Dr. Hachihei Kurematsu (Fujitsu Ltd., Japan), Professor Byeong Gi Lee (Seoul National University, Korea), Professor Teng Joon Lim (National University of Singapore, Singapore), Professor Elvino Sousa (University of Toronto, Canada), Professor Branka Vucetic (The University of Sydney, Australia).
Sponsored by:
Yokosuka Research Park R&D Committee, Communications Research Laboratory, Japan, IEICE, Japan.
In cooperation with (to be approved): IEEE Denmark section, Denmark, IEEE Japan Council, Japan, Royal Danish Embassy, Tokyo, Japan, Center for PersonKommunikation, Aalborg University, Denmark, The Society of Danish Engineers (IDA), Teletechnical Society (TTS).

Symposium Secretariat:
Att. Ms. Helle Kongsved,
CPK, Aalborg University, ,
Frederiks Bajers Vej 7A5-210
DK-9220 Aalborg
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September 9-12, 2001
Aalborg Kongres & Kultur Center, Aalborg, Denmark

An active global platform has been created in 1998 to have open discussions on the future wireless personal multimedia communications by organizing International Symposium on Wireless Personal Multimedia Communications (WPMC) as an annual event.

The first symposium was held in 1998 at Yokosuka Research Park (YRP), Japan, the second symposium was held in 1999 in Amsterdam, The Netherlands, and the third symposium was held on November 12-15, 2000 in Bangkok, Thailand.

The fourth symposium will address the open challenges to realise wireless broadband multimedia communication systems.

The organizing committee for WPMC'01 invites to submit extended abstracts on the following topics (but not limited to) to the Symposium Secretariat, latest by April 30, 2001

- *Broadband Access Techniques*
- *Antennas and Propagation*
- *Coding and Modulation for MM communications*
- *Wireless LANs*
- *Wireless IP*
- *Network Planning*
- *Radio Resource Allocation for MM communications*
- *Traffic Modeling*
- *Authentication, Authorization and Accounting (AAA)*
- *Multimedia Satellite Communications*

- *Wireless Access*
- *Personal Area Networks*
- *Navigation*
- *Intelligent Transport System*
- *Software (Defined) Radio*
- *Embedded Systems*
- *RF Technology*
- *Wireless Broadband Multimedia Communications*
- *Wireless Speech Communications*
- *Image Processing*
- *Protocols*
- *QoS provision*
- *Next generation cellular systems*

The organizing committee for WPMC'01 also invites to submit proposals for tutorials, workshops and panel sessions to the Symposium Secretariat, latest by April 30, 2001.

Deadlines:
Extended abstract (up to 800 words) : April 30, 2001.
Notification of acceptance : May 31, 2001.
Final manuscript in electronic version as PDF or PS : June 30, 2001

Web-address for the symposium : www.wpmc01.org/   *Download as pdf*

YRP Yokosuka Research Park   **IEEE**   **CRL**   **IDA**

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	
20-22 February 2001	EPMCC 2001	Vienna, Austria	http://www.epmcc.com	
26-28 March 2001	3G2001	London, UK	http://conferences.iee.org.uk/3G2001/	
17-19 April 2001	Joint Rail Conference	Toronto, Canada		
6-9 May 2001	VTC 2001-Spring,	See below	http://www.congress.co.il/ieee_new/	
20-22 May 2001	2001 Radio Frequency Integrated Circuits Symposium Phoenix, AZ		http://www.ims2001.org/rfic	
6-8 June 2001	3Gwireless 2001	San Francisco, CA	http://delson.org/3gwireless01	
11-15 June 2001	ICC2001	Helsinki, Finland	http://www.icc2001.com	
8-13 July 2001	APS International Symposium / URSI Radio Science Meeting	Boston, MA	http://www.ieeeaps.org/ 2001APSURSI/	
15-18 August 2001	3rd Int. Workshop on Mobile Wireless Comms Networks	Recife, Brazil	http://www.cin.ufpe.br/ ~mwcn2001/principal.htm	
19-22 August 2001	RAWCON 2001 Radio and Wireless Conference	Boston, MA	mailto:heutmaker@lucent.com	
25-29 August 2001	ITSC 2001	Oakland, CA	http://www.ewh.ieee.org/tc/its/2001/	
9-12 September 2001	WPMC '01	Aalborg, Denmark	http://www.wpmc01.org See overleaf for details	✓
25-28 September 2001	IVEC2001 Veh. Electronics Conf.	Tottori City, Japan	http://www.kankyo-u.gr.jp/	
30 September – 3 October 2001	PIMRC 2001	San Diego, CA	http://www.pimrc2001.org	✓
7-11 October 2001	VTC 2001-Fall	Atlantic City, NJ	http://www.fallvtc2001.org	✓
28-31 October 2001	MILCOM 2001	Washington, DC	http://www.milcom.org/2001	✓
14-16 November 2001	ISCIT 2001	Chiang Mai, Thailand	http://www.kmitl.ac.th/~iscit/	✓
25-29 November 2001	Globecom 2001	San Antonio, TX	mailto:g.weisman@comsoc.org	✓
20-24 January 2002	Int. Conf. on Micro Electro Mechanical Systems (MEMS)	Las Vegas, NV	mailto:kkcline@pmmiconferences.com	
26-28 February 2002	European Wireless 2002	Florence, Italy	http://www.ing.unipi.it/ew2002	✓
Spring 2002	VTC 2002-Spring	Birmingham, AL	mailto:jacksonP2@bek.com	
16-21 June 2002	APS International Symposium / URSI Radio Science Meeting	San Antonio, TX	http://www.ieeeaps.org/ 2002APSURSI/	
24-28 September 2002	VTC 2002-Fall	Victoria, BC	mailto: bhargava@engr.UVic.CA	
Spring 2003	VTC 2003-Spring	Seoul, Korea	mailto:m.lewis@ieee.org	

Conferences marked '✓' have open calls for papers as of 28 February 2001. 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.

Important Announcement
VTC2001-Spring

Due to the security situation in Israel, VTC2001-Spring has been relocated to Rhodes. The timing and programme remain the same. See page 42 for full details.