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FEATURES

4 cdma2000 1X:
New Capabilities for CDMA Networks

13 The Evolution of GSM-R for Railways

16 Speech Processing for Vehicles:
What's Next?

3G has arrived - the Kyocera 2255 (left), the LG TM910 (both cdma2000) and the DoCoMo P2101V (right) FOMA WCDMA videophone. See the Foreword and Edward Tiedemann's articles.

Contents

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Foreword

James Irvine, Editor

Well, the new generation of mobile phones has well and truly arrived. cdma2000 networks have been operating for some time now, but the Japanese launch of NTT DoCoMo's FOMA – Freedom of Mobile multimedia Access – has been much anticipated since it uses the rival WCDMA system which requires the deployment of a new air interface rather than the upgrade of an existing one. A large amount of money is resting on the outcome, not just in terms of the cost of the new infrastructure, but in the spectrum licences which network operators have mortgaged their networks to buy.

Early signs are good. NTT DoCoMo's trails were oversubscribed, and it sold 4000 of its terminals on the first day for a service which is currently only available in Tokyo. The terminals are not cheap – ¥48,000 ($400) for a standard terminal and ¥68,000 for the video phone, while a PC card data terminal for a laptop costs ¥28,000 – so it would seem that there is a market for unsubsidised terminals.

A slow take up in Japan would force a serious re-think amongst operators in other markets, which explains much of the nervousness amongst operators at the moment. Sir Christopher Gent, Chief Executive of Vodafone, summed up this mood when he said that he was grateful to DoCoMo for doing this first. However, the converse is not necessarily true. The take-up of i-mode, which continues its inexorable upward march, is not mirrored by similar WAP services in other markets.

WAP has been predominantly deployed over circuit switched bearers, whereas i-mode uses packet switching, but while this would make WAP inherently more expensive, even when network operators provide free WAP access to their own portal, take-up has been slow. It is not the technology which is the differential here; the data rate of i-mode is only 9.6kbit/s. However, DoCoMo has been very successful at getting other content providers to provide i-mode sites, and this aspect of the business has not been repeated with WAP. 3G gives higher data rates, although not all that much greater than enhanced 2G networks in the first instance. However, except for a PC card in a laptop, the Internet experience will still be constrained, this time by the size of the terminal itself. Japan has i-mode over 3G to fill this gap, but an open question is where this content will come from in other markets.

Over the next few months we will be publishing articles on the different 3G technologies, starting with cdma2000 in this issue. However, the technology has arrived. cdma2000 and WCDMA are here. EDGE still needs chipsets for which the target is next year, but the GPRS 2.5G service is currently being deployed. The new focus needs to be on services – they are the new challenge for mobile systems.

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cdma2000 1X: New Capabilities for CDMA Networks

Edward G. Tiedemann, Jr., QUALCOMM Incorporated

The cdma2000 system is the first of the new 3G mobile technologies to be deployed in revenue earning service. In the first of a series of articles on the new radio technologies for future mobile systems, Qualcomm's Senior Vice-President of Engineering, Edward Tiedemann, introduces cdma2000 and describes its relationship to the TIA/EIA-95 systems it has evolved from.

Introduction

The cdma2000™ third generation wireless standard was developed in response to the ITU call for third generation wireless systems [1, 2] and the continuing desire by wireless operators to increase the performance and capabilities of their systems. In almost all of the Americas, where cdmaOne™ is extensively deployed, new spectrum is not being made available for third generation systems. In many Asian countries, where cdmaOne is also extensively deployed, regulators are allowing third generation systems to be deployed in existing spectrum, even when new spectrum is also being allocated for third generation systems. As a result, a large number of the existing cdmaOne operators required that the third generation air interface integrate well with their TIA/EIA-95 systems to provide a clean, economical, and transparent migration path. The cdmaOne operator community also challenged the designers of the cdma2000 air interface to double the voice call capacity over TIA/EIA-95. This was a significant challenge as TIA/EIA-95 was already the highest capacity wireless air interface. The challenge was met and what resulted was cdma2000, which can be deployed as an evolution of cdmaOne or as a new third generation system.

The first commercial third generation network was the cdma2000 network which was launched in October 2000 by the Korean operator SKT [3]. This was followed by LG Telecom and KT Freetel. A recent report indicated that 820,000 cdma2000 subscribers were added in Korea during September 2001 [4]. By early 2002, most existing cdmaOne operators in North America and Asia will have commercially launched cdma2000.

The initial version of the cdma2000 air interface standard was developed by the Telecommunications Industry Association (TIA) standards body TR45; subsequent versions have been developed by 3GPP2, a consortium of five standards bodies: TIA in North America, TTA in Korea, ARIB and TTC in Japan, and CWTS in China. These regional standards bodies have converted the cdma2000 specifications into regional standards. The TIA designator for the air interface standard is TIA/EIA/IS-2000 [5-9]. In May 2000, the ITU RadioCommunication Assembly approved [10] consisting of five IMT-2000 terrestrial radio interfaces, one of which is cdma2000. The ITU terminology for cdma2000 is CDMA Multi-Carrier.

The cdma2000 system is continually evolving. Commercial systems are using the first version of the cdma2000 air interface standard. The initial version concentrated on providing higher performance for the dedicated channels. Revision A provided support for the new common channels and concurrent services. Work is nearing completion on Revision B and work is beginning on Revision C. In addition to these cdma2000 revisions, a high rate data optimized companion standard, TIA/EIA/IS-856 [11], also called 1xEV-DO, has been developed. This was recently added to the CDMA Multi-Carrier family of standards by the ITU [12]. This high rate data standard is described in [13].

The cdma2000 air interface can be connected to either the ANSI-41 network or the GSM-MAP network [14]. Existing cdmaOne operators are using the ANSI-41 network, which really consists of a circuit switch portion (formally the ANSI-41 network) and a packet switch portion. There is currently considerable work in the standards bodies to transition the circuit switched portion of the network to a unified packet network using internet protocols. This unified network is called the All-IP network.

Most CDMA operators have commercially deployed Revision A of the TIA/EIA-95 standard [15] or the PCS variant, J-STD-008 [16]. Revision B of TIA/EIA-95 [17] introduced many new features to the air interface; however, the main feature in commercial service is the higher data rate capability on the forward link which can provide up to 115.2 kbps, not including overhead. With the deployment of cdma2000, a full set of TIA/EIA-95-B capabilities are being deployed. This paper provides an overview of the cdma2000 air interface and some of TIA/EIA-95-B capabilities that are being introduced with cdma2000 deployments.

Physical Layer Modes

The cdma2000 air interface consists of two basic modes: 1X and 3X. The 1X mode uses the same chip rate of 1.2288 Mcps as TIA/EIA-95 and thus requires the same bandwidth as TIA/EIA-95. A cdma2000 equipped frequency can support mobile stations operating in the TIA/EIA-95 mode and the cdma2000 mode. This is because the forward link consists of orthogonal code channels formed using Walsh functions, which can be assigned dynamically to either TIA/EIA-95 mobile stations or cdma2000 mobile stations.

The 3X multi-carrier (MC) mode is the second basic mode. This mode uses three forward link carriers, each with a chip rate of 1.2288 Mcps and a single reverse link carrier with either a chip rate of 3.6864 Mcps or 1.2288 Mcps. The cdma2000 3X mode was developed to provide higher peak
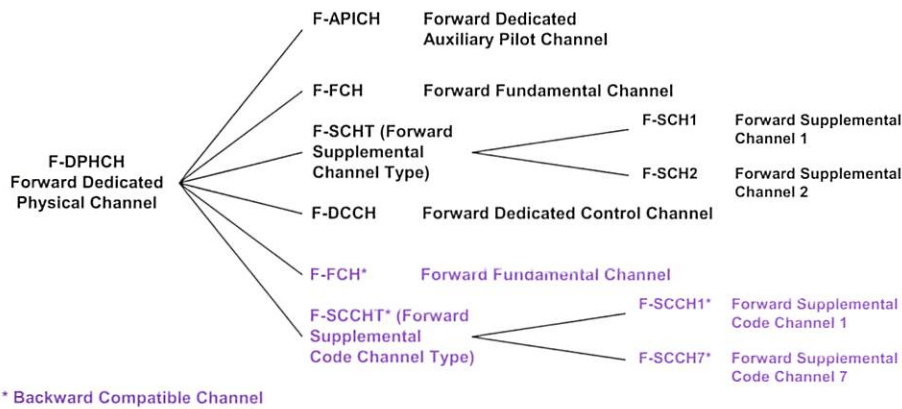
Figure 1 cdma2000 Forward Dedicated Channels (BS to MS).

data rates than are possible with the 1X system. However, subsequent technical development of the high rate data optimized companion standard, TIA/EIA/IS-856, and current work in the standards bodies on cdma2000 Revision C have postponed the need for operators to deploy the cdma2000 3X mode. cdma2000 Revision C plans to incorporate 1xEV-DV, which uses techniques similar to those found in TIA/EIA/IS-856 to enhance support for certain packet services. While many aspects are applicable to all modes, the remainder of this paper is specific to the cdma2000 1X mode.

Dedicated Channels and their usage

Dedicated Channels

The forward and reverse dedicated channels, which are those assigned by a Base Station (BS) to a specific Mobile Station (MS), are shown in Figures 1 and 2. TIA/EIA-95 has a Fundamental Channel (FCH) to carry user data. The FCH provides four data rates with a maximum rate of either 9.6 kbps or 14.4 kbps. The physical layer frame duration is 20 ms. TIA/EIA-95-B can use up to seven Supplemental Code Channels (SCCH) which are identical in structure to the TIA/EIA-95 FCH, except that a SCCH is transmitted at the maximum rate or not at all. In Figures 1 and 2, the FCH and SCCH are called backwards compatible channels to show that they can be operated on the same frequency as the cdma2000 channels.

The cdma2000 Fundamental Channel (FCH) provides capabilities similar to the original TIA/EIA-95 traffic channel, in that it typically provides four data rates with a maximum rate of either 9.6 kbps or 14.4 kbps. The Dedicated Control Channel (DCCH) is either transmitted at a full rate of 9.6 or 14.4 kbps, or not at all. There can be one or two Supplemental Channels (SCH) that provide for higher rate services. For cdma2000 1X, the maximum forward link data rate per SCH is 307.2 kbps. The cdma2000 FCH and DCCH physi-

cal layer frames are 20 ms in duration, but have an option of 5 ms for MAC signaling; the SCH physical layer frames can be 20, 40, or 80 ms in duration, though 20 ms is the duration that is commonly used.

All of the forward link channels typically share a common Pilot Channel, the F-PICH (see Figure 4). Other pilot channels can be used for fixed beams, the F-APICH, and transmit diversity, the F-TDPICH and ATDPICH. The cdma2000 forward link also supports a dedicated auxiliary pilot channel per MS, the F-APICH, which can be used for adaptive beam forming. The MS uses the forward link pilot channels for channel estimation (phase and timing references), for multipath searching, for initial acquisition, and for detecting neighboring base stations for handoff. The cdma2000 reverse link requires a dedicated Reverse Pilot Channel, the R-PICH.

Voice Configurations

In a typical voice configuration only a Fundamental Channel (FCH) can be used. This is essentially the same configuration as used with TIA/EIA-95. The fundamental channel carries voice frames. Signaling messages are either sent by black-and-burst or dim-and-burst. Blank-and-burst has the signaling replacing one or more speech frames. Dim-and-burst has the signaling co-existing in the same frame as voice. If the amount of data for the voice service would require all of the bits in a full rate frame, then the speech codec rate is limited to be at most half rate so that about half of the bits in the frame are used for voice and half of the bits are used for signaling.

The speech codec can be easily controlled when the speech codec is in close proximity to the signaling control entity as would be the case in a typical handset or in an infrastructure configuration in which the speech codec is located in the Selection/Distribution Unit (SDU) attached to the Base Station Controller (BSC). However, when tandem free operation is used for mobile-to-mobile calls or when voice over IP
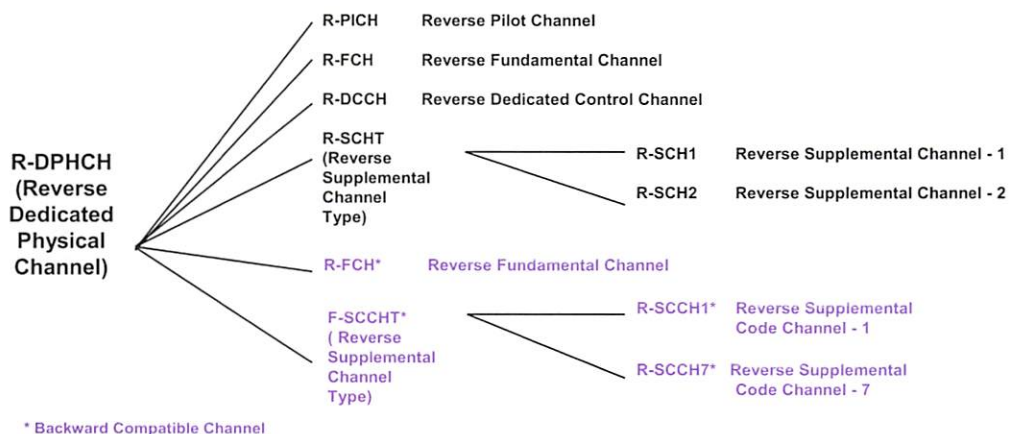

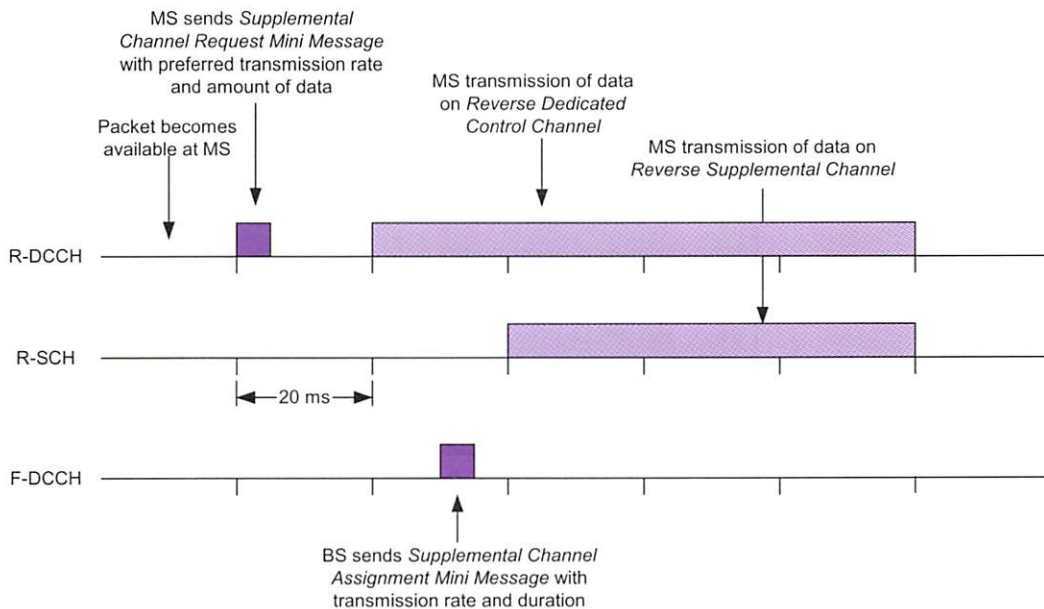Figure 2 cdma2000 Reverse Dedicated Channels (MS to BS)

Figure 3 Reverse Link Scheduling

The R-SCH is typically operated in a scheduled manner. For scheduling, the FCH and DCCH can operate in a short 5 ms frame mode, though the standard 20 ms frames can be used. The 5 ms frames reduce delay, thus enhancing the scheduler's ability to follow changing channel conditions. However, the delays in initially deployed infrastructure are expected to be long, thus the benefits of the 5 ms mode are not fully obtained. As a result, initial implementations are using only the 20 ms mode. Figure 3 illustrates the reverse link scheduling process for the 5 ms mode. When the MS detects that it has a packet to send, the MS determines the size of the packet. If the packet is large, then the MS sends a *Supplemental Channel Request Mini Message* indicating the amount of data that it has in its buffer and the transmission rate that it can support (with this rate, the output power of the MS would typically be several dB below its maximum possible output power). The MS then begins to transmit the packet on the R-FCH or R-DCCH. The scheduler in the BS then determines when the MS is to transmit on the R-SCH and grants the MS permission to use the R-SCH by using the *Supplemental Channel Assignment Mini Message*. This provides the MS with the rate that it is permitted to use and the duration that the MS is permitted to use the R-SCH.

Simultaneous Voice and Data Configurations

A minimal voice plus data configuration supporting primarily low rate forward link data would consist of a FCH and a F-SCH. However, a configuration supporting higher rates and the R-SCH would typically have all three channels supported in both directions.

Common Channels and their usage

Common channels are used to convey overhead information, for broadcast transmissions, for short transmissions, and for establishing dedicated channels. Figures 4 and 5 show the common channels. Both cdma2000 and TIA/EIA-95 use a common Forward Pilot Channel (F-PICH) which is used for channel estimation, acquisition, and handoff. Both cdma2000 and TIA/EIA-95 systems use the Forward Sync Channel (F-SYNC), which serves as a bootstrap channel for the system.

The TIA/EIA-95 common channels are the Paging Channel (F-PCH) and the Access Channel (R-ACH). Because all of the cdma2000 dedicated channels can be established with the TIA/EIA-95 common channels, the initial version of cdma2000 only supported the existing common channels plus one new common channel, the Quick Paging Channel (F-QPCH). The F-QPCH was designed to enhance the battery life of the MS. Initial commercial deployments are using the TIA/EIA-95 common channels plus the F-QPCH.

In TIA/EIA-95, a MS must wake up once every slot cycle during its assigned paging slot to determine whether it is be-

is used, then the BSC is unable to control the speech codec that is located in a MS or in a media gateway. In this arrangement, only blank-and-burst can be used for signaling resulting in some speech quality degradation if signaling is frequent. In these configurations, a Forward Dedicated Control Channel (F-DCCH) can be used to convey signaling. Thus, in the downlink direction to the MS, voice is transferred over the F-FCH and signaling is transferred over the F-DCCH. In the uplink direction from the MS, voice and signaling are mixed on the R-FCH using dim-and-burst. By using the R-FCH and not the R-DCCH to convey signaling, no additional MS output power is needed to send a signaling message, thus maximizing the range of the MS. It should be noted that a physical F-DCCH can be shared among several mobile stations to reduce the amount of Walsh function utilization on the forward link.

Data Configurations

A typical data configuration will use the FCH or the DCCH along with the Supplemental Channel (SCH). The FCH or the DCCH is used to convey signaling, control for the radio link protocol (RLP) and short packets, such as TCP acknowledgements.

On the forward link, the SCH can be used in a dedicated manner with one or two SCHs allocated per MS. However, a preferred manner for many packet services is to operate the SCH like a shared common channel. This avoids the use of dedicated Walsh codes on the forward link when they are not needed. Unnecessary use of Walsh codes results in a lower overall system capacity. When using the SCH in a shared mode, multiple mobile stations can simultaneously monitor the SCH. Since the SCH is covered with a unique MS specific spreading code, called the long code, the MS correctly receives a SCH frame when the SCH is transmitted by the BS using the long code of the MS. The data capacity of a cdma2000 system can vary considerably depending upon the scheduling mechanisms used to control the SCH.

F-CPHCH
Forward Common
Physical Channel

* Backward
Compatible
Channel

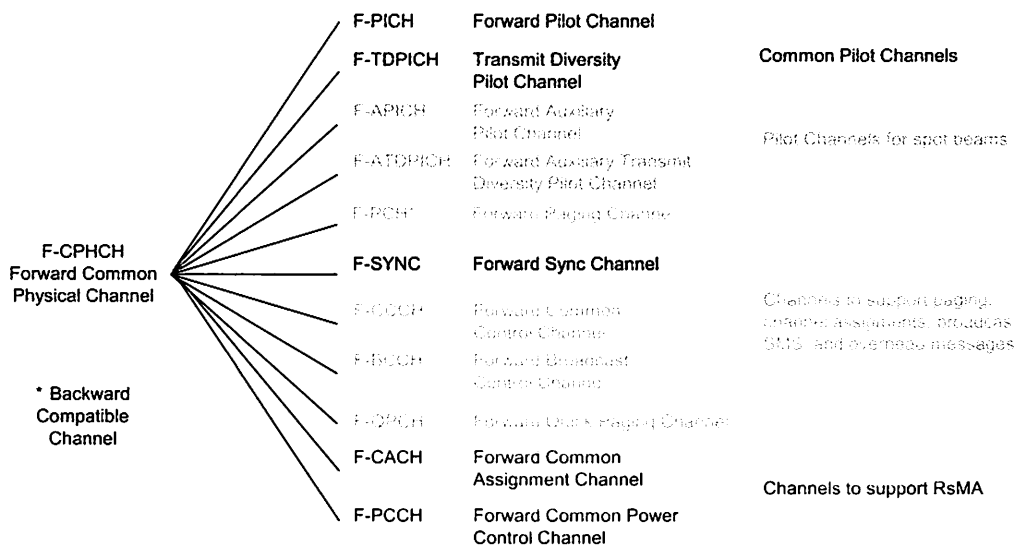|		
F-PICH	Forward Pilot Channel	
F-TDPICH	Transmit Diversity Pilot Channel	Common Pilot Channels
F-APICH	Forward Auxiliary Pilot Channel	
F-ATDPICH	Forward Auxiliary Transmit Diversity Pilot Channel	Pilot Channels for spot beams
F-PCH*	Forward Paging Channel	
F-SYNC	Forward Sync Channel	
F-CCCH	Forward Common Control Channel	Channels to support paging,
F-BCCH	Forward Broadcast Control Channel	channel assignments, broadcast SMS, and overhead messages
F-CPCCH	Forward Common Power Channel	
F-CACH	Forward Common Assignment Channel	
F-PCCH	Forward Common Power Control Channel	Channels to support RsMA

Figure 4 cdma2000 Forward Common Channels

ing paged. The amount of wakeup time depends upon channel loading and implementation, but is around 80 ms. The frequency of the wakeup is given by the slot cycle, which is 1.28×2^N seconds where N is a non-negative integer. The Quick Paging Channel (F-QPCH) consists of one-bit indicators [18]. The MS monitors two indicators; if the MS detects that the first indicator is set, the MS checks the second indicator. If it is also set, then the MS monitors the Paging Channel (F-PCH) for pages during its normal paging slot. Figure 6 illustrates the F-QPCH. The actual F-QPCH transmission is about 100 μs in duration, the actual time that the MS is awake is somewhat longer as time is needed for the receiver to stabilize and to obtain data for channel estimation. Since all BS are synchronized, a MS can obtain sufficient information during its wakeup to process the indicator bits from all surrounding base stations. If the MS has moved into the coverage area of another BS since it last woke up, then the MS can determine which is the stronger BS and can determine whether the indicator bit was set by the stronger BS.

Revision A of cdma2000 [19-23] introduced a new set of common channels. With the TIA/EIA-95 common channels, all overhead information is carried on the F-PCH; with the new cdma2000 common channels, the same overhead information is carried on the Broadcast Control Channel (F-BCCH). The F-BCCH also carries broadcast short messages. The remaining information carried on the F-PCH (pages and messages directed to a specific MS) is carried on the Forward Common Control Channel (F-CCCH). This splitting allows the F-BCCH

and F-CCCH to be optimized for their respective uses, to reduce delay, to reduce the amount of required overhead power, and to enhance reliability. cdma2000 Revision A added two new reverse common channels, the Reverse Enhanced Access Channel (R-EACH) and the Reverse Common Control Channel (R-CCCH). These two channels support two operating modes: Basic Access (BA) and Reservation Access (RsMA). Basic Access uses only the R-EACH and permits the simple transmission of signaling messages from the MS to the BS. RsMA uses the R-EACH, R-CCCH, F-CACH, and F-CPCCH, where the F-CACH is used for fast R-CCCH assignment and the F-CPCCH is used to power control the R-CCCH. Both modes reduce delay; RsMA provides for enhanced reverse common channel reliability, increased message lengths, and power control.

CDMA2000 1X performance enhancements

The modulation and coding structure of the cdma2000 forward link is quite similar to TIA/EIA-95; however, the following enhancements improve the forward link capacity over TIA/EIA-95:
- ✦ Fast forward link 800 Hz power control
- ✦ Transmit diversity (Space Time Spreading)

R-CPHCH
Reverse Common
Physical Channel

R-ACH*	Reverse Access Channel	
F-SYNC	Reverse Enhanced Access Channel	
R-CCCH	Reverse Common Control Channel	Channel to support RsMA
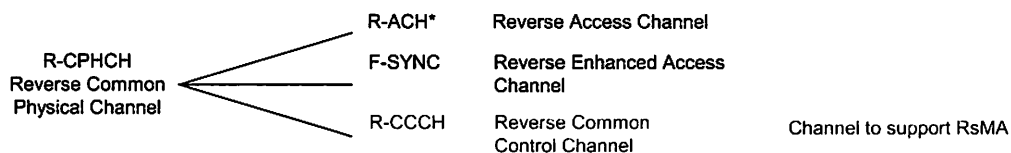
Figure 5 cdma2000 Reverse Common Channels

Quick Page Indications   Assigned Paging Pre-Slot
Assigned Paging Slot

Base station
the MS is
monitoring

Time aligned

Neighbor
Base station

← 80 ms →

← Paging slot cycle period $(1.28 \times 2^N$ sec) →
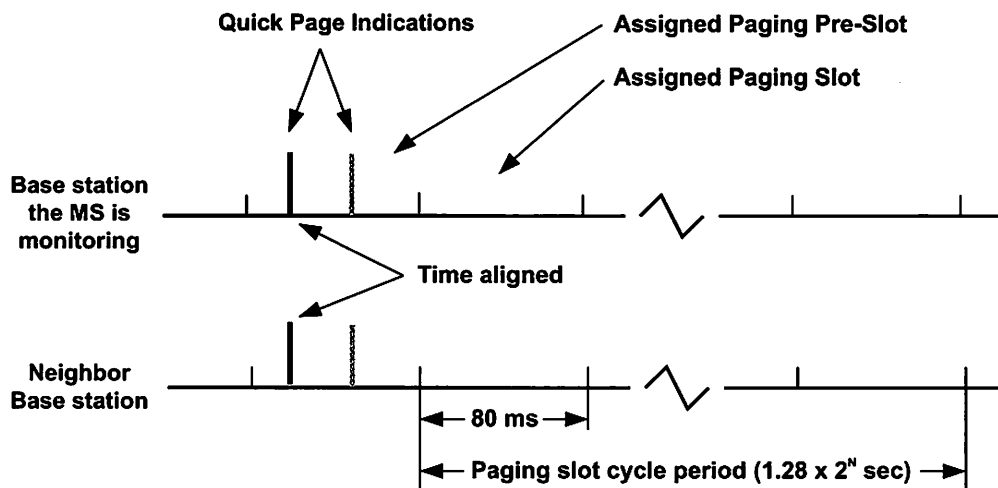
Figure 6 Quick Paging Channel

Figure 7 Traffic Channel Performance Enhancements

♦ Choice of a rate ¼ or rate ½ error correcting coding
♦ Turbo coding
♦ Independent soft handoff for the F-SCH

Figure 7 shows the performance of cdma2000 1X as a function of MS speed for radio configuration 3 (radio configuration 3 uses rate ¼ error correcting coding). The E$_c$/I$_{or}$ is the average fraction of the BS power (in dB) that is required to support the channel. Three cdma2000 curves are shown: with the basic 800 Hz fast forward power control, with a slower 50 Hz power control, and with Space Time Spreading (STS) transmit diversity using 800 Hz power control. The performance of the existing TIA/EIA-95 radio configuration 1, which uses a rate ½ convolutional code, is also plotted. Some cdma2000 performance gain is obtained by using a lower rate ¼ convolutional code. The remaining performance gain is obtained by faster forward link power control. With TIA/EIA-95 radio configuration 1, the power control is relatively slow, based upon messaging between the MS and BS. With TIA/EIA-95 radio configuration 2, a 50 Hz power control is use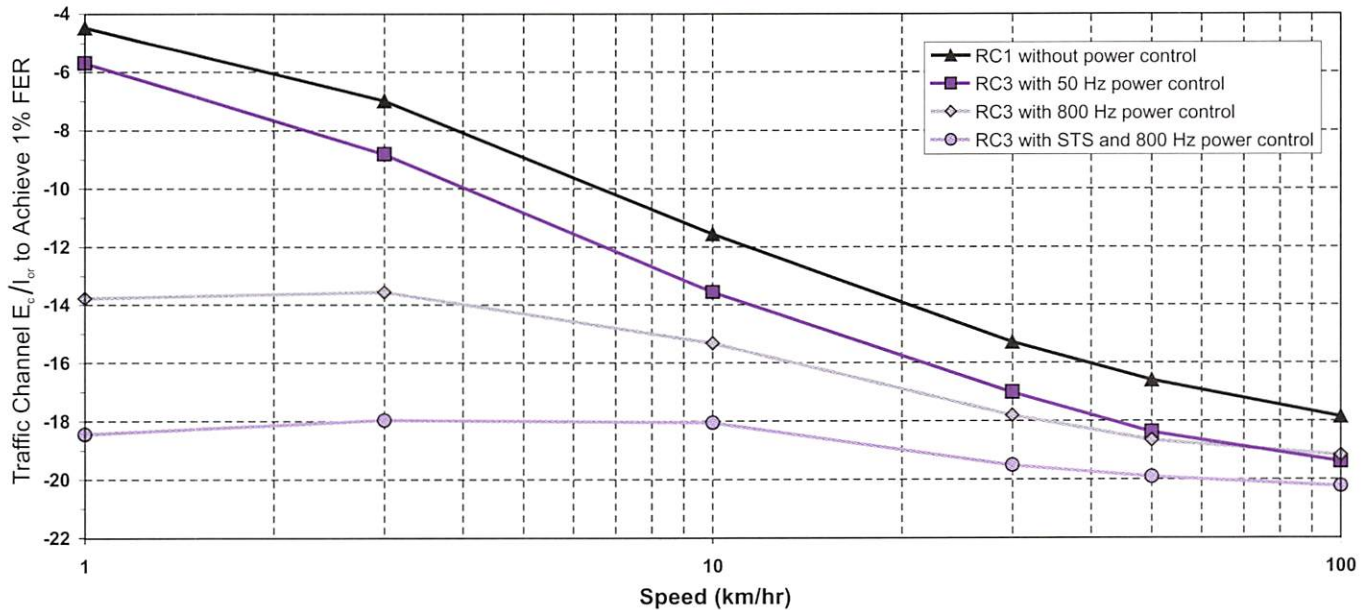d. This power control can follow shadowing. At low speeds, the cdma2000 800 Hz power control provides substantial gain as it is possible to track fading. STS transmit diversity provides spatial diversity by repeating the modulation symbols on two antennas in a way that the transmitted signals from the antennas are orthogonal and don't require additional Walsh functions. STS provides additional performance enhancements, particularly at low speeds. The simulation results in Figure 7 are with 1-path Rayleigh fading and with independent paths for STS.

In order to better ascertain the performance gains of cdma2000 over TIA/EIA-95, a number of tests were run on a small cdma2000 system in San Diego. Figure 8 shows the forward link gain (relative to the pilot) for both TIA/EIA-95 radio configuration 1 and cdma2000 radio configuration 3 without using transmit diversity. Since the BS output power with 800 Hz power control varies very rapidly, a smoothed version of the BS gain is shown for radio configuration 3. The reduction in traffic channel gain for radio configuration 3 is clearly seen by comparing
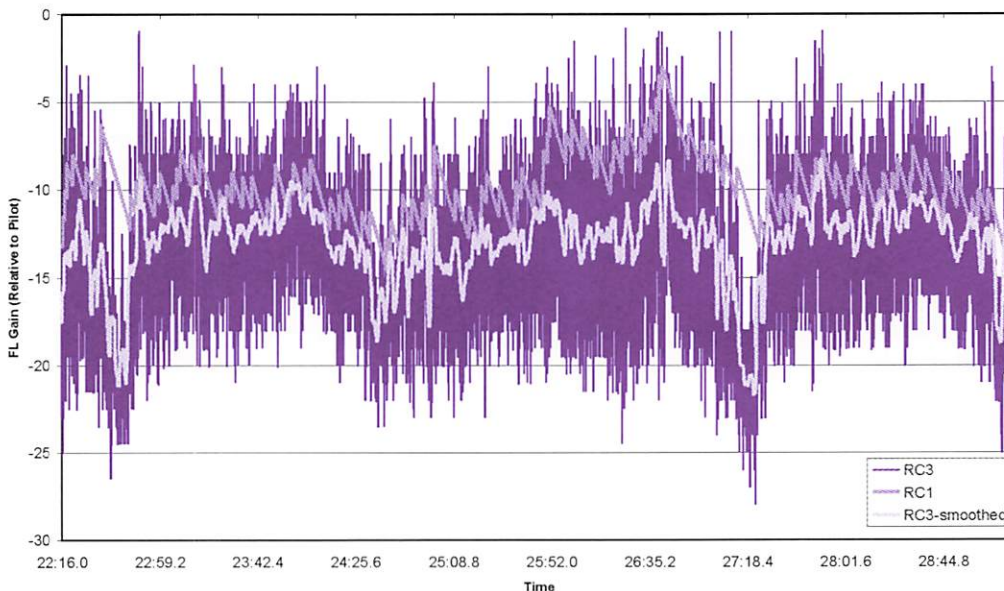

Figure 8 Forward Traffic Channel Gain

with the gain needed for radio configuration 1. Over a number of runs, it was found that the average reduction in traffic channel gain for a test van driving at about 5 mph was 2.9 dB, for 30 mph about 2.0 dB, and for 60 mph, about 1.4 dB. Due to the time varying propagation conditions in the field, comparisons between field results and lab or simulation results are quite difficult. Nevertheless, there is relatively good correlation between gain differences shown in Figure 7.

Figure 9 Using Beacon Cells with a Wedding Cake Buildout

The cdma2000 reverse link changed considerably from TIA/EIA-95, primarily by using coherent modulation and code multiplexing different channels. This made for cleaner integration and better performance for higher rate services. The details of the cdma2000 reverse link design are beyond the scope of this paper [6].

Handoffs

Handoff Between Modes

Since the cdma2000 1X and 3X protocols are identical and are an extension of TIA/EIA-95, services can be handed off between cdma2000 1X, cdma2000 3X, and TIA/EIA-95 without disruption provided that the appropriate data rate is supported. If the MS moves beyond the coverage of a CDMA system, a voice service can be handed off to analog.

Soft Handoff within the Same Mode

The normal handoff case is within the same mode and on the same frequency. In this case normal soft handoff is used. The soft handoff procedure has not been modified for cdma2000; however, many networks are seeing the TIA/EIA-95-B handoff algorithm being commercially deployed for the first time. The original handoff procedure [15] has the MS report when a ne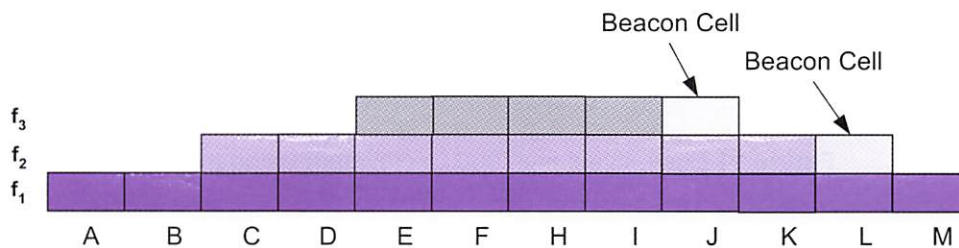ighbor signal is greater than a threshold. Upon the report, the identified neighbor was typically added to the soft handoff set—called the active set—which is the set of base stations transmitting to the MS. The TIA/EIA-95-B handoff algorithm [24] has the MS report when a neighbor signal is determined to improve performance by more than a certain amount. Typically when there are already strong base stations in the active set, a weak BS, which would not enhance performance, is not added to the active set. As a result, the resource requirements to support soft handoff are reduced.

Inter-frequency Handoffs

Most handoffs in CDMA are soft handoffs on the same frequency. However, it is sometime necessary to perform a handoff between frequencies. There are several reasons for performing these types of handoffs including leveling the load between frequencies, handling the case when a MS reaches the edge of coverage for a particular frequency, handling transitions between cdma2000 and TIA/EIA-95 when different carriers are used, and transitioning between overlay and underlay cells when hierarchical cell structures are used. These handoffs are called hard handoffs because they result in a short disconnection of the traffic channel. At any time, the MS can be directed to perform an inter-frequency handoff by the BS sending the *Universal Handoff Direction Message*. However, the keys to a successful hard handoff are knowing when to perform the handoff and what is the active set on the new frequency (the active set is the set of BSs that should be transmitting to the MS). In many cases, particularly when the cell coverage on the new frequency is nearly the same or greater than the cell coverage on the serving frequency, no specific RF environment information is needed about the new frequency. In this case the BS can just send the *Universal Handoff Direction Message*. This process is illustrated in Figure 9 using a "wedding cake" buildout. In a wedding cake buildout, a MS must be handed down to a different frequency when it reaches edge of a particular layer of the cake. For example, if the MS is using frequency f_2 and has an active set consisting of cell C, then the BS can hand the MS off to frequency f_1. With this arrangement, cell C on frequency f_2 is typically not heavily loaded—the MS being in cell C is an indication that a handoff is needed to frequency f_1.
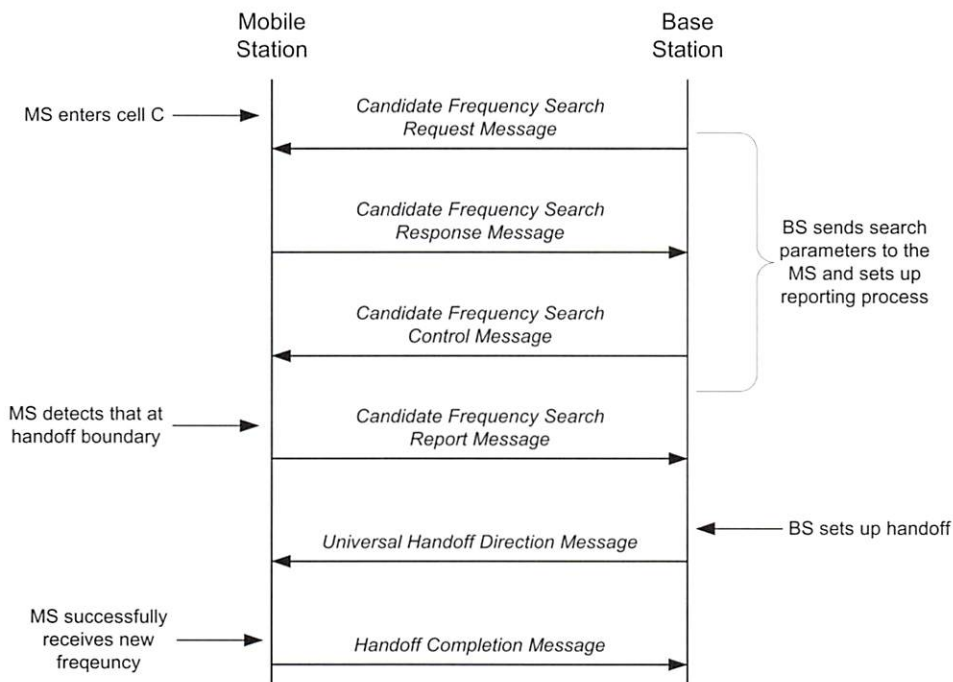

Figure 10 Interfrequency Search Procedure with Handoff

cdma2000 cells
(with TIA/EIA-95 support)   TIA-EIA-95 only cells

f₁ (TIA/EIA-95)
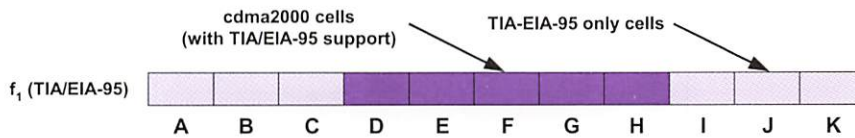
A   B   C   D   E   F   G   H   I   J   K

Figure 11 Illustrative cdma2000 Deployment Using the Same Frequency for cdma2000

The coverage of cell C on frequency f_2 can also be different than the coverage of cell C on f_1. As a result, it is sometimes difficult to accurately determine the active set that should be used. There are a number of techniques that have been used to more fully load Cell C and relatively accurately determine the active set; however, these are beyond the scope of this paper. To overcome these problems, beacon cells, which are base stations transmitting just the Pilot Channel, can be used. For example, consider a hand down scenario from frequency f_2 where the MS is in cell K. When it detects and reports the beacon cell L, then the MS can be handed down to frequency f_1.

A candidate frequency measurement procedure was added to the TIA/EIA-95-B standard. Since most networks did not upgrade to TIA/EIA-95-B, this feature is being commercially deployed as part of cdma2000. Figure 10 shows the signaling for candidate frequency searching followed by a handoff. In the *Candidate Frequency Search Request Message*, the BS provides the candidate frequencies on which to search, the identities of the neighbor cells, a number of thresholds that govern when the MS should search on the candidate frequency, and a number of thresholds that govern when the MS should report back to the BS. In the hand down scenario in Figure 9 from frequency f_2 to frequency f_1, the serving frequency is f_2 and the candidate frequency is f_1. The BS could send the *Candidate Frequency Search Request Message* when the MS enters a boundary cell (e.g., cell C in Figure 9). Typically when the received signal power or total E_c/I_0 on the serving frequency drops below some threshold, the MS would then search on frequency f_1. If the MS determines that the signal quality on f_1 is better than f_2, then the MS would report this to the BS along with the appropriate active set to be used on frequency f_1 using the *Candidate Frequency Search Report Message*. The BS would then typically send the *Universal Handoff Direction Message* directing the MS to use frequency f_1.

Deployment scenarios

cdma2000 leverages the designs of TIA/EIA-95 products. Since the receiver and transmitter characteristics are virtually identical to TIA/EIA-95, most existing TIA/EIA-95 MS designs can be readily modified to support cdma2000 by changing the modem ASIC and upgrading the software. Similarly, many existing Base Transceiver Systems (BTS) designs can be upgraded to cdma2000 by replacing channel cards and upgrading software. However, the higher capacities and data rates of cdma2000 may require some enhancement of the backhaul between the BSC and BTS.

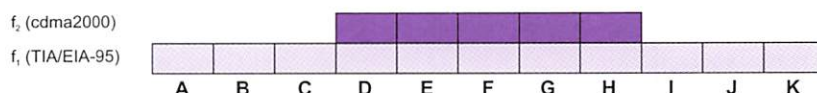cdma2000 smoothly integrates operationally with existing TIA/EIA-95 networks. An operator needing additional capacity in an area can deploy cdma2000 on a separate frequency or on the same frequency as existing TIA/EIA-95 base stations. A typical BTS can have some frequencies supporting the TIA/EIA-95 physical layer configurations, some supporting cdma2000 physical layer configurations, and some supporting both cdma2000 and TIA/EIA-95 physical layer configurations. The cdma2000 signaling protocol is a superset of the TIA/EIA-95 signaling protocol and does not require that the cdma2000 physical layer configurations be used. Thus, a frequency supporting TIA/EIA-95 can either operate using the older TIA/EIA-95 protocol or can operate using the cdma2000 protocol. As a result, a cdma2000 MS using a frequency only supporting the TIA/EIA-95 physical layer configurations can obtain many of the cdma2000 capabilities.

Figure 11 illustrates a single frequency cdma2000 deployment where cdma2000 cells replace TIA/EIA-95 cells in a portion of the network. In this case, the cdma2000 cells support full TIA/EIA-95 capabilities so that existing mobile stations can obtain service. A TIA/EIA-95 MS beginning a call using a TIA/EIA-95 cell will maintain the same channel arrangement as it moves into a cdma2000 cell. A cdma2000 MS can be handed off from TIA/EIA-95 capabilities to cdma2000 capabilities when it enters a cell supporting cdma2000. However, this is not necessary as the MS can be maintained using the TIA/EIA-95 capabilities with no loss in services. A cdma2000 MS that begins a call in a region that supports cdma2000 can be established with either cdma2000 capabilities or TIA/EIA-95 capabilities. If the call is established with cdma2000 capabilities, then the MS needs to be handed off to TIA/EIA-95 capabilities when it encounters a TIA/EIA-95 only BS. The handoff process is straightforward. The MS detects the pilot of the TIA/EIA-95 only BS and sends an indication of detecting this pilot. The infrastructure determines that this is a TIA/EIA-95 only BS and then hands the MS from the cdma2000 mode to the TIA/EIA-95 mode. To avoid the overhead of two sets of common channels, the cdma2000 base stations will use the TIA/EIA-95 Paging and Access Channels for the common channels.

Figure 12 illustrates a dual frequency cdma2000 deployment where cdma2000 cells are added as a second frequency, f_2. A number of different common channel arrangements are possible:

✦ All MSs can use the TIA/EIA-95 Paging and Access Channels channels on f_1.

✦ cdma2000 MSs can be directed to use the common channels on f_2 with TIA/EIA-95 MSs using the common channels on f_1. In this case, either the new common channels or the TIA/EIA-95 Paging and Access Channels can be used on f_2.

✦ Both cdma2000 and TIA/EIA-95 MSs are uniformly distributed between f_1 and f_2. In this case, the TIA/EIA-95 Paging and Access Channels must be used on both frequencies.

In a region where cdma2000 cells exist, a TIA/EIA-95 MS will typically begin a call using f_1 and a cdma2000 MS will begin a call using f_2. However, a cdma2000 call can also be established on f_1 to

f₂ (cdma2000)

f₁ (TIA/EIA-95)

A   B   C   D   E   F   G   H   I   J   K

Figure 12 Illustrative cdma2000 Deployment using a Separate Frequency for cdma2000

level the load across channels. The handoff procedures between f₁ and f₂ are the interfrequency handoff procedures previously described.

Services

Voice Services

The cdma2000 system uses the same speech codecs as TIA/EIA-95. All of the speech codecs are variable rate in that they vary their transmission rate based upon the voice activity of the speaker. In North America, the TIA/EIA-733 high rate speech codec, also called the 13 kbps codec or QCELP13 has been widely deployed. It has a maximum rate of 13 kbps and provides voice quality equivalent to wireline phone service. The TIA/EIA/IS-125 Enhanced Variable Rate Codec (EVRC) has a maximum rate of about 8.5 kbps and replaced the original TIA/EIA-96 speech codec. Almost all 800 MHz systems in Asia are using the EVRC. It is gradually seeing greater deployment in North America. The standards for a new 8 kbps codec, called the Smart Multi-Rate Vocoder (SMV) have recently been completed [25]. The SMV provides higher quality than the EVRC in its normal mode of operation. It has been specifically designed to provide high speech quality in reduced rate modes of operation—it can provide approximately the same voice quality as the EVRC with about 65% of the forward link loading—resulting in considerably more system capacity.

Data Services

TIA/EIA-95 data services that are commercially deployed include pure circuit services, a hybrid circuit/packet method called Quick Net Connect (QNC), and pure packet services. These provide connection to the Internet, WAP networks, and private networks. Short Message Services (SMS) are also provided. cdma2000 enhances these services by providing higher data rates, greater capacity, and less delay. The air interface protocol modifications are primarily to support higher rates [26]. Data mobility is being provided using mobile-IP [27].

Position Location Services

In 1996, the United States Federal Communications Commission (FCC) started regulatory actions to provide the location of an MS making a 911 call to a Public Service Access Point (PSAP). Phase 1 required that the telephone callback number of the MS and the cell and sector serving the MS be provided [28]. The more stringent Phase 2 requirements require a 100 meter accuracy for 67% of the calls and 300 meter accuracy for 95% of the calls when using network-based methods, and 50 meter accuracy for 67% of the calls and 150 meter accuracy for 95% of the calls when using handset based methods [29]. In addition to the deployment of position location to meet United States Automatic Location Identification (ALI) legal requirements, several wireless operators are deploying position location to provide value added services

Network-based methods typically measure the received signal at multiple cell sites to determine the Angle Of Arrival (AOA), the Time Of Arrival (TOA), or both. Network-based methods typically require a considerable investment in special infrastructure hardware and have availability and accuracy problems due to coverage limitations and multipath. Handset-based solutions require some form of handset changes. Advanced Forward Link Trilateration (AFLT) requires an upgrade to the MS so that it can search for weaker Pilot Channels (F-PICH) than would be used for communication. It has similar accuracy limitations as network based methods.

As a result, the CDMA industry is moving to a handset-based method using the Global Positioning System (GPS), called gpsOne™ by some. With this handset-based technique, a simplified GPS receiver is placed in the MS. Since GPS typically requires a long time for the initial location fix, a method called Assisted GPS (AGPS) is being used. AGPS relies on a location server, called the Position Determining Entity (PDE), to provide acquisition assistance information to the MS [30]. This provides information on the expected satellites to be received, their timing relative to CDMA timing, Doppler frequencies, and the GPS Navigation Message bits being broadcast by the GPS satellites. This information allows the MS to acquire the GPS satellites in very weak signal conditions. The MS either provides the estimated latitude and longitude (and optionally height) of the MS or provides pseudorange information back to the PDE for further processing into latitude, longitude, and height. Still, there are locations (such as the interior of a building) where the signals are not strong enough from a sufficient number of GPS satellites to obtain a location fix. Since the CDMA system has path delay estimates from the MS to surrounding base stations; this data can be fused with the GPS satellite information to obtain the location of the MS a greater percentage of the time.

Encryption

After many years of work and public scrutiny by cryptographers, United States National Institute of Standards and Technology (NIST) selected the Rijndael algorithm as the Advanced Encryption Standard (AES) [31]. It was recently decided to use this standard to encrypt cdma2000 air interface information.

Summary

cdma2000 is a high performance third generation wireless system that builds upon the highly successful TIA/EIA-95 system. cdma2000 provides twice the voice capacity of TIA/EIA-95 and provides significantly enhanced capacity and higher rates for data services. The forward link structure of cdma2000 is compatible with TIA/EIA-95, thus permitting a single frequency to support both TIA/EIA-95 mobiles and cdma2000 mobiles. While these and many other compatible aspects provide a graceful transition path for cdmaOne operators to third generation systems, cdma2000 can also be deployed as a totally new third generation system. Finally, the author would like to thank the thousands of people throughout the industry who have brought about the successful commercial deployment of cdma2000.

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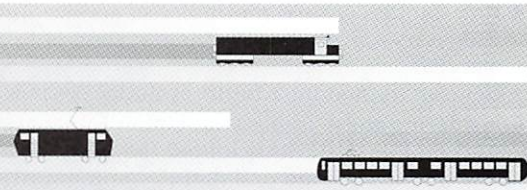
The Evolution of GSM-R
The New European Wireless Standard for Railways

Robert Sarfati, SYSTRA Group

In 1993, the UIC decided to use GSM as a basis for a standardised radio communication system for railways within Europe, GSM-R. Robert Sarfati of SYSTRA, Project Manager of the MORANE project, which was set up in order to conduct trails on the system, discusses the standard and its motivation.

Introduction

The European railways and the Telecommunications industry have developed a new generation digital radio communication system based on GSM, called GSM-R. This new European standard offers an alternative to existing PMR/PAMR networks in the transportation domain. GSM-R is rapidly being deployed as the railway communications system of choice across Europe.
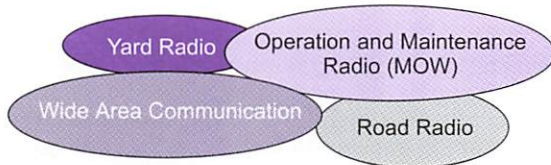
Figure 1 Prevailing situation

In July news reports, Deutsche Bahn joined the list, contracting to replace its analogue telecommunications system with a GSM-R network for railway operations in Germany. The new integrated system will be used for train, vehicle, switching, operations, and maintenance communications. This range of functions is a hallmark of the GSM-R technology.

GSM-R has already entered commercial service in Sweden for Banverket operations (5,000 miles). It is soon to enter operational service in European countries including Germany (20,000 miles), the Netherlands (2500 miles), Spain, Switzerland, UK, Italy, Finland, Belgium and France. Currently, it is being considered for introduction by Indian Railways, Burlington Northern Santa Fe in the US and several countries in Eastern Europe (Czech Republic, Hungary, Baltic countries, Slovenia, and Russia).

The GSM-R, which relies on the GSM world wide standard for mobile communications, integrates all existing mobile radio services for Railways as well as all transport and mass transit services. It offers all the basic features for an alternative to existing analogue as well as digital PMR/PAMR radio systems.

The Drivers for Evolution

European railways are major users of mobile radio systems. They use radio for a wide range of services, such as road radio communication, operation and maintenance, yard communications, and passenger information (see Figure 1). Current systems vary throughout Europe, with different frequencies and technologies employed for different applications even within a single country. Most in service equipment is based on analogue technology and has exceeded its product life cycle.

Railways faced the following questions:
+ Which digital radio system should be used to replace ageing analogue radio systems currently in use?
+ What technological solution will support the needs of our border crossing traffic to co-ordinate with other systems?

Figure 2 Users requirements

♦ How can we ensure continuity of service and respect budgetary constraints if a new system is to be implemented?

♦ How can we guarantee future evolution of a new system?

Considering these issues, the Union Internationale des Chemins de Fer (UIC) anticipated the need for a common wireless frequency band and digital communications standard for border crossing rail traffic. The UIC conducted a detailed technical and economical survey of digital technologies, and in 1993 decided to base the new system on G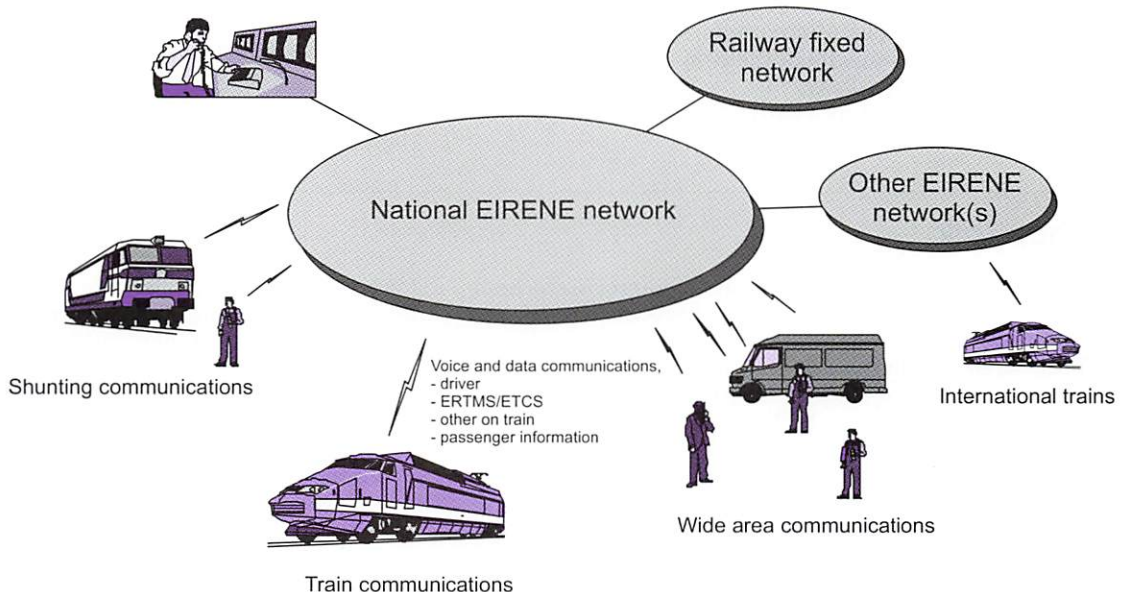SM (Global System for Mobile Communications). This would ensure that railways could participate in the evolution of the public standard to include their specific needs. In addition, they might benefit from the economy of scale of the existing public market for the cost of their equipment.

The Standardisation Work

The decision to choose an open standard had some drawbacks as not all specific requirements were covered by the GSM. Enhancements for special needs where necessary which were researched and defined by the UIC's **E**uropean **I**ntegrated **R**adio **E**nhanced **NE**twork (EIRENE) Project. Figure 2 shows an overview of Users' requirements.

The GSM system had to be modified to meet several types of requirements specific to railways:

♦ Those arising from railway operational needs such as special addressing facilities, numbering schemes and Man Machine Interface.

♦ Those related to railways telecommunications needs such as broadcast and group calls, fast call set up associated with priority and preemption mechanism.

♦ Those related to the Train Control ERTMS (European Rail Traffic Management System) application.

In 1995 UIC decided to establish a project to set up tests of the new system. Three railways, Societe Nationale des Chemins de Fer (France), Deutsche Bahn (Germany) and Firenze SMN (Italy), set up the Consortium MORANE (**Mo**bile Radio for **Ra**ilway **N**etworks in **E**urope) to conduct the trials. The overall aim of the project was to specify, develop, test and validate the new GSM-R (GSM for Railways) system.

In particular the MORANE Project was intended to:

♦ Provide specifications for the new functionalities, the interfaces and the system tests.

♦ Develop prototypes of the radio system (mobile and fixed part) and implement them on 3 trial sites in Germany, France and Italy.

♦ Validate the prototypes with reference to the specifications and the user requirements.

Countries with commercial projects:
Sweden, Germany, Netherlands, UK, Italy, Spain

Countries preparing RFI/Q:
Finland, Belgium, Switzerland, France, Norway

Countries pending:
Denmark, Austria

Countries with an interest:
Poland, Czech Republic, Romania, Hungary, Ireland, USA, China, Russia, Slovenia
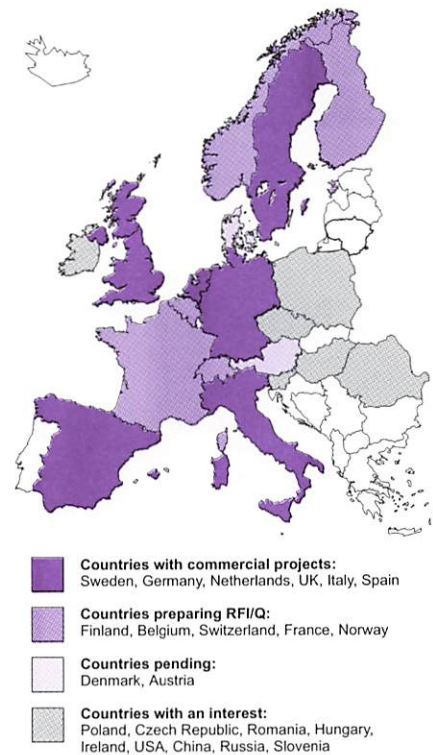
Figure 3 Implementation status

♦ Investigate the performance of existing GSM and new GSM-R standards under railway specific conditions.

♦ Contribute on a high level to the standardisation for the future European Radio System for Railways.

In order to provide the specifications and the related prototypes, major suppliers for GSM and for railway equipment were asked to join the project. Responsibilities were divided within the industry with respect to the different subsystems which have been identified for the new system. Research companies were included so that independent test definition and evaluation was ensured.

The initial tasks performed were at first design specifications, system and equipment validation. Documents were elaborated to allow validation of the actual development results against the performance expected by the users.

The basic assumption for the development work was to use the standard GSM technology. The aim was to stay as close

Shop Talk

GSM is very flexible and tolerant of improving technology and is a good hedge against obsolescence. The defining feature of GSM is the manner in which the network handles wireless information, not any given technology. A common misconception is that GSM is equivalent to TDMA radio technology. While current GSM deployments use TDMA, it is not required. The entire network could be either built on or converted to CDMA as that technology expands. In short, buying into GSM does not lock you into a single vendor and works to assure a lasting investment.

An interesting feature of GSM is the SIM chip; a chip that carries the unit's "personality" such as telephone number, access level, etc. SIM chips have useful features for transit operations because the chip could be placed into a vehicle's radio by an operator to orient the vehicle's network to its assignment (such as train number, route and block, etc.) for the day. If reassignment is desired the next day, the chip could simply be placed in another vehicle. GSM also has an inherent data capacity useful for many IT applications such as AVL, fare collection and vehicle health and welfare monitoring.

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Assistant Vice President, Communications Group
SYSTRA Consulting, Inc.

as possible within the standard evolution path of GSM in order to avoid specialised solutions for railways. The EIRENE project had already identified some basic telecommunication features which they passed on to European Telecommunications Standard Institute (ETSI) for standardisation.

A further assumption for the specifications and developments for the MORANE prototypes was to base them on standard services already defined in GSM or on enhancements which could become open European Standards.

The infrastructure for trial sites was equipped with GSM-R equipment in order to:

- ✦ Evaluate the ability of the GSM-R system to operate in a railway environment,
- ✦ Enhance this GSM based system in order to meet the railways' user needs,
- ✦ Validate and demonstrate to a large set of users the capability of the enhanced system to answer railways radio communication needs.

The project started in 1996 and was successfully finalised in 2000 with the approval of the new system by the Users.

Implementation Status

In June 1997, 32 Railways signed a Memorandum of Understanding (MoU) stating their support to GSM-R for all their radio communications. In June 2000, 17 Railways signed an Agreement on Implementation (AoI) stating their intention to start planning the implementation no later than 2001 and to begin GSM-R implementation and to allow interoperability of rolling stock at the European scale by 2003 at the latest. The current status of implementation is given in the Figure 3.

GSM-R Characteristics

GSM-R is based on the GSM standard technology. It provides additional features customised for railway applications, which could also be adopted by mass transit, such as functional addressing and location dependent addressing. Fast call set up allows allow rapid and secure access to the network for high priority calls. A Pre-emption feature segregates low priority calls in case of network congestion situation. Advanced Speech Call Items (ASCI) features allowing voice broadcast and voice group calls, call priority are also included.

GSM-R offers service improvement in communications by providing a single integrated mobile communication system for both voice and data. Improvements over existing systems include improved voice communications, the addition of data communications, and cost reduction by eliminating the need for multiple systems. Many legacy systems in place require multiple systems, each dedicated to a single function which cannot interact. With GSM-R, Track-to-Train Radio, Operation and Maintenance Radio as well as Vehicle Radio are available on a integrated and standardised platform. This offers uniform and combined operating as well as inter-service applications.

GSM-R is capable of high performance data transmission while mobile at speeds up to 500 km/hr. This provides a direct train-to-wayside data communication path for all categories of railway information technology applications. State-of-the-art IT systems for passenger information, reservations, on-board ticketing, diagnostics and so forth are therefore possible.

GSM-R benefits from the continuing evolution of the GSM standard. This includes the General Packet Radio Service (GPRS) which would allow efficient operational services such as logistics, access of railway staff to data bases through intranet, time scheduling and tariffs, automatic seat reservation, telematic applications for rolling stock maintenance, optimised freight load management as well as development of other on-board applications for passengers services such as ticketing and on-line information via internet.

In Europe, a common frequency range is used in all GSM-R networks to achieve international interoperability. For roaming considerations with existing public GSM networks, terminal equipment operate within the full 900 MHz frequency range. The system allows manual as well as automatic switching from and to the public GSM range and the UIC frequency range.

The GSM-R allows scalability when several small to medium agencies would like to share the same Mobile switching centre and benefit from the overall system features. In addition, SIM cards usage allow flexible differentiation of rights among groups of Users. The customisation of the services offered can be determined by the users. A Location dependent feature allows geographic segregation when several dispatch areas are implemented in the operational network.

GSM-R Economic Aspects

GSM-R offers to transport organisations an end to end solutions for their radio communication networks. It allows digital communication for voice and data.

Road radio, Yard radio, Operation and Maintenance radio as well as vehicle radio are now available on an integrated and standardised platform able to evolve with the user's needs. The system is able to perform all the existing day to day operations of today's analogue radios and offer a platform for evolution. It offers single or combined operation, as well as well as inter agency operation possibilities.

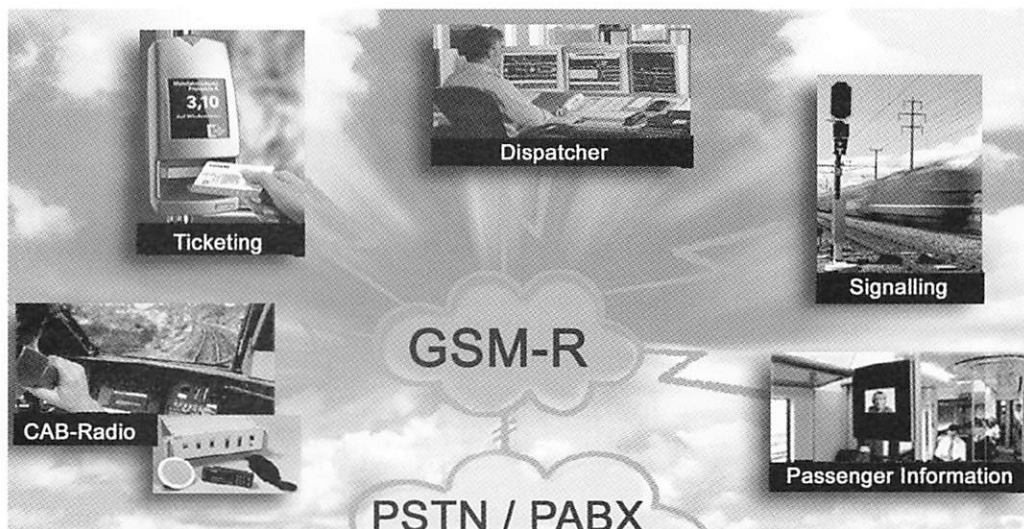Once GSM-R is implemented for a system, the high performance data transmission it provides

Figure 4 GSM-R Applications

will allow new applications to be added on the existing system, such as IT systems for passenger information, on-board ticketing, diagnostics, maintenance and so forth as they are needed.

Introduction of GSM-R offers most railroad organisations:

+ Reduction of operating costs
+ Reduction of maintenance costs (reduced spare parts and training costs)
+ Increased spectrum efficiency
+ High speed data applications and service differentiation with existing systems
+ Reduced capital expenditure by using standard equipment
+ Increased flexibility of operation by using SIM cards

Conclusion

Railroad organisations aiming at renewing their analogue, costly to maintain equipment, should consider the alternative of using the GSM based standard as the answer to their present and future needs. The GSM-R equipment is developed and available off the shelf from several vendors provided that the frequency range is within the overall GSM 900 frequency range. This system is widely deployed in Europe in the demanding railway environment. This system is able to answer to most of the needs of

UIC | E-GSM | P-GSM
876 880   890   915
Uplink

UIC | E-GSM | P-GSM
921 925 935   960   MHz
Downlink

GSM-R terminals operate in the full frequency range

E-GSM : Public GSM extended band
P-GSM : Public GSM band
UIC: International Railway organization
Railway allocated frequency band in Europe

Figure 5 GSM-R European frequency range

the mass transit sector. The selection of the frequency range for usage in different countries is to be carefully evaluated and SYSTRA can offer their services to help transport organisations in evaluating and optimising their radio communication requirements to select the most appropriate solution and benefit from the most advanced digital technique.

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Speech Processing for Vehicles: What's Next?

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The human voice is and remains the best form of communication. Therefore, spoken language interfaces to computers are a topic that has engaged engineers and speech scientists since the fifties. Once limited to the realm of science fiction, speech technology has now passed the threshold of practicality. The commercial deployment of these systems has already begun, although the applications are still specialized for certain purposes. This paper presents a speech recognition sys-

tem that is particularly suited for drivers and passengers in a vehicle environment. The first chapter is describing a typical system design of today. Tens of thousands of these units are already in use. Thereafter a future system design will be described, in which the voice control of a navigation system is the most challenging problem. Finally the papers shows as an outlook, what comes next after the future. In particular, distributed speech processing systems will be used based on client-server architecture.

Introduction

At several research lab all over the world, researchers and developers have been involved in perfecting voice control for over 30 years. The international breakthrough was achieved in October 1996, launching the very first Voice Control System for cellular phone in the Mercedes Benz S-Class. Now voice recognition is available in Mercedes, BMW and Audi

cars, not only for German but also for US-English, UK-English, Spanish, French, and Italian. Worldwide, tens of thousands of systems have already been sold.

The new released speech processing products are setting a new standard in speech technology. Usually such a system allows the user to control the telephone or audio components in a vehicle by voice without touching any buttons, reducing driver distractions in traffic. More than 95 percent of uttered commands are recognized in normal vehicle use correctly. Combined with intuitive dialog, this performance leads to higher user acceptance. Furthermore, the development of noise reduction and echo cancellation algorithms has led to a significant quality improvement for hands-free phones in vehicles.

In this paper, the speech processing technology will be described in detail. Based on the leading edge technology, it will be shown which kind of vehicle applications can be controlled by voice today. For the future or for the next car generation and with respect to telematics services, the requirements of the car manufacturers continue to grow. Therefore voice control has to consider larger vocabularies. In addition more comfortable, intuitive dialog guidance must be offered to the end user. This paper will show which future technologies are under development to fulfil the expectations of voice control in future vehicles.

But what comes next? As an ultimate solution for telematics off-board services in particular, we describe a distributed speech processing approach. The idea of that approach is to complement the scope of an in-car speech recognizer with a large vocabulary recognizer running on a server using client-server architecture without increasing the overall costs.

System Design of Today

For an integrated communication and audio system in automobiles, a hands-free, far-talking speech dialog system for controlling various components such as telephone, radio, CD player and navigation system was designed and realized. The requirements for such a Voice Recognition Systems are the following:

+ Speaker independence, which means the voice recognition system works for each user independently of his sex or age. Since speaker dependent systems have to be trained by the user uttering each of the words in the vocabulary several times, such systems represent not the convenience, which is requested by the car manufacturer.
+ Besides speaker independence the continuity of spoken input is an important requirement. In particular for dialing a phone number it must be allowed for convenience reasons to speak the number as a connected sequence of digits.
+ The vocabulary has to be based on phone-like units, which allows an easy vocabulary generation for new applications. Based on a set of a few hundreds of speaker independent trained phone-like units each vocabulary word can be represented by a concatenation of the appropriate units rather quickly.
+ The speech recognizer has to work robust, which means a high recognition performance has to be achieved even there is loud driving noise caused by high speed, rain on the roof, running wipers or open windows. Furthermore the speech recognizer must be robust against different distances of the speaker to the head-mounted microphone, against louder or gentle speaker and against spontaneous spoken utterances which are influenced by hesitations and filled pauses.
+ A speech output component is required for verification process of the spoken input as well as for intuitive user
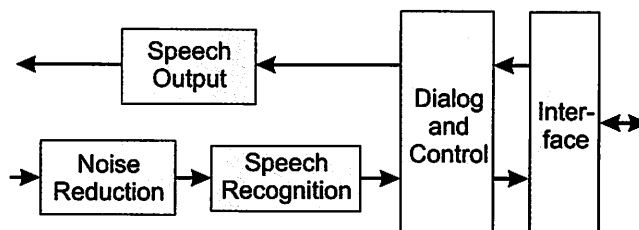

Figure 1 Speech Recognition Architecture

guidance during the dialog. Either a text-to-speech synthesis or pre-recorded speech templates can be used for user guidance.
+ The microphone is mounted on the ceiling near the rearview mirror. As mentioned above, the recognizer must work robust even if the signal-to-noise ratio increases dramatically with the distance of speaker and microphone (approximately 30 to 50 cm).
+ A Push-To-Talk (PTT) button is used for activating the speech recognizer. Key word activating of speech recognizer suffers from the problem that the speech recognizer might be activated although the speaker does not utter the appropriate key word.
+ Despite of the high computational effort requested by the speech recognizer, the waiting time for system response should be no longer than 500 msec.
+ Users simply react to the effectiveness of the dialog, which is realized in the Voice Recognition System. This means that if the dialog system is robust with respect to the environment, the speech recognition module itself can be relatively modest in terms of performance.

Using such a designed Speech Dialog System, the driver can concentrate completely and safely on his driving task while handling the telephone functions by voice or controlling radio and navigation system. With respect to the requirements such a system consists of the modules shown in Figure 1.

The Noise Reduction module eliminates the noise signals from the overall signal before the actual recognition task starts. The Speech Recognition module, which compares a spoken command consisting of a single or several connected words with a list of stored phrases, which are a priori known to the system. The Speech Output module handles the dialog and recognition information. Either voice prompts or synthetic text-to-speech can be used. The Dialog and Control module, which serves as an interface, informs the user about the dialog status and checks if the utterance is consistent with the status of the application.

Possible applications are described in the following:

Telephone Application

Regardless who is speaking, the current system recognizes specified command- and digit-strings. The user can also create a speaker-dependent personal phone directory. He can select his own vocabulary and input, for example, "darling", "Uncle Willie" or "boss" with their respective phone numbers. To place a call, the user only needs to state the name.

A complete dialog structure allows the user to control the phone set exclusively by voice, without having to press buttons. Adding, correcting or deleting names and numbers in the phone directory is also possible by vocal command. Mechanical action is required merely to switch the unit on and off. Light pressure on a lever - the so-called push-to-talk button (PTT) - fitted to the right of the steering column, suffices to put the system into operation.

A Speech Dialog System is able to articulate answers in a relatively short time and at a high quality level. Despite the
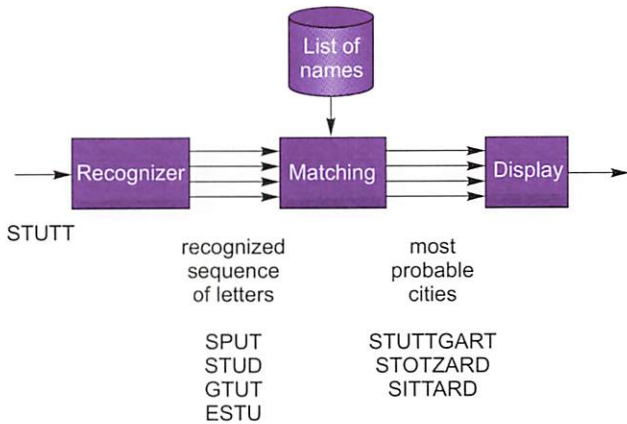
Figure 2 Spelling Mode

recognized
sequence
of letters

most
probable
cities

recognized sequence of letters	most probable cities
SPUT	STUTTGART
STUD	STOTZARD
GTUT	SITTARD
ESTU	

great computing effort that goes into the recognition process, it is possible to reduce reaction time to less than half a second. With a friendly female voice the system asks for input, for example, "the number, please" or repeats the digits before dialing. High quality of the speech output is guaranteed with "coded speech".

The following example shows a typical dialog for entering a phone number:

User: Dial number
System: Please speak the number
User: one two four seven
System: one two four seven
User: oh oh seven
System: zero zero seven
User: dial
System: the number is being dialed

In order to give the user a better control of the numbers entered by voice, the number will be displayed on the radio or instrument panel.

Audio Functionality

Besides the telephone, it is possible to control audio components such as the radio, CD-changer or the tape recorder or even the climate control. The following list shows some typical commands:
+ Next station
+ CD 3
+ Track 7
+ CD 4 track 8
+ Next side
+ Temperature 21 degree
Each audio component can be controlled by voice without touching any buttons.

Noise Reduction and Echo Cancellation

Voice recognition in adverse environment as e.g. in vehicles requires algorithms for reducing or even eliminating noise signals before the recognition task. Especially the large distance between microphone and speaker causes a decrease of acoustic quality. A noise reduction algorithm is realized by the well-known spectral subtraction method, which subtract an estimation of quasi-stationary noise (caused by engines or ventilators) from the estimated clear speech.

Along with sounds from the adverse environment there are signals from the loudspeaker or outputs coming from the dialog output or acoustic echoes caused by the partner on the other side of the phone

line. Those echoes are compensated by an echo cancellation algorithm, which leads to an echo reduction of 35 dB with high speech quality.

The noise reduction approach is not only used for improving the speech recognizer performance but also to enhance the acoustic quality of the hands-free mode. The achieved quality is highly appreciated by the customers. Integrated in a real hands-free set, it was shown that noise reduction achieved a suppression of 12 db while echo cancellation achieved more than 40 dB.

Future System Design

This section describes more sophisticated voice recognition capabilities, which could be available in the next car generation.

Larger Vocabulary

Up to now available speech processing systems suited for vehicles are capable of handling up to 300 different words at one time, which means the number of active words, which can be spoken at one time, are 300. This capability will be extended; thus the speech processing system can handle more than 2,000 words of active vocabulary based on a high recognition performance (more than 95% recognition performance).

Navigation

Unfortunately, 2,000 word active vocabulary is not high enough for offering a voice controlled navigation system which allows entering a destination via voice. For example, in Germany there are more than 50,000 different city names and more than 130,000 different street names which cannot be handled by current state of the art recognizers.

Realizing this limitation, we are developing a new concept where the user can say the larger city names (there are only 1,400 cities with more than 10,000 inhabitants) and where he has to spell all other cities and street names. The spelling procedure is depicted in Figure 2.

For example, the continuous spelling of the first five letters of the German city STUTTGART leads to four different spelling sequences which are similar but not equal to the original spelling. This is due to the fact that some letters are very equal to some other, e.g. "e" is very equal to "t" or "p" and therefore those letters can be mixed against each other. To compensate this effect, these strings are matched against the entire list of possible city names. The most probable city name is shown on a display and has to be confirmed.

The advantages of this approach are: First, the user has to spell only the first letters in a continuous way and secondly, it is allowed to have a failure during the spelling since this will be compensated by the matching. For future
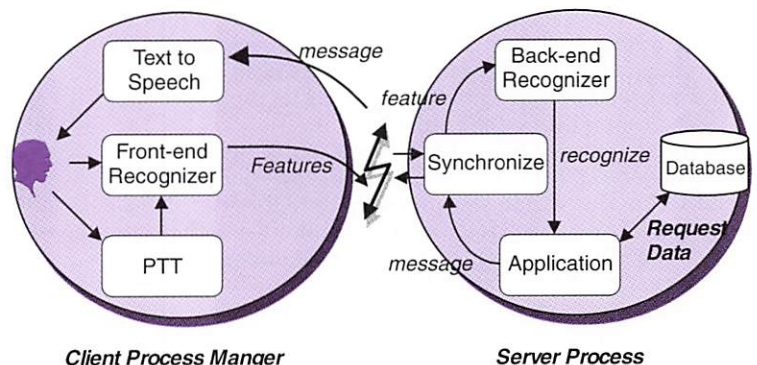

Figure 3 Client-Server Architecture

applications a supplier of speech processing systems has to work together with suppliers of navigation systems to include phonetic transcriptions in the database used by the navigation system. Once this is available, the recognition vocabularies might be generated on the fly. As a consequence, the spelling of a street name might be avoided. After programming the city, the lexicon of all street names can be generated and the user can say the street where he wants to go as one word.

Word Spotting and Natural Dialogs

Word Spotting techniques have to be developed, so the system is able to recognize key words in a naturally spoken sentence. The system looks for partial phrases, ignores embedded and additional, redundant phrases. Thus the driver is allowed to say "I would like to dial a number", even though "I would like to" is not part of the vocabulary.

As a consequence, this functionality is more user-friendly and leads to more natural dialog, which is highly appreciated by the user.

What's Next: Distributed Speech Recognition

Due to cost statements in the automotive industry, a speech recognition system for the vehicle environment has to be as inexpensive as possible. The computational and memory requirements have to be reduced as far as possible. This also means, that we need to have a new speech recognition paradigm for handling large vocabularies with several thousands words so that database requests via voice or dictation applications can be realized in the vehicle environment.

For handling such kind of applications, the idea of our approach is to complement the scope of an in-car speech recognizer with a large vocabulary recognizer running on a server using a client-server architecture without increasing the overall costs.

In this architecture the speech recognition process is split into two parts (Figure 3). The client speech recognizer inside the car performs the preprocessing of the speech signal and computes a digital representation of this signal in which the acoustic car environment is captured. Referring to Figure 1, the speech recognizer is split between the noise reduction and the actual speech recognizer. In terms of speech recognition, this digital representation could be some kind of cepstral features or the result of the vector quantization. Since the computational effort of the feature computation is not very high, the corresponding hardware costs for computing this digital representation are very low. The client sends this digital representation to a server on which a more sophisticated speech recognizer is running. This allows incorporation of applications such as voice based route guidance or voice based information services that require much more computational power and memory.

As a test application we chose the Newsreader where the driver accesses CNN news on the Internet. The driver can choose between different types of news and he can listen to the news while driving. The following is an example of a typical dialog:

Driver: Switch to finance

System: There are seven headlines on finance section. I will read three headlines at a time with pauses in between to let you choose an article. During these pauses you can say "continue" to proceed to the next three headlines.

Driver: Okay.

System: 1. Earning fears upset Dow. 2. Financial sector shakeup. 3. CBS promotes Karmazin.

Driver: Read article 2

System: Washington – A government safety agency said Tuesday ...

Driver: Quit.

Referring to Figure 3 a typical process is the following: The driver has to push a button to start the application. Then the Client-Process Manager creates a TCP/IP connection to a server that has access to the CNN news on the web. The server program listens to a certain TCP/IP port until a connection is created. When this has happened, the server program forks the processes Synchronizer, Recognizer and Dialog and connects all these three process according to figure 3. After this initialization phase, the Dialog Module sends a text message (e.g. greetings like "Welcome to CNN news") to the car via the Synchronizer. The Car Client reads this message and sends it to a Text-To-Speech (TTS). Now the driver has to initiate the next dialog step by pushing the Push-To-Talk (PTT) lever to activate the Front-End Recognizer. Then the driver must speak the information request (e.g. "Read me the headlines in finance"). The Front-End recognizer takes the speech signal and computes a digital representation called the "feature vectors". The car client sends this digital representation to the server. The Synchronizer reads the feature vectors and sends the vectors to the Back-End Recognizer who performs the actual speech recognition. The recognized utterance is passed to the Dialog Module, which controls the dialog. Depending on the recognition result, the Dialog-Module loads the requested news from the CNN news server on the web, edits the message and sends the message via the Synchronizer to the TTS system in the car client which transforms the message in an audio signal.

Now the control turns again to the driver who has to push the PTT lever. He can ask for further news or he can quit the News-Reader Application.

The advantages of our proposed client-server approach are apparent:

♦ Complement the scope of an inexpensive in-car speech recognizer with an expensive large vocabulary recognizer running on a server. The in-car recognizer can be used for command and control applications e.g. for the telephone or the CD player. It doesn't make sense to control such systems via a server since for each command a wireless connection to the server side has to be established.

♦ Generation of a compressed digital representation of an utterance in the car requires only limited system resources.

♦ Since the generation of a digital representation of an utterance includes the speech preprocessing, the noisy car environment can be captured in the preprocessing step.

♦ The back-end speech recognizer is running on a server, which has no limited system resources. Thus, the speech modeling can be as sophisticated as necessary to guarantee a robust recognition even for large vocabularies or spontaneous speech recognition.

♦ The dialog module also runs on the server side, which means that there are no limited system resources, which have to be taken into account for realization of a natural language understanding component.

♦ One has access to an online database that can be updated easily.

Conclusion

Today, speech processing systems are already in use for controlling some functions inside a vehicle. Usually, such a system allows the user to control the telephone and/or audio components in a vehicle by voice without touching any but-

tons. Therefore the driver will not be distracted from the traffic. About 95 percent of uttered commands are recognized correct. Together with the implemented intuitive dialog this performance leads to a high user acceptance. Furthermore, the developed noise reduction and echo cancellation algorithms were leading to a significant improvement of quality of hands-free phones in vehicles.

In future applications for the next model years, speech control for navigation systems will be included. The dialog guidance will be dramatically improved by using natural language understanding techniques based on phrase spotting approaches and parsing technologies.

In a long-term range, speech processing will be processed off-board. Complementing the scope of an in-car speech recognizer with a large vocabulary recognizer running on a server, using a client-server architecture is leading to lower costs and more flexibility, in particular for more complex information services.

For further information please contact Dr. Thomas Kuhn, Soeflinger Strasse 100, 89077 Ulm, Germany, Phone: +49 – 731 3994 107, email: thomas.kuhn@temic.com or Robert Theis, 85 Opdyke Road, Auburn Hills, Michigan 48326, USA, Phone (248) 454 3252, email: robert.theis@temic.com
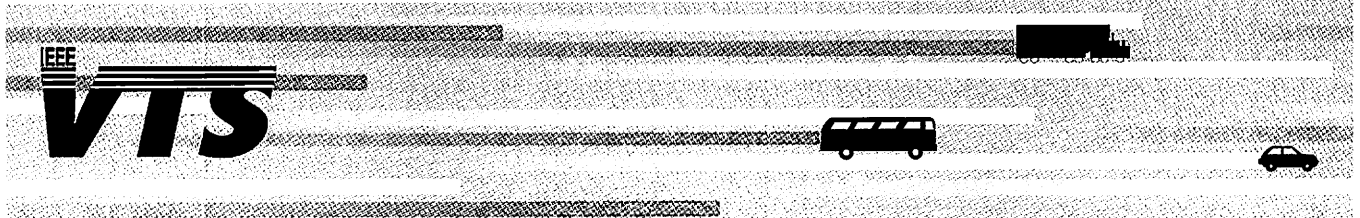
California Fuel Cell Partnership HQ Opening

Don McGrath and Bob Wing

The world's largest assembly to date of fuel cell electric vehicles marked the opening of the California Fuel Cell Partnership new headquarters in West Sacramento. Don McGrath and Bob Wing report on the event and the vehicles on display.

At a ceremony attended by more than 400, the doors to the newly constructed California Fuel Cell Partnership headquarters facility were opened on November 1, 2000. The new 55,000 square-foot facility includes a hydrogen fueling station, offices, work bays for partnership members, and a public gallery with educational exhibits, fuel cell models, and an interactive kiosk. The facility will house more than 50 fuel cell vehicles that will be tested on California's diverse roadways in real world driving conditions. Twenty fuel cell buses will also be demonstrated in regular transit operations.

The California Fuel Cell Partnership was formed in April 1999. The Partnership (www.fuelcellpartnership.org) is intended to promote development and public acceptance of FCV's over the next four years.

Many of the participating partners and associates gave brief presentations before the exhibits opened. Ride and drive opportunities were provided later.

For the first time in history seven different manufactures of fuel cell cars were gathered together at one time for this event. Three fuel cell buses were also demonstrated.

This was by far the most exciting of any EV show exhibits to date, surpassing the excellent exhibits at EVS-12 at Disneyland, California and EVS-14 at Orlando, Florida. These fuel cell vehicles provide us with a look at the future of ultra low pollution transportation.

Inaugural Ceremonies

The inaugural ceremonies were emceed by Alan Lloyd, Chairman of the State of California Air Resources Board, who introduced the Partner members. Partner members today include automakers DaimlerChrysler, Ford, General Motors, Honda, Hyundai, Nissan, Toyota and Volkswagen; energy providers BP, Shell, and Texaco; fuel cell companies Ballard Power Systems and International Fuel Cells (IFC); and state and national agencies concerned with clean transportation.

John Wallace, executive director of Ford's TH!NK group and Chairman of the Partnership Steering Committee, was then asked to introduce the Associate Partners assisting in certain specialities include hydrogen gas suppliers Air Products and Chemicals, Inc., and Praxair; Methanex, a methanol fuel supplier; and bus transit companies AC Transit, operating in the San Francisco Bay area, and Sunline Transit Agency, Palm Springs, CA.

Following the introductory talks, a hydrogen fueling demonstration was given, using a Honda's new FCX-V3. After the fueling demonstration, visitors were treated to a parade of prototype Fuel Cell Vehicles (FCVs), which included the Ford P2000, the Ford Focus FCV, the Honda FCX-V3, Volkswagen's Bora HyMotion, the DaimlerChrysler NECAR 4, the Nissan FCV, and Hyundai's Santa Fe FCEV. Parked nearby were three FCBs (Fuel Cell Busses), two XCELLSIS-powered buses, one being tested by Sunline and the other owned by the Federal Transportation Administration, and a bus by Daimler Benz.

Hydrogen Storage

The West Sacramento hydrogen fueling station is modeled after similar facilities in Dearborn, MI and Nabern, Germany. Liquid hydrogen is delivered by truck and stored in a 4,500 gallon tank. At present, it provides gaseous hydrogen at two pressures, 3,600 psi and 5,000 psi. The dispensers look a lot like a gas station hose, one size filler nozzle for cars at the lower pressure and another set for busses. Fueling is quick and automated, taking just four minutes. Methanol distribution is expected on-site later. If there is a need for delivery of liquid hydrogen in the future, the capability can be easily added.

Exhibits and Ride and Drive

The **Honda FCX-V3** is a truly fine piece of engineering. It is based upon the EV+ platform. With regenerative braking power pumped into an ultra capacitor developed by Honda, it is quiet, has very peppy acceleration, and has very adequate room in both front and back seats. Instrumentation is similar to that of the EV+ but is totally new, designed for FCV operation. Honda's 3rd generation FCX has a 10-second start-time, compared to 10 minutes for previous models. The fuel is pure hydrogen stored at 3600 psi in a 100 liter composite carbon fiber tank. The FCX-V3 has a 60 kW motor, weighs 1750 kg (3850 lbs) with a range of 110 miles.

The four-door **Ford Focus FCV** is based on the Focus gas car and labeled as being powered by TH!NK to highlight the company's environmental brand. The heart of the car's drive train is a Ballard Mark 900 fuel cell stack. This model has a 67 kW motor capable of speeds up to 75 mph but no re-generation. In the Ford work bay there were several other Th!nk models, a smaller two passenger for local street use at under 35 mph and a golf cart type with roof but no doors for use in gated communities. Ford has set up a new assembly plant for alternative fueled vehicles at Carlsbad, California, north of San Diego, with John Wallace as Executive Director. Th!nk models will be assembled there. Ford, along with DaimlerChrysler, is a major investor in Ballard and part of joint ventures with the two of them for marketing both fuel cell power plants (XCELLIS) and electric drive trains (Ecostar).

The **Ford P2000** fuel cell passenger car is a 4 door sedan with a curb weight of 3340 lobs, 100 mile range, Ballard Mark 700 Series fuel cells, 67 kW motor with peak efficiency of 91%. The Ford P2000 was driven in the Ride and Drive. The P2000 is a first generation vehicle, superseded by the Focus FCV. Acceleration was only fair, and there was a lot of noise from the air compressor used to inject air into the fuel cell. Based upon the specifications, the Focus FCV should be a significant improvement, but unfortunately, there was no time to test drive it.

The **Hyundai FCEV** had its first public showing at West Sacramento and is a light weight aluminum chassis based on the gas Santa Fe SUV. It uses International Fuels FCs which produce 75 kW of power and is built on an aluminum chassis, 65 kW motor. It is equipped with a 5000 psi storage tank enabling the vehicle to go more than 100 miles on one fueling. Electric drive train, motor and control unit are from Enova systems of Torrance CA. Top speed is 77 mph, range 100 miles and weight 1,620 kg (3,572 lb), 0-60 in 13.4 sec, and a starting time of 10 secs.

The **DaimlerChrysler NECAR 4** (new electric car) was test driven. It is quite small, roomy enough for two adults in the front seat but the back seat only large enough for children. Acceleration was adequate. An unusual feature was the regenerative braking system, which was used to heat water, presumably for passenger cabin heating.

The **DaimlerChrysler NECAR 5**, also called the California NECAR, is based on the Mercedes-Benz A-class and was especially built for the California Fuel Cell Partnership showing. It has a 50 kW electric drive system, a Ballard Mark 900 Stack with an output of 75 kW. The stack weighs on about 2/3 of the NECAR 4 unit and takes up only half as much space. As a result the entire passenger and luggage compartment can now be used to full capacity. Top speed is 90 mph, and range is about 120 miles.

The **GM Opel** fuel cell car is GM's seventh generation model, it was developed in Germany and the US and it is based on an Opel Zafira 5-seat passenger van which half the size of GM's previous model and 25% smaller than its nearest competitor. This was used as the pace car at the 2000 Olympic marathon in Sydney, Australia last summer. Costs are reduced as the fuel cell requires only half the platinum previously used. A commercial version is at least 4 or 5 years away. This car model is half the size of GM's previous model and 15% smaller than it's newest competitor. Reporter Bob Wing can attest to that! He had trouble getting his six foot frame through the door and into the seat. In fact all of the models in the ride and drive were a tough fit for head room. The Zafira has a range of 250 miles per liquid hydrogen fill, and an 87 mph top speed.

The **Nissan Xtera FCV** was shown to EVS-17 in Montreal. No other information was available on this car at the show, nor was a Toyota FC was observed. The **VW Bora Hymotion** was shown only as a mock up.

Panel Discussion

In the afternoon, Mr. Wallace chaired a panel of 22 experts from automobile companies, energy companies, fuel cell manufacturers and government. All agreed that many obstacles must be overcome, including lack of infrastructure, high cost, and short vehicle range. The partnership is still in a pre-competitive phase and a cooperative effort is essential. The path to a hydrogen economy is not clear. The general public's first exposure to fuel cells will likely not be FCEVs. It's much more likely that the first consumer-oriented products will be auxiliary power units and portable power supplies. Consumers will not buy FCEVs because of low emissions. An example is the failure of battery EVs to create a market. Consumers will only buy FCEVs if and when it is economically advantageous to do so.

Several speakers felt that fuel cells had a great future in distributed power, particularly in areas where there is no well established or extensive power grid. As for vehicles, the first applications will be for public transportation (e.g., buses) and for fleets. The most often quoted date for introduction of is 2004.

Bob Wing (bwing@svn.net, POB 277, Inverness CA 94937-0277,) is an EV consultant and Book Review Editor, Electrifying Times. A past West Coast Editor, EV News/ Advanced Technology Vehicles, he is now driving a leased Ford Ranger pickup with NiMH batteries. He drove his '59 MGA Roadaster as an EV test bed for 27 years, the last version with Zapi regeneration controller, Zivan charger and battery management system with 18 Optima sealed Pb-acid batteries.

Don McGrath (vinter@pobox.com) drives a 2000 Toyota Prius with a cruise control he installed himself, 10.4 gallons of gas from Napa to Los Angeles. He has converted a Fiat X1/9 to an EV using Zapi controller and Zivan charger and battery management system with sealed Optimawith sealed AGM batteries. Don McGrath and Bob Wing were the first two EV home converters in the US to have bought and installed the Italian Zivan battery management system.

Automotive Electronics

Bill Fleming, Senior Editor

Gasoline-Electric Hybrid Vehicle Sales Spurt

High gasoline prices are currently boosting sales of the two gasoline-electric hybrid vehicles, the Toyota Prius and Honda Insight [1]. So far this year, Honda sold 2,534 Insights through May and is on a pace to sell about 6,100 Insight cars in 2001. Despite consistent gains in sales, Honda's Insight continues to lag behind the Toyota Prius. The Prius is on a pace to sell about 14,000 cars this year. Honda has started running TV commercials that highlight their Insight's industry-leading fuel economy, while also trying to end the misconception that the Insight needs to be plugged in [1].

Intelligent Engine Cooling

Both Bosch and Visteon are introducing intelligent engine cooling systems that offer precise engine cooling (and heating) via a closed-loop arrangement that significantly improves on conventional thermostat-controlled systems [2,3]. Introduction of these systems on cars is expected to occur three years from now. Jaguar said it would use the system on its '05 models.

In place of a thermostat; a variable speed water pump (electric), a coolant flow control device (e.g., a five-port valve), and an electronic control module are used. This allows the flow of coolant to be regulated, independent of engine speed [3]. The following benefits are claimed for this system [2]:

1. Improvement in fuel economy by as much as 5% because the system allows the engine to operate at consistently higher temperatures — thereby reducing friction. In addition, the water pump can be switched off, via electronically controlled "clutching," thus reducing engine parasitic power losses.

2. Cold-start emissions (primarily hydrocarbons) are minimized by more quickly bringing engines up to optimum temperatures (by temporarily restricting coolant flow, to speed up engine warm-up).

3. By delivering hotter heater air, more quickly, in cold ambient conditions; passenger comfort is enhanced.

4. There are potentially large cost savings made possible by extending oil-change intervals (by regulating the oil in a temperature-controlled range where deterioration/aging stress is minimized).

In summary, intelligent engine cooling systems offer improved fuel economy because of: reduced friction, faster warm-up, and reduced power requirement to drive the coolant system. Improved emissions occur because of the fast warm-up, as well as the consistent engine operating temperature (achieved by the elimination of temperature

"spikes" associated with conventional thermostat-controlled cooling).

Saturn Continuous-Variable-Transmission

Continuous-Variable-Transmissions (CVTs) were first introduced in the U.S. in 1995, by Honda, on a low-volume vehicle. Outside the U.S., several other automakers — namely: Ford, Nissan, Toyota, and Audi — have already introduced, or are now introducing, CVTs. And now General Motor's Saturn Division will introduce a CVT in its new 2002 VUE sport utility vehicle in October 2001. Saturn says the CVT transmission improves fuel economy by as much as two miles per gallon, and reduces the number of transmission parts by 45 percent. Saturn engineers say they've solved CVT durability problems [4].

A CVT transmission operates by shifting a steel belt in and out of variable-radius pulley spaces between opposing cones in each of two pulleys. Both pulleys have variable-radius spaces between cones that are independently controlled. In this way, the pulley ratio between the engine-drive pulley and the transmission-out pulley is continuously varied. A wide, variable, transmission speed ratio, ranging from 2.6:1 (low-gear ratio) to 0.44:1 (overdrive), is available [5].

Although engineers have long known about the CVT concept, its implementation was far more difficult than anyone expected. The reason: "as the CVT belt moved in and out of each pulley's tapered-cone variable-radius space, the belt often slipped and broke. Saturn engineers overcame this problem by devising a closed-loop feedback control mechanism that prevented belt slippage. A belt-pressure sensor directly measures the clamping pressure on the steel belt, and the transmission control module sends a signal to electrohydraulically actuate the pulley cone spacing. The system constantly adjusts belt-cone clamping pressure/separation to maintain belt tension within acceptable/operational limits [4]. It's said, "CVTs will bring manual-shift fuel economy to the automatic-transmission world."

Next-Generation Automatic High Beam Control

Older versions of headlight automatic high-beam controls were phased out in 1994 because the photosensor-based systems were unable to differentiate faraway headlights from nearby bright reflections and automotive tail lamps. As a result, they occasionally turned the high beams on and off at the wrong times. Gentex, working with Photobit, is now using a CMOS imager to view the entire scene ahead of the car. Pixel imager data are then used to spatially categorize the scene according to the brightness, color, size, position, and movement of objects viewed [6]. The Gentex system, called SmartBeam,

utilizes image-processing techniques to monitor points of light and determine, for example, whether that point is a headlight or a street lamp. In the past, automatic high beams had difficulty making such determinations. Gentex's SmartBeam will debut on unnamed Lincoln Mercury vehicles in the 2004 model year [6].

How Distracting Are Cell Phones?

The U.S. National Highway Traffic Safety Administration (NHTSA) estimates that 20-to-30 percent of all fatal auto accidents occur in part because drivers are distracted. But it now turns out that most of these distractions have little to do with using cell phones. For example, to illustrate this point, it's noted that if cell phones are really that dangerous, shouldn't the rate of traffic accidents and fatalities have skyrocketed in the past few years (proportional to the increased use of car phones)? But, in fact, the reverse is true — in recent years, car crash fatalities per 100,000 vehicles have actually declined slightly [7]. Moreover, there's an unquestionable major benefit to cell phone use — there were nearly 140,000 emergency "911"-calls placed daily in 2000, and these calls have greatly improved vehicle-crash emergency response rates and crash victim survival rates [7A].

NHTSA estimates that over 150,000 crashes each year are related to driver interactions with vehicle entertainment systems, and the resultant distraction. Yet the driving public finds these systems reasonably safe. Maybe this same approach should be taken with cell phones. Evidence suggests more strongly than ever that it's not the use of cell phones in itself that's the problem; it's the driver's mental distraction that's far more important than what the driver's hands are doing [7].

The University of Michigan Transportation Research Institute (UMTRI) has also found that most driver distractions have little to do with using cell phones. According to the UMTRI study, driver distractions include [8]:

1. Distractions inside the vehicle that cause 9% of crashes [e.g., spilled coffee, answering a cell phone, telematics (email, Internet, etc.)].

2. An unknown percentage of crashes that are related to aggression or road rage.

3. Driver sleepiness that cause about 2% of crashes.

4. Distractions outside the vehicle, such as accidents or construction sites, that likewise causes an unknown percentage of crashes.

5. Driver preoccupation that causes 15% of crashes.

The UMTRI study concluded that, "there are all sorts of distractions to drivers, but the ones most amenable to engineering solution are those due to distraction category 1 (above), especially telematics" [8].

An approach to better control of telematics distractions is something called In-Vehicle driver Information Systems (IVIS). The groundbreaking development of the IVIS approach was done at the University of Michigan (their IVIS system is called the "driver assistant"), and at IBM which subsequently developed an IVIS system called a "workload manager") [9,10]. Instead of allowing anytime use of telematics, both these IVIS systems limit access according to driver workload. As an example, based on factors such as vehicle speed, distance between cars, weather, time of day, and possibly even the driver's heart rate; the IBM "workload manager" would decide whether phone calls should go through to the driver or be routed to voice mail. One implementation of the IBM "workload manager" is described in

their US Patent [11]. IBM is also working on an IVIS system that alerts the driver to pending cell phone information (voice mail) with a subtle tone or by turning on a status light. This system lets the driver make a decision about when to listen to the message [10].

Handheld Cell Phone Ban Spurs Telematics

The car phone controversy peaked in June this year after New York State passed a law banning the use of handheld phones in cars. Many experts believe legislation like this could fuel broad consumer demand for the quick fix of a hands-free phone, igniting sales of factory-installed units [7A, 12]. "It's going to be a boon for telematics makers," said Dataquest. This type of legislation leaves telephone-addicted drivers little choice but to move toward built-in car phones, and especially toward hands-free, voice-operated units.

When consumers purchase a new car, options like OnStar, or the Mercedes-Benz Tele-Aid system, will look a lot more attractive because they offer the hands-free capability built right into the vehicle. In the future, it's predicted that every new vehicle will also come with the ability to both speak and understand speech [13]. Many experts, however, believe that hands-free phones and speech recognition are not enough — the issue is really cognitive burden on the driver. The solution to which may require implementation of the above-mentioned IVIS types of "driver assistants" and "workload managers."

Satellite Digital Car Radios

Within the next five years, radio listening will change remarkably as satellite broadcast radio receivers hit the market, and as AM/FM goes from analog to digital [14]. Consumers will be able to choose from two satellite radio broadcasters, each of which will provide 100 channels of digital radio programming for approximately $10 per month. The planned music and topical satellite radio formats seem endless. Both satellite broadcasters will air gospel, top 40, soft rock, and rap. One broadcaster, XM Satellite Radio, also singles out hip-hop, blues, jazz, raggae, soul, salsa, rhythm and blues, classic country, western, and modern country, classic '50s, '60s, '70s, and '80s rock, as well as hard, light, and alternative rock; and so on [15, 16]. Broadcasts will start once the satellite infrastructure is set up, and enough satellite radios become available — expected sometime in 2002.

An eight-chip set, designed by Agere (formerly Lucent) for Sirius Satellite Radio, dynamically combines signals broadcast from three satellites and ground-based repeater broadcasters. The combined digital signals — coded orthogonal frequency-division multiplex (for ground-based repeaters), and time-division multiplex quadrature phase-shift keyed (for the satellite broadcast signals) — achieve the redundancy needed for moving vehicles to enjoy robust reception of up to 100 channels of digital-quality radio [16]. Sirius Satellite Radio has alliances to install satellite radio in Ford, Chrysler, BMW, Mercedes, Mazda, Jaguar, Volvo, and Freightliner vehicles. XM Satellite Radio has lined up General Motors, Honda, Isuzu, Suzuki and Freightliner. (Note. The U.S. government has ordered Sirius and XM to create an interoperable radio design so that consumers can choose either service provider [16]).

Meanwhile, digital AM/FM radio will become available a year or two after satellite radio. Existing analog AM/FM broadcasters will convert to digital in the next couple of years. It's said that, "digital AM will sound like analog FM, and digital FM will sound like CDs" [14, 17].

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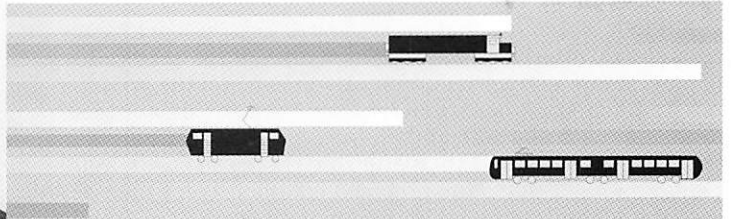
Transportation Systems

Harvey Glickenstein, Senior Editor

As previously reported in VTS NEWS, Florida passed a constitutional amendment requiring the state to build a high-speed rail system in the November 2000 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 states 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 law implementing this amendment has been passed by the legislature and signed into law by Governor Bush. It sets up a 9-member High Speed Rail Authority and provides $4.5 million for the first year of funding.

Alstom unveiled its first Pendolino tilting train for use in the UK in July. The trains, which are being manufactured in Birmingham, are scheduled to be delivered to Virgin, operator of the West Coast Main Line, starting in November. The £1 billion order for a total of 53 cars will be delivered over a one year period.

Bombardier Transportation, in consortium with Alstom, has received an order from RATP (the transport authority for Paris) for 161 five-car MF-2000-type rail rapid transit units — a total of 805 rail rapid transit cars. The total contract is for approximately $C900 million (695 million euros). Bombardier is responsible for the manufacture of 1,610 trucks; 805 painted and insulated passenger cars, fitted with windows and floors; and 322 complete driving cabs. Delivery of the vehicles will take place between the end of 2003 and the end of 2014.

These state-of-the-art rapid transit units will replace part of the existing rapid transit rolling stock in Paris.

Bombardier Transportation's rapid transit unit MF-2000 for the Paris Metro

The new rolling stock will particularly address travel quality and passenger comfort and the passenger compartments and cabs will be completely air-conditioned. The vehicles, lower than the existing stock by 30 mm, will facilitate boarding by people with reduced mobility. In addition, the wide intercar linkages will offer an uninterrupted view of the vehicle interiors.

Portland has opened a new streetcar system in downtown. This system is supplementary to the existing MAX light rail system, which was scheduled to open its airport extension in September.

The Streetcar project is designed to fit the scale and traffic patterns of the neighborhoods through which it travels. Vehicles, manufactured by Skoda in Plzen, Czech Republic, are only 8 feet wide and 66 feet long, about 10 inches narrower and 1/3 the length of a MAX double car train. They will run in the right lane in mixed traffic and, except at stops, accommodate existing curbside parking and loading.

During construction neighborhood disruption was minimized. A unique shallow 12-inch deep track slab design reduced the construction time and utility relocations. Maneuverability of the shorter and narrow Skoda vehicles has allowed the 8-foot wide track slab to be fitted to existing grades limiting the scope of street and sidewalk reconstruction.

The fares are the same as Tri-Met's, and the system accepts Tri-Met passes, short-hoppers, and transfers. There is no charge to riders who travel only within Tri-Met's Fareless Square. Fareless Square extends from NW Irving through Portland State University.

New Jersey Transit (NJT) formally retired its President Conference Committee (PCC) cars that had been running in the Newark City Subway. The cars were retired on Friday, August 24 in a special ceremony at Branch Brook Park, the current end of the line that had been previously known as the Franklin Loop. After the ceremony, the cars remained in regular revenue service until 7:30 PM. At that time, NJT ran two hours of free service to allow trolley fans to take last rides on them.

On Monday, August 27 NJT began operating new light rail vehicles (LRVs) in the subway. The LRVs were procured under the Hudson-Bergen Light Rail Project, although some minor modifications were made to the ones that are operating in the Newark City Subway. Unlike the PCC cars, the LRVs are air-conditioned and have public address systems. The LRVs are longer than the PCC cars and can carry up to 68 passengers seated and 120 standees. They have four low doors on each side, providing for handicapped access and allowing for faster boarding. NJT had

Portland's new streetcar in operation

previously introduced a proof of purchase fare system to allow patrons to board from all doors.

The present Newark City Subway is 4.3 miles long from the loop at Newark Penn Station to Branch Brook Park. Late this fall, the Newark City Subway will be extended one mile with the opening of two new stations—Silver Lake Station in Belleville and Grove Street Station in Bloomfield.

Although the new LRVs have been on New Jersey Transit's property for some time, the retirement of the PCC cars had to wait for the completion of the new Vehicle Base Facility (VBF) next to the new Grove Street Station. Until the two new stations on the extension are ready for passengers, the extension will only be used for vehicles traveling to and from the VBF. The small maintenance facility at Newark Penn Station that had been used to maintain the PCC cars will be modified to handle light maintenance and cleaning duties.

Portland's new streetcar in operation

Portland Streetcar route ——

Fareless square (within ----------)

Portland's streetcar route
(see www.portlandstreetcar.org)

The total cost of the Newark City Subway extension and rehabilitation is $188 million and includes:

+ $55 million for 16 light rail vehicles.
+ $25 million for power, signal and track rehabilitation on the current Newark City Subway segment.
+ $30 million for accessibility improvements and modernization at Newark Penn, Washington and Orange Street stations.
+ $78 million for construction of the one-mile extension into Belleville and Bloomfield, including the new Vehicle Base Facility.

Three of the PCC have been donated cars to the New Jersey Transportation Heritage Center. NJT has retained the rest of the 24 cars they own for the present.
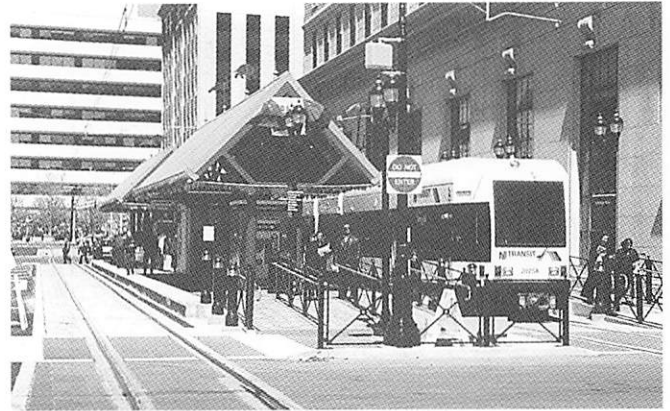
The new LRV on the Hudson/Bergen Light Rail Line

Mobile Radio

Javier Gozalvez, Senior Editor
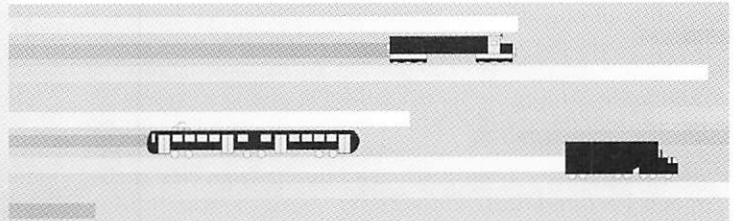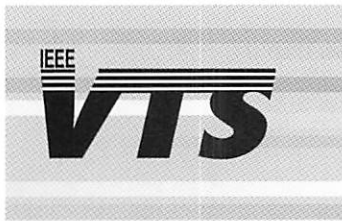
Migration to 3G: TDMA and CDMA

The CDMA Development Group (CDG) and the Global mobile Suppliers Association (GSA) have both published reports on the migration to 3G. In its report, "It's About Services That Make Money - The AMPS and TDMA Roadmap to 3G", the GSA outlines the business and technology advantages of the GSM/GPRS migration path to 3G for AMPS and TDMA operators. The report identifies some key factors for the success of a 3G migration with GSM: evolution path, global footprint, economies of scale, choice of user-devices, and the support of a large scale independent application developer community. The report is available at www.gsacom.com. Pyramid Research, a Consultancy research firm, has also released a white paper titled "The Great Standard Migration: IS-136 TDMA Moves to GSM/GPRS Overlay" on TDMA operator migration to 3G. Meanwhile, the Universal Wireless Communications Consortium (UWCC) has released its latest figures showing a 67% increase in the number of TDMA subscribers world-wide, with an important influence of the Latin America region.

The CDG announced the publication of reports on the benefits of CDMA technology to provide 3G services. The first report, titled "GSM or CDMA: The Commercial and Technology Challenges for TDMA operators" and authored by The Shosteck Group, compares CDMA and GSM migration paths as 3G options for TDMA/IS-136 carriers. The report, available at www.cdg.org, concludes CDMA may offer significant advantages over GSM for some TDMA operators, especially for those licensed with 800MHz. In a presentation, titled "3rd Generation Mobile Wireless – A Presentation on the Opportunities and Challenges of Delivering Advanced Mobile Communications Services", the CDG Group discusses what are in its opinion, the advantages of cdma2000 in delivering 3G services based on critical factors such as spectrum efficiency and flexibility, cost and ease of migration from 2G, and handset and services availability. The CDG also announced that during the first quarter of 2001, the number of CDMA subscribers reached 90million world-wide, which corresponds to an increase of 58% since last year. The group also identifies CDMA as the fastest growing technology in the Americas with nearly 60million subscribers.

3G trials and roll-out

Nokia announced it made the world's first 3GPP Release 99 standard compliant AMR (Adaptive Multi-Rate) end-to-end WCDMA voice call. The call was conducted using a 3GPP compatible commercial network and the first commercial versions of Nokia 3GPP standard compatible dual mode GSM/WCDMA mobile terminals.

Ericsson showed during the 3G CDMA World Congress held in Hong Kong the feasibility of roaming from a 3G CDMA network to a wireless LAN network. The demonstration included a laptop computer with a CDMA modem, working to the cdma2000 1xEV-DO standard, and a 802.11 Network Interface Card.

Qualcomm and Nortel Networks completed the industry's first successful end-to-end live cdma2000 1X Mobile Internet Protocol call. Mobile IP provides a method to allow IP traffic to find nodes whose point of attachment to the Internet changes. The IS-835 standard codifies the use of Mobile IP in a cdma2000 1X Packet Data Network. Today's CDMA packet data services provide only islands of mobility.

Mobile IP will solve this problem by providing "always on" access to a carrier's entire network, enabling wireless users to access Web and data services without interruption while moving between buildings and networks, using a variety of wireless handheld devices, laptops and appliances.

Lucent and Russian's Moscow Cellular Communications, a NMT-450 operator, announced that the Russian operator is to install a digital IMT-MC 450 solution over its spectrum in the 450MHz band. An initial pilot network in Moscow will be built with the tests expected to finish by the end of the year. IMT-MC was approved by the ITU as one of the IMT-2000 standards for 3G mobile networks. IMT-MC 450 represents the first phase towards 3G networks for NMT-450 operators. Lucent also announced a contract with Telesp Celular to introduce the first 3G network in Brazil. The network will be based on the cdma2000 standard. Lucent will provide its 3G-ready Flexent family of network switched, base stations and software.

NTT DoCoMo has confirmed its 3G launch for October but has announced that some of its planned services would be delayed, in particular music and video downloading and streaming. In the meantime, the company has announced that it has jointly developed with PacketVideo Corp the world's first one-to-many live-video distribution platform that will enable delivery of live video streaming content over its network. The platform enables video and data transferred in Realtime Transport Protocol to be converted into 3G-324M-based data compliant. It employs the MPEG4 technology for its data-coding standards.

Manx Telecom said it has successfully completed the first packet-switched data call over its trial 3G network on the Isle of Man. The operator, which aims to be the first operator to launch 3G services, already completed trial voice and video calls. The test was done using NEC and Siemens infrastructure; both companies are partners in the Manx 3G project.

Verizon Wireless said it has successfully deployed a 3G wireless network in the New York metropolitan area. The company has upgraded its network within a 100-square-mile area to support 1XRTT-enhanced CDMA technology. The company is still undergoing compatibility tests between handsets from different manufacturers.

Italy has established strict electromagnetic radiation limits, the strictest in Europe, that could hamper the building of 3G networks. According to a commissioner, the presence of two antennas on the same site would be enough to breach Italy's electromagnetic emissions limits. The limits will also be breached if two antennas were built within 15 to 40 miles of each other as no overlapping of the transmitting range is allowed, unlike other countries. A proposal to be debated this autumn in the German parliament proposes to cut the national exposure rate by a factor of 10 which could cost operators an estimated additional 4.1billion euros in rollout costs. In Belgium, the government has ruled that one antenna must not produce more than one quarter of the recommended exposure rate while in Spain 3G operators are required to come to a mutual agreement to ensure the recommended rate is not topped where there are more than one antenna in close proximity.

A report from consultancy Analysys claims that the rollout of 3G networks will be very difficult in Europe unless European regulators change their attitude towards network sharing. According to the report, "Evaluating the Business Case for 3G Network Sharing", there is no evidence that network sharing will hinder competition. On the other hand, network sharing could allow capital expenditure savings on network build of as much as 38% in some markets. Following Germany's initiative, the Dutch regulator announced the operators can team to build up the network as long as competition is not hampered. The European Commission has declared itself "positively open to network sharing" but would still not favour sharing of all the aspects of a network.

Technology and research news

The Ministry of Public Management, Home Affairs, Posts and Telecommunications of Japan has announced it will gradually reallocate part of the spectrum used by wireless operators from 2004 to prepare for the 2010 start of 4G systems. The Japanese Government is also considering compensating the operators for equipment that becomes useless after the reallocation. The Ministry has also decided to seek $10million to fund 4G research. The Ministry, together with Japanese operators and manufacturers, have already compiled the basic specifications for 4G mobile phone technology. Samsung has set up a 4G research centre in UK to create software and hardware Intellectual Property for 4G products around 2010. The company will form technology partnerships with local universities and other companies.

Telephia has launched what it claims is the first continuous, wireless data Quality of Service measurement system that evaluates network performance from the end-user's perspective. The service, called Wireless Data Network and Application Performance, collects performance metrics on all applications, all carrier networks and all mobile devices. Customers can select the set of applications to be measured, the markets and networks from which to take measurements and the frequency of the measurement.

Massachusetts-based Millennial has launched i-Bean 4000, an ultra-small, ultra-low power, wireless computing device from the company's line of wearable computing products. The device transmits data, with a maximum bandwidth of 115kbits/s, over a range of about 30 meters. It incorporates a selectable RF capability, that can be switched between 300 and 900MHz, eight channels of 10-bit A/D conversion, two channels of 10-bit D/A conversion, ten digital I/O channels and two channels of PWM output.

A Power and Energy Alliance Consortium, including among others Motorola Labs, Honeywell International, Engines and Systems, SAIC and MIT, have been awarded, by the US Army Robert Morris Acquisition Center, $49million for fuel research over a period of eight years. Miniature fuel cells are being targeted as on-board battery chargers that could later on replace the traditional batteries for portable electronics, such as cellular phones and laptops. Fuel cells are expected to deliver ten times the power of conventional batteries. Medis Technologies is also developing a fuel cell power pack for Sagem, the French cell phone manufacturer.

The Canadian Center for Marine Communications and Quester Tangent, in partnership with the Communications Research Center of Canada, have started a project to place wireless communications technology in scientific data acquisition systems. The project was started to connect Quester's ocean-mapping technology to its communication technology. The project will allow scientists to communicate directly with a research vessel's system mapping the oceans. The idea can be expanded to other scientific instrumentation.

The WAP Forum released the next version of WAP 2.0 which will support XHTML so that developers can write applications for both PC and WAP clients using a common subset of language elements and development tools. The standard will remain backward compatible with WML.

ARM, provider of embedded RISC microprocessor solutions, and Sun Microsystems have entered into a collaboration and licensing agreement to jointly develop new Java technologies for the wireless device market. ARM will incorporate Sun's Java technology into its roadmap of Jazelle technology-based microprocessors. Sun

Microsystems has also joined forces with Motorola and Hutchison Telecom in Hong Kong to develop Java-based mobile communications services.

Red Hat and 3G Lab have formed an alliance to develop an open source operating system for 3G web handsets. The code for the new system will be published on the Internet and will be available to everyone at http://sources. redhat.com/ecos/sources. The new software, called eCos/M3, is based on Red Hat's eCos (embedded Configurable operating system) but also includes Linux code. Hewlett-Packard is also going to launch a new platform, called HP Chai-LX, to develop Linux applications for small consumer devices such as mobile phones.

Ericsson has developed with Anoto a new pen, called the Chatpen, which can be used to send a written message anywhere via Bluetooth and a GPRS mobile phone. The device weights about 86 grams. Inside, it has a small infrared camera, which takes 50 pictures a second of whatever is written on the paper, a battery, microprocessor, memory storage chip and Bluetooth transceiver. The special paper the writer has to use has a pattern of microscopic dots printed over it. The digital pen can also be used to interact with cellphones, computers and the Internet.
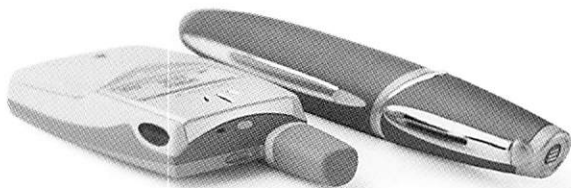
Ericsson's Chatpen

Carucell LLC has developed a new wireless broadband infrastructure providing data rates of 20Mbits/s when travelling on highways. The system uses a small-cell moving base station infrastructure. The infrastructure uses the 60GHz spectrum which is currently unlicensed in the US.

The University at Buffalo has developed a new system to effectively deal with "hot spots". The system, called iCAR (integrated Cellular Ad hoc Relay), combines conventional cellular technology with Ad hoc Relay Station (ARS) technology, in which the stations relay or reroute calls from the congested cell to an adjacent one that is not congested. Ad hoc relay stations cover a small area, typically only a few hundred meters. Due to their limited range, an ARS can be very small and since it is wireless, it is also portable.

Qualcomm, Samsung and SchlumbergerSema have successfully demonstrated, at the 3G World Congress, a Removable User Identity Module (R-UIM) solution that allows roaming across CDMA and GSM networks. The solution allows storing a subscriber's identity in a single removable card so that subscribers can exchange handsets while using the same card (this capability is mandatory for the Chinese Wireless market). Qualcomm has also signed an agreement with Gemplus to ensure Gemplus's R-UIM solution supports roaming services and value-added service capabilities across cdmaOne and cdma2000 1x and GSM networks.

M-commerce and location-based services

The Fire and Disaster Management Agency (Japan) is planning to develop a system to locate missing mountaineers using radio waves sent from their mobile phones, even when the missing people are in zones where the phones cannot be used to make calls. Initial tests will start next year.

Real Media and Sonata have formed a partnership to deliver location-specific wireless advertisements via voice or data. Sonata's software operates over WAP, i-mode or Java-enabled phones, PDAs and Voice/CallXML/VoiceXML.

CellPoint and SiRF Technology announced a partnership to integrate SiRF's Assisted GPS(A-GPS/a) technology and CellPoint's network-based Enhanced Cell-ID (E-Cell-ID) location platform technology. The combination of both techniques meets the accuracy and performance requirements of the E-911 US mandate.

BeyondGuide, based in Maryland, has launched an application offering audio guides to cities over mobile phones. The application uses location-based technology to locate the tourist and then sends information on the attractions on the vicinity. The company, which already offers the service in Washington, has also partnered with Bertelsmann's Locality.de to launch and expand the service in Europe and the US.

The California Public Utilities Commission has published guidelines on m-commerce billing. The guidelines stipulate that consumers have to opt-in for the service, must be provided with a PIN and cannot be disconnected in case consumers didn't pay for items unrelated to their phone service.

A pilot program in Sidney has tested the payment of parking meters using mobile phones. The test conducted by Soprano, SkiData, Hectronic and Wilson Equipment Services included 400 mobile-payment enabled parking meters. The software sends a signal to the mobile phone warning if a parking meter is about to expire and allows to top up the meter using the mobile phone. The software also allows traffic wardens to use their mobile phones to check who parked illegally and book the offenders in real time.

A study released by Allied Business Intelligence (ABI), "Mobile Commerce: Analyzing Emerging Opportunities in Technologies, Applications, Markets and Trends", predicts world-wide revenues from m-commerce to reach $34 billion in 2006 with nearly 25% of those revenues from the US, despite poor actual figures.

Spanish wireless operators Telefonica Móviles and Airtel have established with two local banks, BBVA and BSCH, a mobile payment consortium, named Mobipay. The two other operators, Amena and Xfera, are also expected to join the consortium.

Fujitsu said it will start selling fingerprint sensors for mobile phones later this year, improving security for m-commerce transactions. The firm expects the market to be worth $800million by the end of 2004.

Initiatives and forums

Qualcomm has launched its Binary Runtime Environment for Wireless (BREW) Developer Alliance Program designed to provide developers with technical training and support, product development guidance and marketing assistance.

The Mobile Wireless Internet Forum has released their new industry-wide reference study, "OpenRAN Architecture in 3rd Generation Mobile Systems MTR-007." This technical report on mobile systems outlines new and innovative mapping functions for both 3GPP UTRAN and 3GPP2 cdma2000 Radio Access Network (RAN) architectures. The report considers the way in which IP can be applied in Radio Access Networks within 3G mobile systems. The report can be found at www.mwif.org

OPNET Technologies, a provider of intelligent network management software, announced the launch of a new OPNET-sponsored 3G consortium. Members of the consortium include AT&T Wireless, France Telecom, Samsung, NTT DoCoMo, NEC and SK Telecom amongst others. The consortium aims to provide direction, recom-

mendations and feedback for UMTS model development and implementation.

Ericsson, Motorola, Nokia and Siemens launched the Mobile Games Interoperability Forum which will work to define a mobile games interoperability specification for network-based servers. The Forum has evolved out of the "Universal Mobile Games Platform" initiative. The initiative will work to specify a global standard and to develop certification procedures to encourage a wide adoption of the standard.

Mobey Forum announced a recommended architecture for mobile payments. The key to the proposal is a dual chip in the user's handset. The chip will be provided by the banks with a corresponding PIN and will sit next to the SIM card. Another feature is a server-based wallet in the issuing bank. The protocol for remote payments is 3D secure, specified by Visa International.

The GSM Association, representing 538 companies, launched its Mobile Services Initiative (M-Services), which aims to deliver a globally available set of services through the Mobile Internet. The initiative is targeted to GPRS handsets. According to Openwave, Alcatel, Sagem, Samsung, Siemens and Telit are set to commercially launch M-Services-compliant phones by the end of this year.

FCC & US mobile market

In an attempt to identify additional frequency bands that could be used to support the introduction of advanced wireless services, including 3G, the Federal Communications Commission (FCC) has adopted a Memorandum Opinion and Order and Further Notice of Propose Rulemaking that explores additional bands, including the bands currently designated for the Mobile Satellite Service (MSS), the Unlicensed Personal Communications Service, the Amateur Radio Service and the Multipoint Distribution Service. The FCC is seeking comments on reallocating some spectrum in the 1910-1930MHz, 1990-2025MHz, 2150-2160MHz, 2165-2200MHz and 2390-2400MHz bands. The FCC had previously delayed a spectrum auction in the 700MHz band and the designation of frequency bands for 3G services as the bands previously identified are occupied by education television, commercial providers and the military. The Department of Defense (DoD) has been reluctant to share or move its operations from the given band due to the costs of the reallocation and doubts whether the same amount of spectrum would be available at other bands. A report released by the General Accounting Office (GAO) states that previous studies undertaken by the FCC and DoD used radically different methods and formulas to calculate potential interference from sharing spectrum. The report, available at www.gao.gov, concludes that neither report contains enough information to make reallocation decisions.

The Wireless Telecommunication Bureau returned NextWave licenses to active status as required by a mandate from the US Court of Appeals for the District of Columbia Circuit that prevented the cancellation of licenses held by NextWave Personal Communications Inc and NextWave Power Partners Inc. The FCC has already indicated its intention to ask the Supreme Court to review the D.C. Circuit decision. The FCC previously repossessed 90 licenses won by NextWave at an auction in 1996 after the company was unable to pay on time the amount due, and auctioned these licenses in January. The auction raised $16.9billion. In the meantime, NextWave has filed a new reorganization plan with a New York bankruptcy court that provides $5billion in total financing. The company also entered an agreement with Lucent Technologies to begin phased construction of a 3G network based on cdma2000 technology. The construction of the network will be funded by a $2.5billion loan commitment from UBS Warburg LLC; the loan is subject to NextWave finally getting ownership of the licenses. Qualcomm will also inject $300million into the company and will technologically cooperate to deploy the cdma2000 1x and 1xEV network.

The FCC adopted its Sixth Annual Report on the state of competition in the wireless market place. The report notes increased competition and innovation, and extended nation-wide coverage by means of mergers, acquisitions and license swaps. The report found that the mobile telephony sector generated over the year 2000 $52.5 billion in revenues, increased the number of subscribers from 86million to 109.5million producing then a penetration rate of 39%. In the US, seven operators are offering mobile data services with the total number of mobile Internet users for four of this seven operators reaching 2.5million.

The Association of Public Safety Communications Officials has revealed that less than 10% of the US's 4,300 police departments are ready for cell phone location emergency services. Several carriers, including Sprint PCS, AT&T Wireless and Verizon, have asked the FCC to delay the implementation of the enhanced 911 caller-location system. The Phase II of 911 systems requires the ability to locate a caller within 400 feet. San Francisco has already said it will not be able to meet the October deadline.

AT&T and Qualcomm are the contractors for the "Universal Handset" to be developed for the Pentagon. The handset will be a 1.5-pound device intended for: cellular and mobile satellite communications for voice, Internet access and full-motion video; short distance exchange via Bluetooth; plus an option for operating in a peer-to-peer mode for group services on a wireless LAN. The handset, to be delivered next year, will have to use encryption and other security features defined by the National Security Agency through its "Condor" program. The Pentagon is expected to buy full deployable PCS networks.

A US Senator introduced the Location Privacy Protection Act. The proposal suggests that wireless service providers will be required to notify consumers when they are analysing their location from signal information. The bill, which does not interfere with enhanced 911 services, states that consumers should have access to their location information.

Mobile satellite communications

The European Commission and the European Space Agency are developing a new European Strategy for Space. The initiative should include regulatory policy as an essential element. Some of the important issues that the Commission has to tackle are the evolving relationship between networks and content, and the improvement of the management, on a global basis, of scarce resources like spectrum and orbital slots.

The Federal Communications Commission (US) issued a notice of proposed rulemaking regarding the request from some satellite companies, such as New ICO, to allow mobile satellite service operators in the 2GHz band to re-use their assigned frequencies for terrestrial services. The proposal from satellite providers has not been positively received by wireless carriers. In fact, the CTIA countered with an appeal to the FCC to re-allocate spectrum assigned to satellite providers in order to make best use of the spectrum. The FCC has also awarded new licenses to eight satellite companies. New ICO, Iridium and Globalstar received licenses.

Inmarsat announced the launch of a global IP-based mobile packet data service for its corporate customers via its Global Area Network.

Iridium signed a service partner agreement with Global Plus, a division of satellite service provider Multisat PLC, to

address the African market. Global Plus has distribution into 35 African countries.

Thuraya Satellite Telecommunications Co, based in Abu Dhabi, launched commercial operations in 35 European, Asian and African countries. The company has signed agreements with about 40 institutions for the distribution of its services. Thuraya's mobile telephone units comply with the GSM technology.

Denmark-based Thrane & Thrane acquired Nera's satellite communications division to create the world's largest mobile satellite communications equipment supplier with research departments focusing on satellite broadband transmission development. The merged companies intend to focus on satellite ground equipment.

Mobile phones and health concerns

The European Committee for Electrotechnical Standardisation (CENELEC) has released an EU-wide electromagnetic safety standard for mobile telephone manufacturers. The new standard (EN 50360) will apply to mobile phones marketed within the European Union. It was established through measurement methods based on "dummy heads" filled with test devices called phantom heads. More info can be found at http://www.cenelec.org/BASIS/celis/free/project/SF. Nokia, Motorola and Ericsson have also agreed with CENELEC to notify European users of the radiation levels on mobile phones. The information would be included in user manuals.

Spanish wireless operators Telefonica Móviles, Airtel, Amena and Xfera, electronics and telecoms employer's association Aniel and the Spanish Consumer's board have signed a self regulation agreement to avoid social alarms due to the proliferation of mobile phone masts and their possible health effects. The companies will limit exposure to electromagnetic waves and will consider sharing networks to avoid concentration of masts in one area.

Professor Suh Jung-seon of Seoul National University in South Korea has submitted a report to the Ministry of Information and Communication showing that cell phones do not have an effect on the growth of human cells although the report concludes that there is still insufficient information to declare cell phones safe or dangerous. In the study, human and mouse cells were subjected at an SAR of 1.5 watts per kilogram for 12 hours and no defects were found in the growth of cells and the replication of DNA. When the cells absorbed 75 watts per kilogram, there was some stress on the cell membranes but the cells showed no chromosome aberrations.

A study from Lennart Hardell, a cancer specialist at Orebro University in Sweden, concludes that people who used a cell phone for more than two hours per day in the 1980's and early 1990's show a significant raised possibility of developing a brain tumour. The study tracked 1,600 survivors of brain tumours along with 1,600 healthy people and found that those using extensively the phone over 5 years had a 26% higher chance of developing brain tumour; the percentage increased to 77% for periods longer than 10 years. The tumours were also 2.5 times more likely to appear on the same side of the head as a cell phone was usually used.

Wireless industry forecasts and surveys

Cahners InStat forecasts in its report, "Base Stations Go Bonkers", that despite a slow down in the handset market the wireless infrastructure growth will accelerate as a result of growth in emerging nations and roll out of 3G networks. The report predicts that the world-wide number of base stations will more than double between 2001 and 2005 with an average of 286,000 new base stations per year.

The Yankee Group has predicted that wireless penetration will double over the next five years, reaching 21% of the world's population by 2006, i.e. 1.3billion subscribers. According to the company, today there are 625million wireless subscribers and a 10.6% penetration rate. The increase should be mostly due to an important growth of wireless subscribers in regions like Latin America and Asia. The research firm also predicts that wireless subscribers in the Asia-Pacific region will hit 575million by 2005, surpassing Europe as the world's leading wireless market. Another report from Telecompetition also highlights the importance of developing countries in the mobile data industry. The report predicts that by 2010 the 729million mobile data subscribers in the developing regions will nearly equal the 796million in developed countries.

A report from UK-based consultancy ARC forecasts the mobile gaming users to grow to around 850million by 2006 from 43million at present. The firm expects online games to show a strong growth rising from 21.8% in 2001 to 43.2% by 2006. Online games are also expected to be second most popular service after ring tone downloads.

A new report from the Yankee Group reveals a lack of consistency and innovation coupled with high costs characterising current GPRS offerings. The report, "Mobile Data Pricing: Will European Consumers Pay a Packet?", looked at 29 Western European operators and found that for consumers the average monthly cost for 10MB of data is around US$170. GPRS pricing was found to be uncompetitive with PSTN data services beyond 500KB of consumption and at around 2MB against ADSL. The report suggests three different pricing models depending on the type of application. Applications of a predetermined size, such as video postcards or SMS, should be billed per application. Real-time services, such as gaming and teleconferencing, should be billed by duration while features such as email and Internet browsing should be billed by volume.

Spectrum licenses

Bharti Enterprises won eight of the seventeen GSM licenses auctioned by the Indian Government. Other winners include Birla AT&T, Hutchison Telecom, Escorts Telecommunications and Reliance Group. The Government initially received 57 bids from seven companies for the country's 21 telecom zones. The Indian Government is preparing to re-offer the unsold GSM licenses in some areas.

A consortium including LG Telecom, Hanara Telecom, Powercom and 1,000 other small firms won the third 3G licenses in South Korea. The consortium will have to operate a network based on cdma2000 technology as established by the Ministry of Information and Telecommunications. The country previously awarded two 3G licenses based on the WCDMA standard.

Singapore has awarded to the three existing GSM operators more GSM spectrum in the 1800MHz band. Each operator has been awarded two blocks of 2×5MHz.

Greece awarded, via an auction process, three UMTS licenses to mobile phone operators CosmOTE, Panafon and Stet Hellas for a total of $414.1million. Panafon has been awarded 2×20MHz FDD and 5MHz TDD; CosmOTE received 2×15MHz FDD and 5MHz TDD and Stet 2×10MHz FDD and 5MHz TDD. Greece also awarded more GSM spectrum to Panafon and Stet Hellas.

Sonera is returning its Norwegian UMTS license to regulators after failing to find a new partner to replace Enitel after its withdrawal from its joint venture with Sonera.

The Bosnian Communications Regulatory Agency has cancelled the tender of a third GSM license in the country. Slovakia has approved plans to offer a third GSM license operating in both 900MHz and 1800MHz bands. The license

will also include spectrum in the 3G band; the two incumbent operators are supposed to receive a 3G license.

Russian operator Sonic Duo, participated by Sonera, has been awarded frequencies in the E-GSM band, between 890-915MHz and 925-935MHz, in the Moscow area. The company was previously awarded other frequencies from the Russian military.

The Industry Committee of the European Parliament has approved a resolution stating that the political control of the allocation of radio spectrum should remain within the EU national authorities. The European Commission has been aiming to get more power on this area.

Brazil has failed again to sell its Band C mobile phone license. The Telecoms Regulator offered the license as a nation-wide permit after failing initially to sell it as three separate regional licenses. Venezuela has delayed until the first half of 2002 an auction of 11 licenses for Local Multipoint Distribution Systems (LMDS). Uruguay is planning an auction of 2G and 3G licenses in November.

Egypt's Orascom Telecom has won Algeria's second GSM license after beating the only other bidder, Orange. The country plans to grant another license in December 2003. Tunisia has abandoned its plans to tender a second GSM license as the Government was not satisfied with the highest bid. The Government of Ivory Coast is planning an international tender for a fourth mobile phone operator. Morocco is also planning to launch a third GSM mobile phone license in 2003. Mozambique has also announced it will soon launch an international tender for the country's second mobile phone license.

Wireless LAN and Bluetooth

Jacksonville (US) has created an initiative to provide broad wireless community access to the Internet through the creation of multiple public Wireless Internet Zones (WIZ). A WIZ is an access area providing wireless connectivity to the Internet through laptops or web-enabled handheld devices. The connection is free of charge but requires the device to be 802.11b or WiFi-enabled. More information about this project can be found at www.jaxwiz.org

SkyCross has introduced what it claims is the wireless industry's first embedded 2.45 and 5.25GHz dual frequency antenna that can be designed into high data rate WLAN devices including wireless laptops, PDAs, and PCMCIA cards. The antenna which is designed in a small 1.4×0.97×0.21 inch package is based on SkyCross's patented Meander Line Antenna (MLA) technology. Systemonic introduced the first single-chip, baseband solution to seamlessly support both 802.11a and HiperLAN/2 protocol standards. The H01 Baseband Processor is a complete physical layer implementation supporting high-speed data rates up to 60Mbits/s. Envara Inc has also announced a wireless chipset design, WiND, operating in the 5GHz band that will offer compatibility with 2.4GHz, IEEE 802.11b (Wi-Fi) compliant wireless LAN devices.

The report "Public Wireless LANs: Challenges, Opportunities & Strategies" from Datacomm Research identifies wireless LANs as the superior solution for providing wireless services indoors and on hot spots. The company explains in the report why 3G wireless network operators need public wireless LANs to serve the most demanding users. In another report, consultancy firm BWCS also identifies the capabilities of WLANs to serve hot spots which will damage the revenue of 3G mobile operators. According to the company, by 2006 the US will have an estimated 69,360 WLAN public access hotspots, compared to 30,020 in Europe and 14,840 in Asia.

The American Transat Technologies announced a solution for integrating 3G services with WLAN technology. The solution is said to cut network deployment costs by a factor of ten. Transat's approach uses full GSM protocols and security features but replaces the standard GSM radio card with a WLAN card. The WLAN radio connection is made transparent to the GSM protocols and is invisible to the GSM network. The authentication, authorisation, encryption, mobility management and billing are all fully GSM compliant.

Researchers from Cisco Systems and the Weizmann Institute in Israel published a paper in the Eighth Annual Workshop On Selected Areas in Cryptography in which a new flaw in the security system used by the 802.11b standard is unveiled. The weakness, which apparently is easier to crack than previous reported problems, is in the way the encryption engine is initialised. Researchers found that there is a correlation between the encryption key and the scrambled output, so that by looking at the output the keys can be recovered. A program called AirSnort, which has been released on the Internet, also exploits security flaws in the 802.11b standard, allowing hackers to grab and analyse data to recover master passwords.

A survey from the ARC Group, "The Bluetooth Industry Survey Report" predicts that by 2006 over 500 million Bluetooth enabled devices will be in use. The market is expected to take off once the price of a Bluetooth chipset drops under $5; 48% of the respondents expect the price to be by the end of the year between $11 and $25. In a different report, Frost & Sullivan is predicting Bluetooth shipments to pass from 4.2million in 2001 to 1.01billion by 2006. The revenues are expected to pass from $2billion to $333billion in the same time frame.

Twenty leading Chinese companies and research institutes have formed the Bluetooth Technology Commission to support the standardised development of the technology in China.

Asian mobile market

China has become the biggest cellular phone market after reaching 120.6million users at the end of July compared to the 120.1million users in the US. China is still expecting to reach 132million by the end of this year which will mean 46.4million new users during 2001.

The Ministry of Information Industry of China has announced it will start this October a large-scale field trial to test the TD-SCDMA technology. The trial is expected to last a year with commercial launch in the second quarter of 2002. In the second phase of TD-SCDMA product development, China will conduct a similar trial with IP networks.

Qualcomm opened its CDMA Development Center in Beijing to provide training, support and equipment testing services to manufacturers and mobile carriers, as well as to support R&D of 3G standards based on CDMA. The Center will house Qualcomm's CDMA University. Qualcomm has also announced that a subsidiary of China Unicom has signed a memorandum of understanding to run Qualcomm's Binary Runtime Environment for Wireless (BREW) on its application platform. Meanwhile, China's State Development Planning Commission has approved 19 Chinese firms, including Motorola China Ltd, to produce CDMA handsets

The report "China Unicom's CDMA project: The Big Pie Finally Falls" from the Yankee Group predicts 55million CDMA subscribers by the end of 2005 in China. According to the study, the CDMA infrastructure and terminal market will be worth about $50billion over the next five years. The firm has also published the report "Mobile Data Services in China: The Party Has Yet to Start" where it analyses the long-term Chinese mobile data market. The report predicts 112.5million data users by the end of 2005 with data service revenues reaching $5.68billion; SMS will still be the dominant service.

China Unicom has announced a technology and mobile roaming tie-up with the Japanese operator KDDI. The deal will allow CDMA roaming between Japan and China. The Chinese firm previously signed other deals with SK Telecom from South Korea, which will allow Korean subscribers to access CDMA services in four Chinese provinces.

Japan Telecom, Japan's third largest wireless carrier, has decided to merge its J-Phone group wireless units with Vodafone expected to take an increasing role within the company. The firm has also announced that its subscribers will be able to access DoCoMo's i-mode web sites. DoCoMo users have access to around 48,000 sites while J-Phone users can only access 850 sites through the "J-Sky" service. DoCoMo has started with Coca-Cola and Itochu a trial of a new service, named "Cmode", that will link a specially developed Coca-Cola vending machine equipped with a printer, sensor and speaker, and connected to i-mode. The service transforms the vending machine into an information station and services terminal offering 'fun, excitement and entertainment.' DoCoMo has also announced a deal with Toei Co. to distribute movie contents over DoCoMo's 3G FOMA system.

According to figures released by the Cellular Operator's Association of India (COAI) the number of cellular subscribers in the country grew 86.9% year-on-year to reach 4.078 million at the end of June.

African mobile market

The two new private GSM operators, MTN and Econet, have started their operation in Nigeria. Nigeria is considered to be one of the most important African telecoms market with 110million people and less than one connected phone line for every 250 people. The two operators, which previously sealed an interconnectivity agreement, have been initially limited to 5,000 lines each as state telephone company Nitel cannot support more than 10,000 lines. The initial network of Econet should be able to support 100,000 lines. Nigerian Communications Commission (NCC) is expecting to add over one million lines in the first six months, which represents more mobile lines than the rest of West Africa together. Within the next five years, NCC expects between six and ten million subscribers. MTN and Econet have announced that they have already attained the one year target in less than three weeks. Nitel is expected to launch the third GSM network in the coming months once its privatisation is over.

Saudi-backed Cell C has been finally awarded by the South African Telecoms regulator the GSM1800 license it won last February. The company is now expecting to launch commercial service before the end of the year. The South African Cabinet has approved legislation that will allow the bugging of mobile phones in an attempt to fight against crime.

After winning the first private GSM license in Algeria, Orascom Telecom has unveiled its plans to launch an initial network of up to 500,000 mobile lines for the first year with a total investment of US$500million over the next five years. The Zambia Privatisation Agency has granted the state owned Zambia Telecommunications permission to build out its GSM network.

Other news

Motorola announced it is unleashing its embedded 2.5G and 3G semiconductor and software technology arsenal for the world's manufacturers of mobile communications products to address a $35billion market by 2004. Motorola's 2.5G and 3G platforms are total system solutions that bundle the chipset, software, development tools, reference design, test environments and type certification support. In a similar move, Ericsson has set up a new division, Ericsson Mobile platforms, dedicated to license its 2.5G and 3G technology. The unit, that will remain a part of Ericsson, will offer platforms including component specifications, printed circuit board layouts and software, plus support for customization.

Sony and Ericsson have finally agreed the terms to merge their mobile phone businesses world-wide. The two companies signed a Memorandum of Understanding last April. The new company, Sony Ericsson Mobile Communications, will be based in London and will begin its activity with global product, marketing and sales operations.

The merger of North-West GSM, Sonic Duo and five regional GSM 900/1800 operators owned by Telekominvest has created the first pan-Russian mobile operator. The new company will have 400,000 subscribers and cover 80% of Russia.

Motorola and Think Outside announced the first portable keyboard for wireless phones. The Motorola iBoard keyboard was designed for use with Motorola's i85s and i50sx Internet-ready wireless handsets. The keyboard allows users to surf the web, launch programs, turn the phone off and activate the speakerphone. The keyboard can be folded from a full size 343×127×13mm to a compact size 89×127×19mm.

Following a previous Ericsson announcement, Philips has also revealed it would outsource its entire mobile handset manufacturing operation to a Chinese manufacturer. Alcatel has also announced it will sell most of its manufacturing plants world-wide. According to a report ("Contract Electronics Manufacturers Explode") from consultancy firm Strategy Analytics, vendors will outsource 70% of handset production and Contract Electronics Manufacturers (CEMs) will generate $80billion in revenues by 2006 from handset manufacturing. Meanwhile, Microsoft has announced it is entering the handset-making business after investing in the UK-based handset maker, Sendo.

The European Commission is asking telecom companies to apply for EU grants, under the Trans-European Telecommunications Networks programme, worth 20 million euros over the next 18 months. Projects on the exploitation of broadband mobile networks are of particular interest. More information can be found at http://www.ten-telecom.org/

The police, fire and EMS in Pinellas County, Florida, are deploying a wideband data system from Motorola, designated the Greenhouse Project. The system operates at 460kbps (48 times faster than the current US public safety standard) and enables simultaneous live wireless mobile video, voice and Intranet/Internet high-speed data transmission. The system operates in the new 700MHz public safety band, under an experimental 150 kHz FCC license. More information can be found on www.motorola.com/greenhouse.
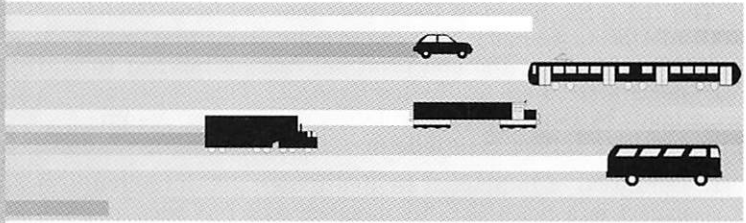
Standards

Dennis Bodson, Senior Editor

cdma2000 1xEV-DO recognized as a IMT-2000 standard

The International Telecommunications Union Radiocommunications (ITU-R) Working Part 8F recognized cdma2000 1xEV-DO (1x Evolution Data Only) as a third-generation IMT-2000 standard. The standard will now be submitted to ITU-R SG-8 for formal approval. cdma2000 1xEV is part of the evolution of cdma2000 1x. cdma2000 1xEV-DO is optimized to support 2.4Mbps peak rate in a standard 1.25Mhz channel for fixed, portable and mobile applications. SK Telecom and KT Freetel in Korea are expected to launch the standard commercially early next year.

TIA published New Project 25 Standard

The Telecommunications Industry Association (TIA) has published a new standard, "Project 25 Digital Radio Over-the-Air Rekeying (OTAR) Protocol," TIA/EIA-102.AACA.

The document is an upgrade of TIA/EIA/TSB-102.AACA. It is part of a comprehensive set of documents designed to promote interoperability between various pieces of compliant radio equipment, regardless of their origin. This standard defines the over-the-air-rekeying protocol for Project 25 systems for Type 3 OTAR.

TIA/EIA-102.AACA directly addresses many of the requirements in the Statement of Requirements in Reference 1 and it uses the elements of the model given in the general System Model. Specifically, the scope of this document is to address methods of OTAR and closely associated over-the-air key management functions in a multi-key Project 25 system. The primary objective of this standard is to enable subscriber units and systems which conform to this document to be interoperable to the extent that keys can be passed via the CAI between communicating units and enable encrypted communications.

The Association of Public-Safety Communications Officials (APCO); the National Association of State Telecommunications Directors (NASTD); and Federal Government Agencies (FED), known as APCO/NASTD/FED, will be issuing common system standards for digital public safety radio communications (APCO/NASTD/FED Project 25 Standard). TIA, in cooperation with APCO/NASTD/FED, has generated standards, interim standards, specifications and telecommunications systems bulletins that define the equipment and processes necessary for implementation of the APCO/NASTD/FED Project 25 Standard.

DECT/GSM interworking

The European Telecommunications Standards Institute (ETSI) has published a new version of the DECT/GSM Interworking profile. The document contains general description of service requirements, functional capabilities and information flows.

To enable DECT terminals to inter-work with DECT systems which are connected to the GSM infrastructure, the document specifies the additions to the Generic Access Profile (GAP) specification, on which this profile is based. The additions are also based on the DECT Common Interface specification.

Interworking requirements are based upon Mobile Switching Centre (MSC) attachments for the DECT Fixed Part (FP) that emulates a GSM Base Station Controller (BSC). The complete interface used between the DECT FP and the GSM MSC is specified in ETS 300 499.

The DECT access protocols and FP and Portable Part (PP) interworking/mapping necessary for the support of basic voice telephony service are specified in EN 300 370 also recently republished. The complete set of GSM services according to GSM Phase 2 is supported.

The functional separation of the DECT/GSM interworking between DECT FP and PP allows for terminal portability. All GSM roaming scenarios based on SIM roaming are applicable.

ETSI releases report on HIPERLAN interworking with 3G

A Technical Report on "Requirements and Architectures for Interworking between HIPERLAN/2 and 3rd Generation Cellular systems" has been published. The document is available for download free of charge on: http://pda.etsi.org/pda/home.asp?wki_id=7078. The report first defines requirements concerning the interworking of HIPERLAN/2 and 3G systems, then two interworking scenarios, called "loose interworking" and "tight interworking", are also defined. All the requirements are analyzed in detail for both scenarios. Based on the results of this report, ETSI BRAN has started work on a Technical Specification (TS 101 961), which will specify the architectures and protocols of a HIPERLAN/2 network that interworks with 3G networks. The work will include both the radio access part and the fixed part of the network. The publication of this specification is scheduled for July 2002.

Distributed Speech Recognition is included in 3GPP

The inclusion of Distributed Speech Recognition capability (DSR) services in 3GPP has been agreed by the 3GPP Services and System Aspects Technical Specification Group (TSG SA). This has successfully resulted in the creation of a new Work Item in SA1 (Services) as well as a series of liaison statements to the appropriate TSGs in 3GPP. The new work item in 3GPP is an important first step towards widespread adoption of DSR services. It is expected that a Packet-switched Speech Driven Service and a Packet-switched Multi-modal Service will allow an exciting new set of applications (e.g. Voice Portal, Form Filling, Dictation, Voice Browsing, etc.).

IEEE-SA Board of Governors

The IEEE-SA Board of Governors met on June 25-26, 2001 in Alberta, Canada. There were many items that were discussed, however, the one principal item of interest to VTS deals with " Fees for Invited Experts." Three motions were made by Dennis Bodson relating to this area. A summary of these actions is as follows:

1. Definition of Individual Invited Expert – "An invited expert is a non-IEEE-SA member who has been requested (invited) by a sponsor or working group chair to ballot on a specific document for the purpose of providing expertise to improve the quality of that document. Invited experts are not involved in the activities of the IEEE, and therefore, are not usually members of the IEEE or IEEE-SA, and may not be willing to pay the non-member fee for balloting."

2. The sponsor shall provide the following information when requesting the participation of an invited individual expert in a particular balloting group:

   a) A rationale as to why the invited expert is needed

   b) Brief background information on each individual invited expert including qualifications

   c) A statement explaining the detrimental impact if the invited individual expert does not participate

   d) The total number of individuals in the balloting group

   e) The total number of individual invited experts in the balloting group

3. The IEEE-SA Standards Board shall be the approval body for invited individual experts for a particular balloting group according to the IEEE-SA Standards Board Bylaws.

All of the motions were approved.

IEEE-SA Standards Board Meetings

June 2001 IEEE-SA Standards Board Meeting

The June 14, 2001 IEEE–SA Standards Board was held in Piscataway, NJ. The following Target Extension Requests and Revised PARS were approved:

Target Extension Requests:

P1512b (SCC32) Amendment for Implementing Foreign Data Elements for Common Incident Management Message Sets for Use by Emergency Management Centers, IEEE 1512-2000

Revised PARS

P1489 (SCC32) Standard for Data Dictionaries for Intelligent Transportation Systems

September 2001 IEEE-SA Standards Board Meeting

The September 13, 2001 IEEE Standards Board meeting scheduled to be held in Piscataway, NJ was cancelled due to the terrorists attacks on the World Trade Center and the Pentagon. The next meeting of the Standards Board is scheduled for December 6, 2001, in New York City.

IEEE Standard Helps Us Connect In A Wireless World

From airport lounges and hotel meeting rooms to coffee shops and restaurants across the globe, a wireless world is being built for mobile professionals to stay connected to the Internet. The key to connecting these laptops, personal digital assistants (PDAs) and new devices yet to come is the IEEE 802.11b standard, known in industry as Wi-Fi. As part of the IEEE 802.11 wireless Local Area Network (LAN) standard, IEEE 802.11b was published in 1999. While the original target of the standard were businesses looking to save money on LAN installation costs, Wi-Fi products have now penetrated the consumer networking market. For the complete IEEE Institute article, visit http://www.spectrum. ieee.org/INST/jul2001/fconnect.html.

IEEE 802 Standards Group Authorizes Wireless Coexistence Study

The IEEE Standards Association (IEEE-SA) with Mobilian Corporation, announced that Dr. Jim Lansford, Mobilian's VP of Business Development, has been selected by the IEEE 802 to chair a study group that will examine the coexistence issues between multiple standards in all the unlicensed bands.

This is especially important as industry experts expect multiple standards to continue to emerge to meet the differing and often conflicting needs of different wireless data networking applications. More information can be found at the following URL:

http://standards.ieee.org/announcements/802mobilian.html

Recently Published IEEE LAN/MAN Standards

The IEEE has recently published the standards below in telecommunications and information exchange between systems, specifically for Local and Metropolitan Area Networks (LAN/MAN):

802.1t-2001 IEEE Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Common Specifications – Part 3: Media Access Control (MAC) Bridges. They are available in both print and PDF versions as follows:

Print: http://shop.ieee.org/store/product.asp?prodno=SH94915
PDF: http://shop.ieee.org/store/product.asp?prodno=SS94915

802.1u-2001 IEEE Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Virtual Bridged Local Area Networks – Amendment 1: Technical and Editorial Corrections. They are available in print and PDF versions as follows:

Print: http://shop.ieee.org/store/product.asp?prodno=SH94916
PDF: http://shop.ieee.org/store/product.asp?prodno=SS94916

VTS Board of Governors Election Results

This year's ballot for IEEE VTS Board of Governors election was highly competitive, with nine candidates for the five positions which fall vacant this year. This year's successful candidates were:

Charles Backof

Dennis Bodson

Samuel R. McConoughey

Tadashi Matsumoto

Eric J. Schimmel

Charles Backof, currently Society Treasurer, Dennis Bodson, Executive Vice President, and Sam McConoughey, a Past President, are existing members of the Board.

Eric Schimmel will be well known to members of the Society. An elected member of the Board of Governors until 1999, he is currently Vice President Mobile Radio and Senior Past President, having been Society President during the period 1997-8.

Tad Matsumoto will also be familiar to members as the Secretary for the very successful VTC2000-Spring in Tokyo, which set records in terms of the surplus generated for the Society. Dr Matsumoto gained his B.S., M.S. and PhD degrees from Keio University, Yokohama-shi, Japan in 1978, 1980 and 1991 respectively. After his Masters degree, he joined Nippon Telegraph and Telephone Corporation (NTT), serving variously in NTT DoCoMo and NTT America. He is currently a head of radio signal processing laboratory at NTT DoCoMo. Tad Matsumoto's election is a landmark for the Society as it is the first from outwith North America.

This year's election sees the retirement of Robert Fenton. His term on the Board of Governors comes to an end at the end of the year, and he did not stand for re-election.

Bob Fenton is a well-respected member of the Board. He has a very long-standing relationship with the society, having been Chairman of the Papers Procurement Committee back in 1972, at a time when the Society was working with the SAE to set up what has now become the Convergence conference. Bob has served on the Board of Governors since 1980, in various capacities as Treasurer, Vice President, and then was elected President in May 1985. He held this position until 1988.

More recently, Bob Fenton was responsible for liaison with the Convergence conference, and for the Convergence Fellowship, the graduate fellowship in Transportation Electronics established jointly by IEEE VTS and the Convergence Education Association to support a student for one year of graduate study. Chairmanship of the Covergence Fellowship Committee has now been taken over by Mark Ehsani.

Two other candidates from this year's election will continue to serve on the Board of Governors in an appointed capacity. Kent Johnson, as President of the Society from 1999 to 2000, will remain on the Board as Past President until 2003. Mel Lewis, who is Conference Coordinator, was appointed to the Board last year for a three-year term.

VTS Executive Committee Elections

Elections were also undertaken at the October Board of Governors meeting for the Executive Committee for 2002. J. R. Cruz was re-elected to serve as President for 2002. The sitting candidates in the other Executive positions were also re-elected to serve for 2002, with the exception of Harvey Glickenstein, who having served four years as Vice President Land Transportation, is not eligible to stand again. His position is taken by John Kingham, of STV Inc., who is Chair of the VTS Land Transportation Division. Harvey Glickenstein will remain as *VTS News* Senior Editor for Land Transportation.

Dan Noble Fellowship

There were no candidates for the Daniel E. Noble Fellowship for the coming year. The Graduate Fellowship in Electrical and Electronic Engineering, which has a value of $7500, is jointly established by the IEEE VTS and Motorola as a memorial to Daniel E. Noble, in recognition of his valuable contributions to the development of two-way vehicular communications and solid state technology. Recipients of the award are selected by a committee on the basis of the candidate's potential to contribute to the profession of Electrical and Electronic Engineering, specifically in the technology areas covered by the VTS.

Transactions in VT Ranked Top Again

IEEE Transactions on Vehicular Technology ranked first in its subject category again in the Institute for Scientific Information's newly released 2000 Journal Citation Report. The ISI study ranks journals' impact by the number of times they are quoted or cited by other scientific publications in their initial year of publication.

This reflects another good year for IEEE journal and magazine citations performance. The IEEE had 9 of the top 10, 16 of the top 20 and 40 of the top 60 most influential journals in the field of electrical and electronic engineering, based on a selection of 202 journals in this category. The IEEE publishes 6 of the top 10 publications in telecommunications. *The Proceedings of the IEEE* was the most highly cited IEEE journal in electrical & electronic engineering, ranking second. The number one ranked journal in the field was *Progress in Quantum Electronics*, published by Elsevier, although this journal publishes a much smaller number of articles.

Also ranking first in their categories were *IEEE Transactions on Automatic Control*, *IEEE Transactions on Semiconductor Manufacturing*, and *IEEE Transactions on Robotic Automation*.

VTC2001-Fall in Atlantic City

Despite the tragic terrorist attacks on the East Coast, VTC2001-Fall went ahead as planned from 7–11 October 2001. Attendance was down, at about 400 rather than the 650 originally envisaged, but in this the conference was not as badly affected as some other mobile conferences. A full report will appear in the next issue.

VTC2002-Spring in Birmingham, AL, 5-9 May 2002

The VT2002-Spring Conference will be held in Birmingham, AL on 5–9 May 2002.

The objective of the conference is to provide the opportunity to present technical papers and posters, tutorials and panel sessions, and exhibits that represent technical innovation and applications associated with an ever-expanding mobile wireless industry. Although the main focus of the conference is voice and data wireless mobile communications, technical papers, tutorials and panels addressing rail and automotive transportation topics are included. Attendees will have multiple opportunities for interactive participation.

Birmingham is located in North Central Alabama and early May is the peak of spring time in the "Magic City". Attractions include: NASA's Marshall Space Flight Center at Redstone Arsenal in nearby Huntsville, AL; The Robert Trent Jones Golf Trail; Alabama Sports Hall of Fame; The McWane Center, an interactive hands-on science adventure that also includes an IMAX Dome Theatre; Mercedes Benz, manufacturer of the M-Class ATV, who offers tours of the facility, and Honda. Both Mercedes Benz, located in Vance, AL and Honda, located in Lincoln, AL are within a one hour drive of Birmingham.

Important dates are:

◆ December 15, 2001: Notification of Accepted Papers

◆ February 15, 2002: Deadline for Submission of Full Paper

Further details of technical subject areas, registration, the conference program and activities will be forthcoming on the VTC-02 Spring web site, www.ieee.org/vtc02spring.

Visit the web site: www.ieee.org/vtc02spring

8 May 2001 VTS Board of Governors Meeting Report

The VTS Board of Governors' Meeting was held at VTC 2001-Spring in Rhodes. Attendees included Charles Backof, Dennis Bodson, J.R. Cruz, Bob French, Art Greenberg, Ghobad Heidari, James Irvine, Preston Jackson, Kent Johnson, Anil Kripilani, Mel Lewis, Bob Mazzola, George McClure, Sam McConoughey, Reuven Meidan, Stefan Parkvall, Tom Rubinstein, Joel Snyder (2001 IEEE President), Mihael Sternad, Gordon Stuber, Ray Trott, Jim Worsham, and Yu-Dong Yao. As a citizen of Taiwan, the secretary required a visa to attend the meeting and this could not be obtained in time.

VTC2001-Spring Reuven Meidan gave a report on the conference in Rhodes. 608 papers had been accepted and were printed in the proceedings, of which 420 were oral papers and 188 were posters. In total about 800 papers had been submitted. 639 people registered for the conference, and about 200 people had attended the tutorials. A total of 305 who attended were registered as students, which meant that income was lower than expected. Reuven highlighted the problem that 83 people had registered for the conference but had not turned up, 61 of whom were students. This could not have been due to the change in venue since registration only started after the change had been confirmed. He noted that for students, submitting a paper and then paying the $75 registration fee to ensure that the paper is printed in the proceedings is a very cheap way of getting published. If that student co-authored multiple papers, it became cheaper still, since only one co-author was required to register for the paper to be printed, and in some cases a single author was involved as many as five papers. The large number of no shows would suggest that at least some people submitting papers do not plan to come, and an additional problem is the student registrations are subsidised and do not cover actual costs. Boston had had a similar number of no shows, at about 10 to 15%.

It was expected that there would be a loss from the conference, since the large local support that had been expected from Israel would not be repeated in Rhodes. This would reduce income, while expenses were larger than expected due to the costs of bringing people and equipment from Israel. There were some savings and room costs ($70 compared to $150 in Israel), but in Rhodes conference facilities had to be rented as opposed to the situation in Israel where the conference facilities were thrown in with a minimum room allocation. Therefore $40 was added to the room rate to compensate.

Mel Lewis noted that there was a problem of not having the paper copies of the conference proceedings available at the conference. Rueven said that the aim was to have the paper copies by the conference, but the firm doing the printing had taken longer than promised due to problems with PDF files coming from different parts of the world.

Treasurer's Report Charles Backof reported that the society had made an operating loss during the previous year. No conferences were closed in the year 2000, while service charges from the IEEE went up very significantly. The loss was around $65,000. The loss would not have occurred if conferences has had been closed out or if the service charges had not been increased, but with both occurring the loss was unavoidable. In addition to this there was $146,000 charge on reserves to cover IEEE corporate deficit. It was likely that another $240,000 would go the same way in the year 2001, although the Society budget for this year includes a surplus. The net worth of the Society was now about $1.2 million.

Bylaws Change. Dennis Bodson proposed a change in section 2 of the bylaws to remove the word "elected". Bob Mazzola seconded the motion. The bylaw would therefore read "The President or the Executive Vice President must be members of the Board of Governors". The reason for the change is that the election results may not the available prior to the last Board of Governors meeting, so the election to the executive may occur prior to return the Board of Governors elections, which means in the current situation second guessing the Board of Governors election results. Ken Johnson noted that although he supported the amendment, the way round the problem was to get the election done right so the result is available, and that if this was done there was no requirement for an amendment. George McClure said that while ideally this may be the case, the change in the bylaw would give the additional flexibility if

some unforeseen delay did occur. The bylaw change was passed by 12 votes for with none against, with President J R Cruz, in the chair, abstaining.

Conferences and meetings : Mikael Sternad made a presentation on behalf of the Swedish chapter proposing Sweden's as a site of the spring conference in 2005. They would be targeting early June. VTC was held in Sweden in 1994, the first time ever outside North America, and 750 people attended and a $17,000 surplus was made. Issues raised included a possible conflict with ICC, and the short notice from the fall VTC which a June date would entail. The Swedish chapter were encouraged to bring back a formal proposal and budget.

Preston Jackson gave a report on the VTC2002-Spring in Birmingham. This conference will be based on volunteers rather than a conference organising company. Three-quarters of the organising committee had previous experience in organising a successful conference in Birmingham in 1986. The submitted budget has been approved.

Professor Khaled Ben Letaief presented on VTC2002-Fall on behalf of Vijay Bhargava. A detailed budget was submitted and a call for papers is now out. There were some concern that some of the figures were a little low, and Mel will work with them to revise them.

The newly reactivated Vancouver chapter requested matching funding of $500 to hold a workshop on 3rd generation CDMA. This was approved.

Awards Committee Ray Trott reported that the awards were "in transit". He put forward motion to make some minor modifications to bring the formal description of the awards into line with current practice, and this was approved. This will now go into Technical Activities Board (TAB) to get final approval. It was agreed that awards for conference chairman be considered individually after each conference closed.

For the record, the awards did in fact arrive one hour before the awards lunch!

VTC2001-Fall. Art Greenberg gave a comprehensive presentation on the plans for the event. They have a full committee in place and the keynote speech in the shape of Dr George Zysman, past CTO, Lucent Wireless. On the last day the conference they will have a half day workshop on application driven interaction assessment presented by companies. Fifteen tutorial proposals had been submitted to date, along with 780 abstracts. The social programme will include tours to Cape May, the FAA, Philadelphia, Renault Winery and a Historic Town Tour.

Past Conferences: Jim Worsham reported on past conferences. He had attended the IEEE Conference Workshop and reported that money from conferences is becoming a greater proportion of IEEE funding. There was a requirement for common branding, with 'IEEE' appearing in the conference name, and another issue raised in the workshop was that of tax in respect of overseas conferences. Given the reaction at the workshop from some parties to the possibility of not having printed proceedings, he felt that printing had a long future. Libraries are the major post conference buyers of proceedings, and they do not consider CD-ROMs are achievable. Six conferences are currently awaiting closure. JRC 1999 and 2000 are currently cosponsored by Vehicular Technology Society, although in practice the conference was run ASME, and the reports the IEEE require are not available. It was therefore proposed to change to Technical Co-sponsorship which involves no financial commitment. This was agreed unanimously. On VTC'99-Spring in Houston, there was nothing at report, and he was still pressurising the local committee without results. The board agreed that matters would have to be taken further, as until the conference is closed the Society is being penalised by

$750 per quarter. Charles Backof recommended that in future the situation be avoided by the use of concentration banking as an audit trail then exists; the 2002-Spring conference is already using this method. Regarding VTC'99-Fall, the IEEE recommended more control be kept of overseas conferences. There was some discussion on this point and the need for someone from the Board to sit on the local organising committee of conferences. It was suggested that this might be done by rotation round board members given the number of VTC conferences. VTC2000-Spring is basically done. There was a currency exchange variation in the money received by the IEEE which needs to be verified. It is likely this conference will be close within the next few weeks. VTC2000-Fall looks like it will produce a surplus of about $100,000.

Mel Lewis gave a short report on VTC2003-Spring and VTC2003-Fall. Regarding the former, a hotel had now been lined up. For VTC2003-Fall, he had been maintaining contact with Dr Mohsen Guizani, the conference chair.

Joel Snyder, IEEE President visited the meeting at this point. San McCourtney noted that this is the first time in the Society's 50 year history that a Board meeting had had the pleasure of the company of the IEEE president. Joel Snyder was asked about budget for 2002. He said that this is starting to be prepared and they were targeting a break-even budget by looking at both income and expenditure. They are looking at several methods to cut back on expenditure, as well as looking at the market value for services, conferences and publications to see how income could be improved. 1.25 million documents had been downloaded through the IEEE Xplore system in the first two months of the year, and this system will start to make money this year. The large amount of investment of the past few years had cost money, but was now starting to bear fruit.

VTC 2003-Spring: Tom Rubenstein reported that a subcommittee had been formed to look at whether Milan or Genoa was the better option. Mel Lewis and Bob Mazzola had visited both locations. Bob reported that there was more to do in Millan, but more within walking distance in Genoa. Access to both cities is about the same, and the same conference organising company would be used for either location. It was agreed to go for Genoa.

Future Conferences: Different locations were being considered for VTC2004-Fall. Of these, Los Angeles was most keen, but their sponsoring arrangements might prove difficult. Discussions are still ongoing. As well as the proposal from Sweden reported earlier, there was a tentative proposal from London for Spring 2005. They will be invited to come back with more a detailed proposal which can be considered along with the Swedish proposal.

Publications. The report was given by JR Cruz on behalf of Greg Bottomley, who proposed a supplement the given to the system administrator working on the online peer review process at Ericsson. This was agreed. James Irvine reported on the newsletter, and the fact that with the small changes made to the headings from the May issue almost all of the changes approved by the Board the previous year have now been implemented. The new branding rules for the IEEE would be implemented with effect from the May issue. It was also now possible to use up to two pages of full-colour per issue. It was agreed to purchase a desktop publishing package to speed the processing of copy before it is sent to the IEEE.

An advertising policy for the newsletter was agreed whereby conferences not sponsored by the VTS would be charged for advertising in the VTS News.

Distinguished Speakers and the **Fellows Committee:** Gordon Stuber reported that an additional member had been appointed to the Fellow's committee. He also reported

on the distinguished speakers programme, where he has been trying to get an additional four figures on the roster; two in North America, one in Europe and one Asia. The speaker from Asia had not yet been identified but the others were in place. The board agreed that speakers be appointed for a two-year period.

Electric Vehicles: Bob Mazzola reported for Mark Ehsani on the Electrical Vehicles committee. Two invited sessions have been prepared for the conference in Atlantic City. Bob also reported that Convergence 2002 has now been fixed at 21-23 October 2002.

Chapter Development: Anil Kripalani reported that he was following up on opportunities for new chapters.

ITS Bob French reported on ITS. Societies within the council, of which VTS is one, were asked to consider themselves co-sponsors of ITS Council conferences. The Council is now collaborating with the Aerospace Policy Committee, but this did not prevent individual societies from raising issues directly. Eric Schimmel does this for VTS.

Board of Governors elections Kent Johnson reported on nominations for the Board of Governors elections. Bob Fenton was not running for re-election. There are four candidates whose term expires this year who will be running again, along with Mel Lewis, Tad Matsumoto, Evan Richards, Mark Ehsani, and Eric Schimmel. The board approved the slate.

Standards. Dennis Bodson reported that Standards Association membership was grown well, and it now has about 10,000 members. Bob Laurent is now the acting chairman of SEC 32.

Election for Division IX George McClure is running for the position of Director of Division IX. The last time a VTC

Board member had been director was Art Goldsmith more than ten years ago.

Five Year Review: Kent Johnson reported on the outcome of the five-year review, which had been very favourable, and was accepted by the Society without comment. Their comments included the fact that with two conference is every year, the surplus generated by the conferences would be reduced, but it increases the societies exposure and provides a better service members. Other areas which were commended were the increased page count and use of color in the VTS News, and the extensive standards activities. The review did point to the need for a greater international presence in on the Board of Governors, and the need for more equitable split between a different areas of activity identified in the charter of the Society, i.e., radio, land transportation, and automotive electronics.

Wireless Title: The meeting ended with some discussion on the use of the term Wireless in the name of the Society and for the transactions. Previous discussions had lead to agreement on the title Vehicular and Wireless Technology, but there was no eternal support for this within TAB. JR Cruz reported that the situation had moved on since then, and it was no longer a discussion between the Communications Society and the VTS, but rather many more societies were wishing to get involved in the "wireless" area. The brand is therefore losing some of its appeal. It was agreed to discuss this matter more fully at the next meeting.

Student registration for conferences: Bob Mazzola will circulate a paper for the Board so that advice can be given to Atlantic City.

Next Meeting It was agreed that the next meeting would be in Atlantic City during VTC-Fall.

Calls for Papers

2002 IEEE/ASME Joint Rail Conference in Washington, D.C. 23-25 April 2002

New applications of technology in the railroad and rail transit industries are presented periodically at conferences and trade shows. The annual IEEE/ASME Joint Rail Conference offers a unique and comprehensive technical forum. Join your peers to share information, learn about technology progress, share operating experiences, and find new approaches to current and future challenges.

The Joint Rail Conference is sponsored by the Land Transportation Division of the Vehicular Technology Society (VTS) of the IEEE and the Rail Transportation Division of the ASME. The 2002 Conference will be held in Washington D.C. at the Washington Plaza Hotel. The Conference is scheduled for Tuesday, April 23 through Thursday, April 25, 2001.

You are invited to submit abstracts of papers for inclusion in this Conference. Papers should cover topics of current interest in railroad system design, hardware/software development, transportation technology, service experience, or related issues. Papers are solicited from members of the supply industry, rail transportation corporations and rail transit agencies, governmental agencies, consulting/engineering firms, academia, technical organizations, and others.

This year's conference will feature a special theme:

Rail Industry Productivity and Safety
– A Capital Call for Progress

Papers in the areas listed below are especially appreciated; all papers of interest are also welcome. Topics can include:

◆ Maintenance procedures, monitoring and fault detection, remote diagnostics.
◆ Computer modeling and simulation of transportation systems.
◆ Rail transportation, high speed passenger rail, rail transit, systems.
◆ Braking systems, coupling/cushioning systems, truck suspension systems.
◆ Passenger and Freight Car Mechanical Design and Analysis.
◆ Crashworthiness of vehicles—locomotives, cab cars, light rail cars.
◆ New freight transportation concepts.

Authors are requested to submit 200-300 word abstracts by electronic mail (preferred) or by 5 printed copies **no later than November 15, 2001** to:

Margaret Burnett, Papers Chair
Land Transportation Division, IEEE-VTS
LTK Engineering
401 S. Jackson St.
Tel: 206-689-3322, Fax: 206-689-3339
E-mail: burnettm@soundtransit.org

If submitting by mail or fax, please forward a diskette copy of your abstract, preferably in Microsoft Word format.

Notification of paper acceptance will be made by November 30, 2000. Selected papers must be submitted in acceptable format, as instructed, **no later than January 15, 2001** for publication in the Conference Proceedings.

Lead author Advance Registration for the Conference will be required.

VTC2002-Fall
VANCOUVER
Pathway to Ubiquitous Wireless Communications

VTC2002-Fall in Vancouver, British Columbia, Canada Hyatt Regency Hotel, 24-29 September 2002

The VTC-2002 Fall Conference, to be held in Vancouver, Canada, aims to capture and present the current state of the innovative and highly active mobile wireless industry. We seek to present the changing face of wireless technology and a glimpse in the future of this exciting field. Over 400 full technical papers and posters are expected to be presented, along with tutorials, business application/panel sessions and exhibits. Authors are invited to submit extended abstracts describing original research results, innovative applications, and experimental or field trial/test results in the following mentioned fields of wireless communication, transportation and automotive technology.

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

Paper Submission Guidelines

Authors MUST submit an extended abstract (up to 2 pages) at the SAME time of their short abstract submission (approx. 150 words). Forms for submission are soft copy in MS Word, PDF or PS file formats. The submission must include the name, complete mailing address, telephone and fax numbers, the designation number of the Technical Subject Area of the paper and the email address of the author(s).

Panel Sessions & Tutorials

Proposals for Tutorials and Panel sessions are also accepted in the VTC-2002/Fall. Tutorials (half-day or full-day sessions) that are intended to provide in-depth learning on a specific topic of interest to the participants. Panel sessions are 90 minutes long. They present leaders in a particular area discussing a topic of interest to the attendees of VTC-2002/Fall. There is usually significant audience participation in Panel sessions. Proposals for Tutorials and Panel sessions should consist of a 250 word summary, a 100 word abstract, and a cover page listing the details of the author(s) as given above. Summaries should be submitted electronically (MS Word, PDF or PS) by February 15, 2002. Submissions should be made at the website "http://www.fallvtc2002.org"

Important Dates

Nov 01, 2001   First date for submission of abstracts (Authors MUST submit the short **and** extended abstracts at the **same** time)
Feb 15, 2002   Last date for submission of abstracts
May 15, 2002   Notification of acceptance
July 15, 2002   Last date for submission of camera-ready version of accepted papers

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Conferences of Interest

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

DATE	CONFERENCE	LOCATION	WEB PAGE	
13-16 November 2001	ISCOM01	Tainan, Taiwan	http://www.ncku.edu.tw/ ~ISCOM01	
14-16 November 2001	ISCIT 2001	Chiang Mai, Thailand	http://www.kmitl.ac.th/~iscit/	
25-29 November 2001	Globecom 2001	San Antonio, TX	http://www.globecom2001.com	
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	
19-21 March 2002	11th Int. Conf. On Road Trans. Information and Control	London, UK	http://conferences.iee.org/RTIC	
23-25 April 2002	JRC 2002	Washington, DC	mailto:burnettm@soundtransit.org	✓
28 April - 2 May 2002	ICC2002	New York, NY	http://www.icc2002.com	
6-10 May 2002	VTC 2002-Spring	Birmingham, AL	http://www.ewh.ieee.org/soc/ vtc02spring/	
6-8 May 2002	3G2002	London, UK	http://conferences.iee.org/3G2002	
15-17 May 2002	Wireless Design Conf	London, UK	http://www.wirelessdesignconf.com	✓
28-31 May 2002	3G Wireless 2002	San Francisco, CA	http://delson.org/3gwireless02/	
16-21 June 2002	APS International Symposium / URSI Radio Science Meeting	San Antonio, TX	http://www.ieeeaps.org/ 2002APSURSI/	
16-21 June 2002	IST Mobile Summit	Thessaloniki, Greece	http://www.iti.gr/summit2002	
2-5 September 2002	ISSSTA 2002	Prague, Czech Republic	http://www.ure.cas.cz/isssta2002	✓
15-18 September 2002	PIMRC 2002	Lisbon, Portugal	http://www.pimrc2002.org	
23-27 September 2002	European Microwave Week	Milan, Italy	http://www.eumw.com	✓
24-29 September 2002	VTC 2002-Fall	Vancouver, BC	http://www.fallvtc2002.org	✓
21-23 October 2002	Convergence 2002	Detroit, MI	http://www.convergence2002.org	
27-30 October 2002	WPMC '02	Honolulu, Hawaii	http://www.wpmc02.gatech.edu/	✓
17-21 November 2002	Globecom 2002	Taipei, Taiwan	http://www.globecom2002.com	✓
24-26 March 2003	Int. Symp. On Wireless Systems and Networks (ISWSN'03)	Dhahran, Saudi Arabia	http://www.kfupm.edu.sa/ee/ ISWNWeb/first_call.htm	✓
21-24 April 2003	VTC 2003-Spring	Seoul, Korea	mailto:jhlee@gong.snu.ac.kr	
23-25 April 2003	EMPCC2003	Glasgow, Scotland	mailto:j.dunlop@eee.strath.ac.uk	
11-15 May 2003	ICC2003	Anchorage, AK		
Fall 2003	VTC 2003-Fall	Lake Buena Vista, FL	mailto:mguizani@cs.uwf.edu	
Spring 2004	VTC 2004-Spring	Genoa, Italy	mailto:vatalaro@ing.uniroma2.it	
Spring 2005	VTC 2005-Spring	Stockholm, Sweden	mailto:m.lewis@ieee.org	

Conferences marked '✓' have calls for papers which close on or after 15 November 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.