IEEE VTS NEWS

Connecting the Mobile World

FEATURES

Contents

Examples of current i-mode terminals. In this issue we interview Kei-ichi Enoki of NTT DoCoMo to find out more about i-mode.

Vehicular Technology Society Executive Committee

Foreword

James Irvine, Editor

In this issue we feature two very different technology areas which have some interesting commercial parallels.

The first is mobile data for existing digital cellular systems. While there is a lot of talk of data services for third generation (3G) systems, Internet access is possible today with i-mode and WAP being the main technologies. i-mode has been extremely successful, signing up over 20 million customers in Japan in little over two years. WAP has been less successful, although the comparison is not exactly fair, since messaging services are included in i-mode but are provided by a separate, very successful, SMS service if GSM is used for WAP. However, the lukewarn success of WAP, combined with the high prices paid for 3G licenses, are starting to prompt people to whisper that 3G may not be the success everyone expected. For example, Professor Peter Cochrane, until recently head of British Telecommunications research labs, was quoted as not being optimistic about 3G ever becoming a major force in the UK as it will end up being both too expensive and too complex.

The other technology area is hybrid vehicles. In this issue we focus on the US Government's work in the Partnership for a New Generation of Vehicles' (PNGV) on electrical and electronic innovations, while in the next issue we will take a close look at Ford's zero emission P2000 fuel cell vehicle. The VTS itself is also active, with the Electric Vehicle/Hybrid EV Committee being reestablished under Professor Mark Ehsani (see page 41). However, as reported by our Senior Editor Bill Fleming, hybrid vehicles are getting a lukewarm reception in the marketplace (see page 32), and Lave and MacLean, writing in the March 2001 issue of *IEEE Spectrum*, suggest that there is currently no economic case for using hybrid vehicles.

Both hybrid vehicles and mobile data are examples of high technology innovations which fulfill a need that perhaps the customer does not realise they have yet. One of the difficulties WAP faces is that it is often sold as the Internet on your mobile. As Barry Goodstadt pointed out in VTC in Boston (*VTS News*, Feb. 2001), we all like fast connections and wide screens. The same is true in the automotive field – hybrid vehicles are not the same as IC vehicles, but like WAP, the technology does fulfil a need.

Which brings us to i-mode. The situation in Japan is different because they have got the marketing right. Helped by a lower home PC penetration rate, rather than trying to turn a phone into an Internet access point to compete with a PC, they focus on the innovations which can be undertaken in the format. i-mode users can now correspond with virtual lovers (see Page 30), while GSM text messaging by teenagers is spawning a new shortened language like telegrams did at the beginning of the last century. Both hybrid vehicles and WAP can have a good future, but the marketing must match the technology.

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i-mode

Kei-ichi Enoki, NTTDoCoMo

Since its launch only a little over two years ago, NTT DoCoMo's i-mode service has grown to have more than 20 million customers, making it a benchmark for future cellular data provision, including 3G. In this article, we interview Mr. Kei-ichi Enoki, Managing Director of the Gateway Business Department to ask about i-mode, the services it provides and its future plans for the system.

In general terms, what is i-mode and how does it work?

In addition to voice communications, i-mode handsets also allow you to use e-mail and access the Internet. The i-mode service enables users to access Internet services via their cell phones.
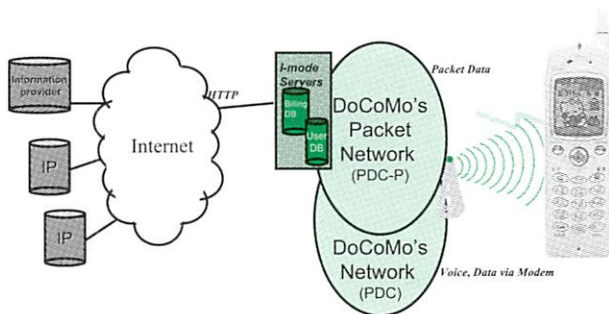
Figure 1 i-mode uses DoCoMo's packet network to access the Internet, while voice calls are carried on the normal PDC network

DoCoMo's i-mode connects users to a wide range of handy online services, many of which are interactive. These services include mobile banking, news and stock updates, telephone directory service, restaurant guide, ticket reservations, purchase of books and CDs, and much more. All services linked directly to the DoCoMo i-mode portal Web site can be accessed immediately by simply pushing the cell phone's dedicated i-mode button. Users can also access thousands of voluntary sites via WWW addresses. Since i-mode is based on packet data transmission technology, users are charged only for the amount of information they retrieve and not for how long they are online.

What user applications does i-mode support currently?

i-mode mobile phones are equipped with 9600bps packet-communication capability and browser software that can read a subset of HTML. Java-compatible 503 series i-mode terminals have the following main functions:

1) Support of permanent memory devices

2) Support of multimedia data

3) Automatic booting of an application

4) Enhanced security

Moreover, they support two versions of SSL (Secure Sockets Layer) SSL v2 and SSL v3 for enhanced security. This is a data security technology that prevents the interception of data, the falsification of personal identities and tampering with existing data.

And what will it support in the future?

DoCoMo intends to enhance its i-mode services by adding additional banking functions and forging ties with providers of content, such as Sony's "Playstation." The forthcoming introduction of an advanced wireless network based on Wideband CDMA (W-CDMA) technology prompted by NTT DoCoMo will provide an all-new platform for accessing increased Web content and applications via i-mode that is also provided in the current PDC system in the 50X series.

What is the most popular i-mode service?

Entertainment Sites.

How easy is it to create a new application or Web page for i-mode?

How hard is it to develop applications and design Web pages with i-mode? It is very easy, because i-mode supports programming in a subset of HTML, a de-facto description language for Web pages.

On our site, we also show you how to design i-mode Web pages (http://www.nttdocomo.com/i/tagindex.html). Today there are more than 40,000 sites for the i-mode service.
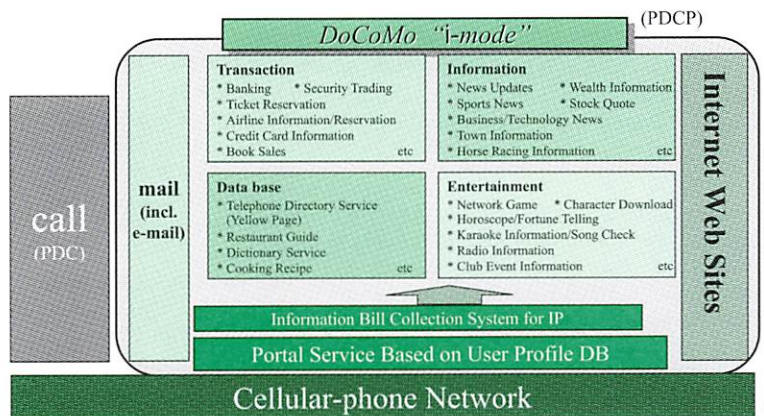
Figure 2 Overview of i-mode services

```
<HTML>
<HEAD>
<TITLE>, I , ` , h , m, l, d, m, t
</HEAD>
<BODY >
<DIV>My Menu</DIV><br>
<A ACCESSKEY="1" HREF = "http://www.docomo.ne.jp/gw/Main/mymenu.htm">1.My Menu</A><br>
<A ACCESSKEY="2" HREF = "http://www.docomo.ne.jp/gw/Main/osusume.htm">2.Recommends</A><br>
<A ACCESSKEY="3" HREF = "http://www.docomo.ne.jp/gw/Main/search.htm">3.Menu Search</A><br>
<A ACCESSKEY="4" HREF = "http://www.docomo.ne.jp/gw/Main/option.htm">4.Settings</A><br>
</BODY>
</HTML>
```

```
<HTML>
<HEAD>
<TITLE>Registration</TITLE>
</HEAD>
<BODY>
<DIV>Registration</DIV>
Day of Birth<br>
<Form Action="mailto:"Method="POST">
Year<INPUT TYPE = "TEXT" NAME ="TEXT" VALUE ="" SIZE = "2" MAXLENGTH = "2" ALIGN = TOP><br>
Month<INPUT TYPE = "TEXT" NAME ="TEXT" VALUE ="" SIZE = "2" MAXLENGTH = "2" ALIGN = TOP><br>
Day<INPUT TYPE = "TEXT" NAME ="TEXT" VALUE ="" SIZE = "2" MAXLENGTH = "2" ALIGN = TOP><br>
<INPUT TYPE = "SUBMIT" NAME ="Submit" VALUE ="1.SEND" ALIGN = TOP>
</BODY>
</HTML>
```
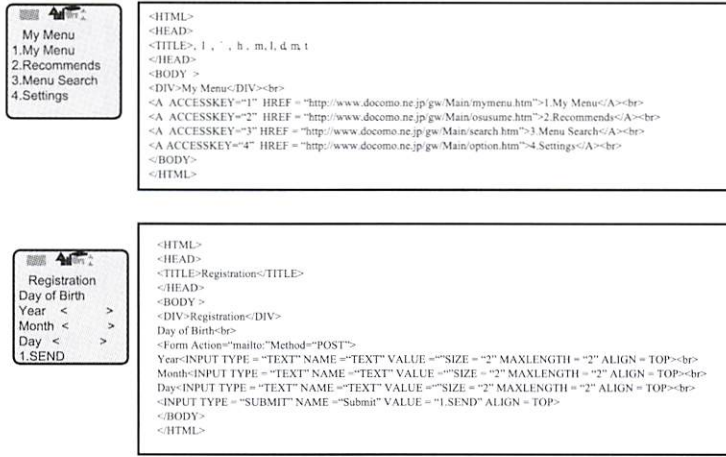
Figure 3 i-mode pages displayed with their source

Does i-mode currently support mobile commerce? If so, how is security guaranteed during electronic transactions?

Eleven companies, including NTT DoCoMo have announced plans to jointly promote the "Edy" prepaid electronic money service and the use of "Edy" cards in the mobile environment as of Dec. 25, 2000.

As for our current services, the level of security of Java-compatible terminals has been further improved by use of the Secure Sockets Layer (SSL) protocol for mobile communications, and the issue of client certifications.

How many subscribers does i-mode have?

20,173,812 as of March 7, 2001.
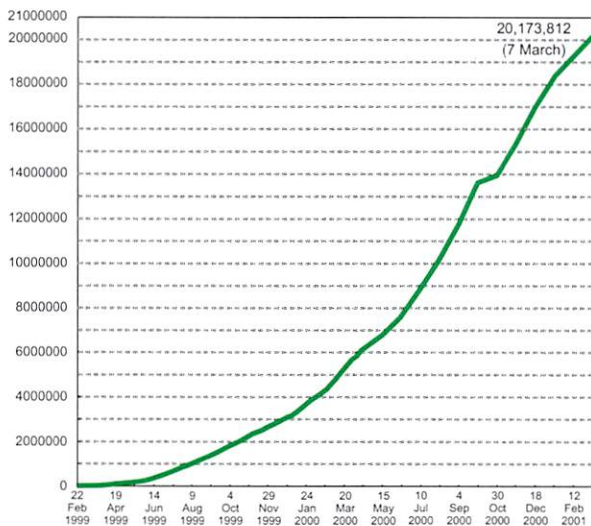
Figure 4 Increase in i-mode subscribers since launch

How many content providers does i-mode have?

Official sites: 1,500 as of March 5, 2001.
Non-official sites: 40,269 as of March 8, 2001.

How do you charge for the service?

i-mode users are charged according to the volume of data they transmit and not for the length of time they are online or the distance over which the data is transmitted. The basic packet transmission charge is equal to 0.3 yen per packet (128 bytes). Therefore, short e-mail of about 20 full characters can be sent for as little as 1 yen (about a third of a cent), a lengthier e-mail of 250 characters would be about 4 yen and an airline reservation may be sent for as little as 20 yen ($0.07). i-mode users also pay DoCoMo a 300 yen ($1) monthly charge in addition to the standard monthly charge for voice service. And there are additional information charges payable to content providers when subscribers use certain i-mode sites on DoCoMo's portal site for information.

How are revenues shared between the service provider and NTT DoCoMo?

Content provider fees are billed through DoCoMo, which receives a commission (9% of information charges) from providers for its billing and collection services.

Is i-mode available throughout Japan or only in urban areas? Can i-mode be used at high speed (e.g., in "bullet" trains)?

i-mode is available throughout Japan. The service can be used at high speed and even in the bullet train, which travels at an average speed of 200 kilometers per hour.

Development

What are DoCoMo's goals for i-mode development?

We developed i-mode technology so users can exchange information anytime, anywhere, and with anyone using i-mode handsets. We will continue to listen to our users by developing additional services and content based on what they tell us they need.

Do you envisage increased use of i-mode with Personal Digital Assistants (PDAs) rather than mobile phones?

That is difficult to answer since i-mode handsets and PDAs tend to be used for different purposes. It is said that more cell phones are being shipped and there are more cell phone users worldwide.

Is Java available on i-mode phones? How will this affect the services which will be supported?

On January 18, 2001, NTT DoCoMo announced the launch of a new i-mode service based on Sun Microsystems' Java technology. The service, dubbed "iappli," officially started on January 26, 2001. Java technology will allow users to run a wider variety of programs, including advanced video games, and process information with greater security compared to current i-mode technology.

Providers will be able to offer a wide variety of content and we will continue to see much more content produced specifically for the i-mode service.
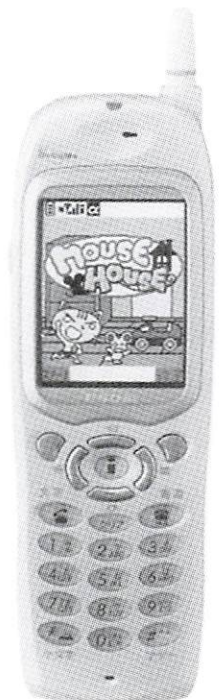
Users will be able to access high-quality content, which will result in wider use of the service.

Can i-mode work with other air interfaces (GPRS, for example)?

It is possible to use the i-mode service as long as handsets support i-mode-compliant HTML.

How will i-mode be affected by the development of 3rd generation systems?

We will continue to offer the i-mode service. By exploiting FOMA's high-performance characteristics, we will provide a more sophisticated i-mode service.

Relationship to WAP

NTT DoCoMo is a major player in the WAP forum. Do you see i-mode and WAP as competing technologies or in the longer term do you see a convergence?

i-mode and WAP will eventually be integrated into X-HTML.

Why do you think i-mode has been so successful in comparison to WAP? Does the reason have to do with technology or marketing?

It is a combination of both. Technically, the i-mode service supports HTML, an Internet language, so anyone can produce content. It also uses the packet communications network that allows for volume-based charges, which has made the service available at low cost. In terms of marketing, we use easy-to-understand terminology and we classify content into four portfolios such as e-commerce, information, database and entertainment, facilitating easy access to information and encouraging further use (see Figure 2).

Figure courtesy of NTT DoCoMo

Figure 5 i-mode development path

Background

i-mode is an Internet access system for cellular phones developed by NTT DoCoMo and launched by them on the market in February 1999. Over the past two years its phenomenal growth has made it the standard-bearer for mobile data provision to public cellular customers.

The system works on top of the Japanese PDC (Personal Digital Cellular) system. Unlike WAP, which modifies HTTP traffic for transmission, i-mode passes the HTML (web) pages straight through the system, although a subset of HTML is used. The HTTP and secure HTTP (HTTPS) layers are maintained, while the lower layers are processed at a gateway from TCP and IP on the Internet to packet mode for the radio link. Web pages can be up to 5Kbytes in size, although 2Kbytes is recommended, with 94 by 72 pixel GIFs. As well as web traffic, i-mode supports email which the system pushes to the mobile phone, again using packet mode. Email can be up to 500 bytes (250 Japanese characters).

PDC is a TDMA system standardised by the ARIB (Association of Radio Industries and Business, the Japanese standardisation body). Each 25kHz carrier can carry 3 full rate or 6 half rate speech channels. The physical layer of the PDC system uses $\pi/4$-QPSK with BCH codes for forward error correction. This maintains a bit error rate of about 10^{-2} to 10^{-4}. Operating on top of this is a link layer, LAPD-M (Link Access Procedure for Digital Mobile) which uses selective repeat ARQ (automatic repeat request) to maintain an error rate of 10^{-6} or better. The TL layer uses stop go ARQ to give a 9.6kbit/s packet data stream with packets of up to 1400 bytes for the application layers.
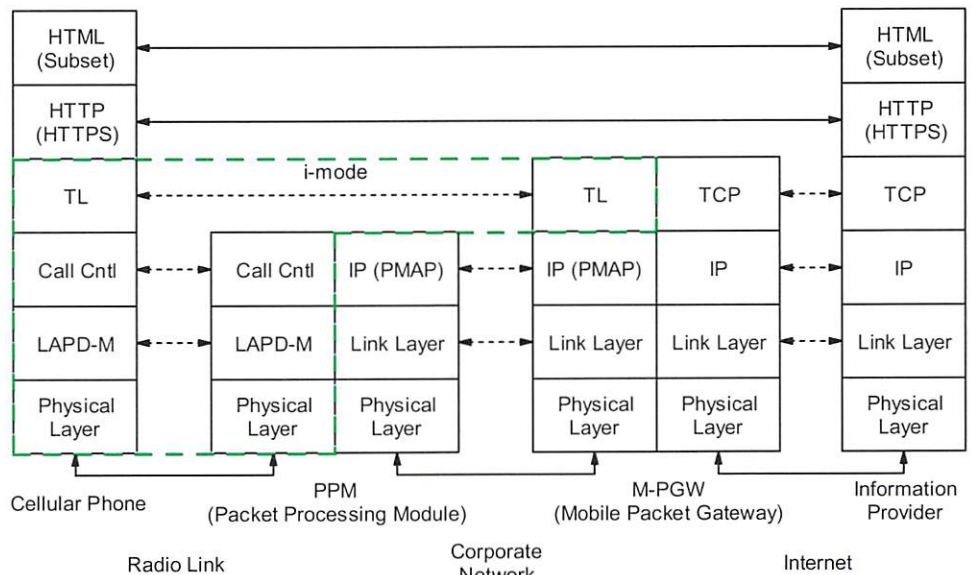
Do you see this success transferring to other markets like the USA and Europe?

Cell phone usage is spreading worldwide. At the same time, cell phones are becoming smaller and more portable. By enabling these devices to process e-mail and access the Internet, as well as facilitate the instant exchange of information, we are allowing ourselves to participate in the new information society.
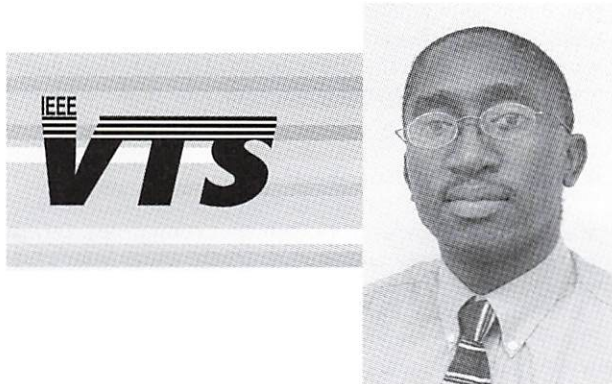
Why did you choose extended HTML rather than a more specialized language optimized to a radio link?

HTML is a de-facto Internet language that allows anyone to become an information provider. That is why we decided to adopt it.

Wireless Application Protocol (WAP)

Mjumo Mzyece, University of Strathclyde

The second of our articles on mobile data in current cellular systems provides an overview of the Wireless Application Protocol (WAP). The article gives the background and motivation for WAP, before going on to outline some of the basic technical details of WAP technology. Several examples of WAP applications and services that have either already been deployed or could be deployed are described. Finally, there is a brief description of a few factors that could impact WAP's bid to become the global standard for wireless applications and services.

Introduction

Since the early 1990s, there has been phenomenal growth in the global wireless communications industry. Alongside this rapid numerical growth have been continual technological developments to meet emerging requirements. One such requirement is for wireless networks to provide services other than the traditional voice, fax and low bit rate data services. The Wireless Application Protocol (WAP) is designed to provide advanced information and telephony applications to wireless devices such as cellular phones and personal digital assistants (PDAs). The first release of WAP (version 1.0) was in April 1998 and there are currently more than 8 million WAP subscribers worldwide [1].

This article gives an overview of WAP, beginning with the background and motivation for the technology. The technical aspects of WAP are then outlined followed by some examples of existing and possible WAP applications. Finally, the future prospects and technical developments of WAP are briefly discussed.

Background and Motivation

There are a number of background and motivating factors that have led to the development of WAP:

Growth in Internet, Wireless and Handheld Device Technologies

During the last decade or so, there has been tremendous growth in three high-technology sectors: the Internet, wireless communications and smart handheld devices.

The Internet has grown explosively in terms of both the number of Internet users and the number of Internet hosts. An Internet host is any computer system that is connected to the Internet, whether by permanent or temporary, dial-up or direct connection, and has an associated domain name and Internet protocol (IP) address. According to Internet pioneer Vint Cerf, at the end of 1991 the Internet had over 700,000 hosts used by over 4 million people [2]. In March 2001, it is estimated that there are more than 116 million Internet hosts and more than 428 million Internet users [3]. The International Telecommunication Union (ITU) projects that by the end of 2002, there will be approximately 600 million Internet users [4].

Running almost concurrently with this growth in the Internet has been the equally extraordinary growth in the number of mobile cellular networks and subscribers (Figure 1). The number of mobile cellular subscribers worldwide grew from a mere 11 million in 1990 to 472 million in 1999 [4].
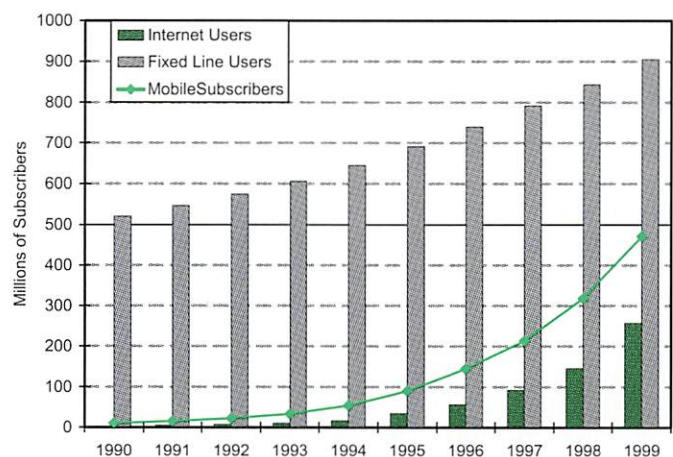
Figure 1 Worldwide Growth in Mobile and Internet Subscribers
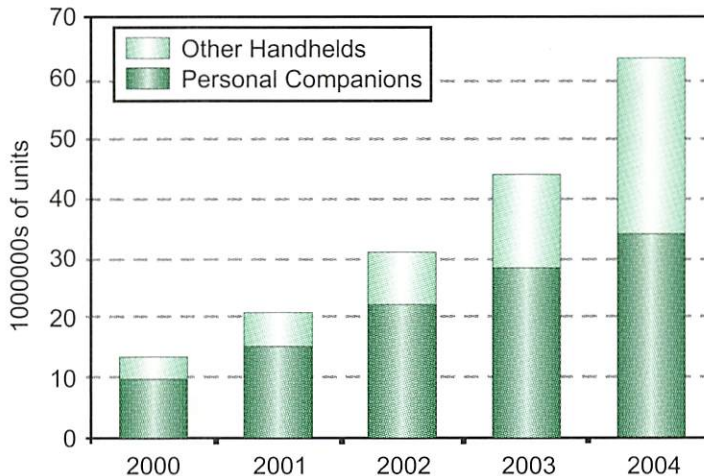
Figure 2 Unit Shipments of smart handheld devices (Source: IDC Research, 2001)

The third and most recent area of rapid growth has been in the smart handheld devices market. Some examples of such devices are PDAs, palmtop PCs, gaming consoles and smart phones. Figure 2 shows an analysis and forecast for the smart handheld device market from 2000 to 2004.

Convergence of Internet and Wireless Communications

The Internet and wireless communications have conventionally been regarded as separate technologies. This is because originally, the Internet was designed to carry mainly data traffic, whilst wireless networks were designed to carry mainly voice traffic. This boundary has become increasingly blurred in recent years.

According to one estimate, the Voice-over-IP (VoIP) market was equivalent to 2.7 billion minutes of traffic in 1999 and will grow to about 35 billion minutes, with revenues of US$19 billion, by 2004. Other sources estimate that by 2004 as much as 25% or 40% of all international calls will be carried over IP [5].

Mobile telephony, on the other hand, has seen some remarkable growth in the carriage of data. The huge popularity of the GSM-based Short Message Service (SMS) vividly illustrates this strong trend. The GSM Association forecasts that by December 2001, global SMS traffic will soar to 25 billion text messages per month, up from 15 billion in December 2000 [6].

These are just two examples of the convergence of traditional Internet/IP/data communications (which are data-centric) and traditional wireless communications (which are voice-centric). WAP delivers both data and voice services to wireless devices.

Need for Standardisation

Given the extremely competitive global telecommunications market and the resultant desire to provide value-added services on top of voice telephony, there is a need for a standard for the delivery of wireless applications and services. Such a standard has to be open,

global and enjoy wide industry support. The alternative is a fragmented wireless services market with many proprietary standards. WAP fulfils the role of being a single standard platform for wireless services and applications.

What is WAP?

WAP is an optimised communications protocol stack *and* an application environment designed for the deployment of advanced information and telephony services for wireless devices. It has been *optimised* to cope with the constraints of the wireless operating environment, and the limitations of its targeted wireless devices.

A Brief History of WAP

WAP is the creation of the WAP Forum [7], a consortium of wireless operators, Internet companies, terminal manufacturers, network infrastructure manufacturers, software companies and other interested parties. The WAP Forum was founded in June 1997 by Phone.com (formerly Unwired Planet and now part of Openwave Systems), together with Ericsson, Motorola and Nokia (the world's three largest cellular handset manufacturers). As of January 2001, the WAP Forum membership stood at over 630 [1].

The latest approved version of WAP at the time of writing (March 2001) is version 1.2.1 which was released in June 2000. The following discussion is based upon the specifications for WAP 1.2.1.

WAP Specifications

The WAP specifications comprise almost 40 documents that in total run into the hundreds of pages [8]. Given the volume of the specifications, it is not possible (or even desirable, for that matter) to discuss all the details of WAP in an article of this length and nature. Therefore only the basic features of WAP will be highlighted.

Conceptually, WAP can be considered as comprising two complimentary parts:

✦ A *lightweight, optimised communications protocol stack* closely based on the Internet protocol stack;
✦ An *application environment* that provides a platform for the delivery of advanced information and telephony services to wireless devices.

Most Internet applications have been designed for desktop and other powerful computers, and for medium-to-high bandwidth available from fairly reliable wired communications networks.
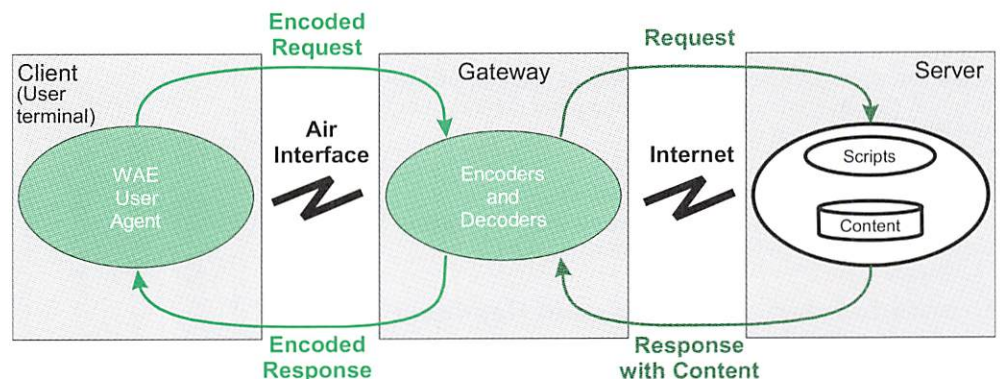
Figure 3 The WAP Architecture
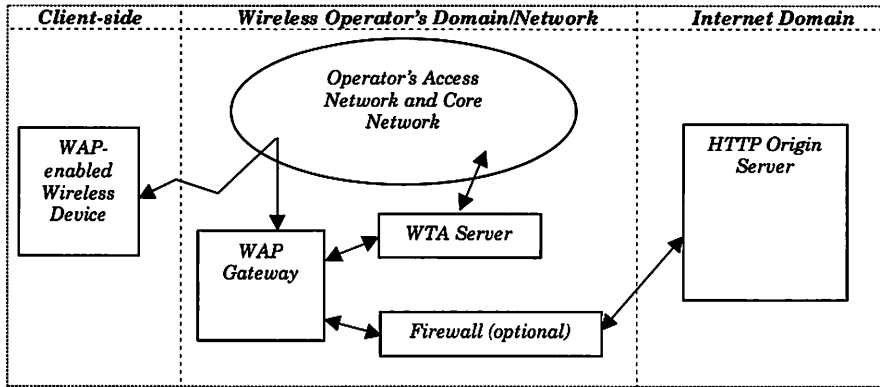
Figure 4 Interconnection of key network components for WAP service

In contrast, the types of devices targeted by WAP have considerable limitations compared to desktop computers. These limitations include:

+ Limited processing power i.e. less powerful CPUs
+ Limited memory (ROM and RAM)
+ Limited power supplies
+ Limited displays
+ Limited input devices (e.g., a phone keypad).

In addition, wireless communications networks present a number of constraints not found in their wired counterparts. Due to limited radio spectrum, the peculiarities of radio propagation and the mobility of users, wireless communications networks tend to suffer from:

+ Limited bandwidth
+ Interference and fading effects
+ Unpredictable and variable delays
+ More unstable connections
+ Less predictable availability.

The WAP specifications are specifically designed to address these limitations through a number of optimisations which will be discussed shortly.

The WAP specifications are also designed to be both *bearer-independent* and *device-independent*. Therefore, WAP is not tied to any particular wireless bearer technology or any particular type of wireless device. WAP can therefore be used with any bearer from GSM to CDMA, and on any device from a pager to a PDA.

The WAP Architecture

The WAP Architecture Specification acts as the starting point for understanding the WAP technologies and specifications. It provides an overview of how the WAP technologies fit

and work together. Figure 3 shows a schematic of the WAP architecture.

As already mentioned, the WAP architecture is closely modelled on the Internet architecture. The Internet architecture works on the *client/server model* in which content and applications stored on an *origin server* (a web server, for instance) are accessed by a *client* (such as a web browser).

Similarly, WAP content and applications are stored on origin servers using existing server technology such as the World Wide Web's Hypertext Transfer Protocol (HTTP). These applications and content are then accessed by the WAP client using a *microbrowser*.

Sitting in between the WAP origin server in the *Internet domain*, and the WAP client in the *wireless domain* is a *WAP gateway* or *proxy*. The WAP gateway is the translator between the Internet domain and the wireless domain and comprises the following functionality:

+ Protocol Gateway – The protocol gateway translates requests and responses from the WAP protocol stack to the Internet protocol stack, and vice-versa.
+ Content Encoders and Decoders – The content encoders translate WAP content into compact encoded formats to reduce the size of transmitted data over the wireless interface (also known as the air or radio interface).

Figure 4 depicts the interrelationship of the key network components required for a WAP service.

The WAP Protocol Stack

WAP provides an optimized five-layer protocol stack. The layered structure enables services and applications to utilize the features of the WAP stack through a set of well-defined interfaces. The five layers are:

+ **Application Layer** Wireless Application Environment (WAE)
+ **Session Layer** Wireless Session Protocol (WSP)
+ **Transaction Layer** Wireless Transaction Protocol (WTP)
+ **Security Layer** Wireless Transport Layer Security (WTLS)
+ **Transport Layer** Wireless Datagram Protocol (WDP)

Figure 5 shows the WAP protocol stack in relation to the Internet protocol stack.

It is worth noting that the *bearer services* at the base of the stack are not part of the WAP specifications.

External applications and services (in the application layer) may access any of the lower layers directly. Each layer of the WAP protocol stack will now be defined briefly.

Wireless Application Environment (WAE)

WAE is the uppermost layer in the WAP protocol stack, and it provides a general-purpose application environment combining elements of WWW and mobile telephony technologies. The key components of WAE are as follows:

+ **WAE User Agents** – client-side in-device software that

Internet	WAP		
HTML/JavaScript	Wireless Application Environment (WAE)		
HTTP	Wireless Session Protocol (WSP)		
	Wireless Transaction Protocol (WTP)		
TLS-SLL	Wireless Transport Layer Security (WTLS)		
TCP/IP	Wireless Datagram Protocol (WDP)		
UDP/IP	BEARERS CURRENTLY SUPPORTED BY WAP: GSM SMS, USSD, CSD, GPRS; IS-136 R-DATA, CSD, PACKET; CDMA SMS, CSD; PDC CSD, PACKET; PHS CSD; CDPD; IDEN SMS, CSD, PACKET; FLEX & REFLEX, DATATAC		

Figure 5 WAP protocol stack in relation to the Internet protocol stack

provides specific functionality (e.g., display content) to the end-user. Micro-browsers and phonebooks are examples of WAE user agents.

- ✦ **Wireless Markup Language (WML)** – a lightweight markup language that has been implemented using the eXtensible Markup Language (XML). XML is a meta-language used for defining markup languages. Unlike HTML which is rigidly defined for all applications environments, WML has been *specifically* designed and optimized for use on limited capability wireless terminals and for transmission in wireless channels. WML uses a *card and deck metaphor*. WML documents are made up of multiple *cards*. Each user interaction and navigation through an application is described by a set of cards called a *deck*. Decks are downloaded from the WAP origin server as and when required. Each card in a deck defines a single unit of interaction with the user.
- ✦ **WMLScript** – a lightweight scripting language, based on JavaScript. WMLScript adds procedural logic and intelligence to WML decks to allow for capabilities such as validation of user input and access to device facilities and peripherals.
- ✦ **Content Generators** – Applications or services on origin servers that produce standard content formats in response to requests from user agents in the mobile terminal. WAE does not specify any standard content generators, but allows for any content running on a typical HTTP server commonly used on the World Wide Web. WAP content may be static (already resident on the server) or dynamic (produced on-the-fly in response to some user input or behaviour e.g. content from CGI scripts). To specify content and resources, WAP uses Uniform Resource Locators (URLs), the same addressing scheme used on the Internet. WAP also uses Uniform Resource Identifiers (URIs) to address resources that are not accessible via commonly used protocols e.g. a URI is used for local access to a wireless device's telephony functions.
- ✦ **Wireless Telephony Applications (WTA)** – WTA provides a collection of telephony based extensions to WAP that allow for the deployment of services such as initiating phone calls, call-management, handling of text messages and phonebook control.
- ✦ **Content Formats** – a set of well-defined data formats with optimized compression for transmission on wireless networks. These include encoded WML format, WMLScript bytecode format, Wireless Bitmap format (WBMP), electronic business cards, and electronic calendars and scheduling exchange format.

Wireless Session Protocol (WSP)

WSP provides the upper WAE with a consistent interface for two types of session services. First, a *connection-oriented service* that operates above the transaction layer protocol (WTP) and the datagram layer protocol (WDP). And second, a *connectionless service* that operates above WDP only, bypassing WTP. Both types of session services may operate in secure or non-secure modes (with and without WTLS respectively).

WSP facilitates organized exchange of content between co-operating client/server applications. Specifically, it allows applications to:

- ✦ establish and release sessions between clients and servers;
- ✦ agree on a common level of protocol functionality using capability negotiation;
- ✦ exchange content between client and server using compact encoding;

- ✦ suspend and resume sessions.

WSP is based on HTTP/1.1.

Wireless Transaction Protocol (WTP)

WTP provides the services necessary for interactive "browsing" applications (i.e. request/response applications). During a browsing session, a client requests information from a server, and the server responds with that information. This request/response pair of events is called the *transaction*. The purpose of WTP is to reliably complete a transaction taking into account both the degree of reliability required and the cost of achieving that reliability. WTP runs on top of a datagram service (WDP) and optionally a security service (WTLS).

WTP specifies three classes of transaction service:

- ✦ Unreliable invoke message with no result message;
- ✦ Reliable invoke message with no result message;
- ✦ Reliable invoke message with one reliable result message.

Other key features of WTP include:

- ✦ Acknowledgements, duplicate removal and re-transmissions;
- ✦ Optional user-to-user reliability whereby the WTP user confirms every received message;
- ✦ Concatenation and separation of multiple Protocol Data Units (PDUs);
- ✦ Message orientation so that the basic unit of interchange is an entire message and not a stream of bytes;
- ✦ Asynchronous transactions by which a responder sends back a result as data become available.

Wireless Transport Layer Security (WTLS)

WTLS is the security layer protocol in the WAP protocol stack. The WTLS layer operates above the transport protocol layer (WDP). The WTLS layer is an optional layer, and whether or not it is implemented depends on the required level of security for a given application. The purpose of the WTLS layer is to provide privacy, data integrity and authentication between two communicating applications.

WTLS is based on the Internet standard Transport Layer Security or TLS protocol (previously called Secure Sockets Layer or SSL). WTLS provides the following features:

- ✦ Data integrity
- ✦ Privacy
- ✦ Authentication
- ✦ Denial-of-service protection

Wireless Datagram Protocol (WDP)

WDP is the transport layer in the WAP protocol stack. The WDP layer operates above the data capable bearer services supported by the various wireless network types. It provides a common interface to the upper layer WAP protocols and enables them to function independently of the underlying wireless network.

This bearer independence is achieved by adapting the WDP layer to specific features of the underlying bearer. Figure 6 depicts WDP bearer adaptation for four different bearers.

WDP offers transparent service to the upper layers of the WAP protocol at the Transport Service Access Point (TSAP) interface. This allows applications to operate transparently over different underlying bearer services.

The varying heights of each of the bearer services and their respective bearer adaptations indicates the differences in operation of the various bearers, and the different WDP adaptations required to maintain consistent service to the upper layers above the TSAP interface.

Each individual bearer service that is supported by WAP has its own WDP profile. This is called the *WDP Bearer Dependent Profile*. It defines the operation between a wireless

Transport Service Access
Point (TSAP)

Wireless Datagram Protocol			
Bearer A Adaptation	Bearer B Adaptation	Bearer C Adaptation	Bearer D Adaptation
			Bearer Service D
		Bearer Service C	
	Bearer Service B		
Bearer Service A			
Physical layer air interfaces			
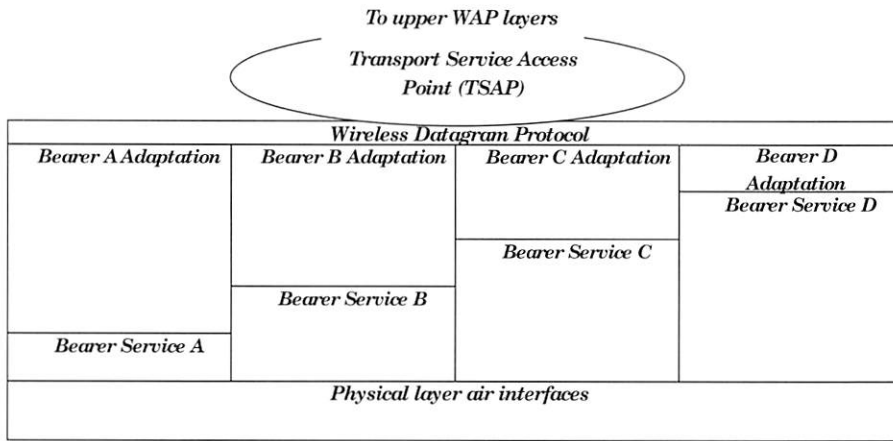
Figure 6 Wireless Datagram Protocol Architecture

terminal and the WAP Gateway over that particular bearer. For example, the current WDP specifications define the following protocol profiles for GSM: GSM SMS, GSM USSD, GSM CSD, GSM GPRS and GSM Cell Broadcast. Similar WDP profiles are defined for each bearer service supported by WAP.

Since the WDP layer provides the interface between the bearer service and the rest of the WAP protocol stack, the WDP specification specifies the bearers that are supported together with their adaptation profiles. As more bearer services such as Wideband-CDMA are developed and deployed, it is expected that they will be incorporated into the WDP specifications.

WAP Applications and Services

There are a variety of WAP applications and services that are existing or feasible, including:

Content-based Services

In this context, content could be current affairs, stock market news, movie clips, sports scores/highlights, cartoons and downloadable jingles. This is the sort of content that has proved very successful for Japanese wireless operator NTT DoCoMo's i-mode service.

Examples of existing content-based WAP applications include: StockSmart (http://agsub.stocksmart.com) which provides up-to-the-minute stock market news and the FT.com WAP site (http://wap.ft.com) which provides business news and analysis. Figure 7 shows the opening screens of the FT.com WAP site viewed with one of the numerous free WAP emulators available on the Internet.

Location-based Applications

Location-based or *position-dependent services* are services delivered to a wireless terminal on the basis of its current location or position. The UK-based National Geospatial Data Framework (NGDF) estimates that as much as 80% of information has some relationship to the earth's surface or is, in other words, geospatially referenced [9]. This gives some indication of just how valuable information about position or location is in general.

There are a wide variety of location-sensitive applications which can be implemented with WAP including:

✦ **Emergency/Safety Services.** These types of services could include roadside assistance/rescue services and emergency medical services.
✦ **Localised Information.** This category of services could include targeted advertising, WAP-enabled tour guides, Yellow Pages, weather reports, and car parking information.

✦ **Traffic/Routing Information.** This is a prime example of the value of timely position-dependent information. A WAP-enabled traffic and routing application would be able to locate the user and only relay information that is useful in their current position. The route planner could dynamically update the planned route to avoid areas of congestion.
✦ **Tracking Services.** These services use tracking devices such as GPS receivers to locate and monitor moving objects. Obvious areas of applications for individual consumers would be tracking of property, pets or children. Commercial applications could be fleet management and despatch services.

A good example of location-based WAP services is from FedEx. A FedEx customer can use their WAP-enabled device to find the closest FedEx drop-off location complete with driving directions. They can also track the progress of their deliveries via WAP [10].

Financial Services

There are a wide variety of WAP-enabled financial applications and services available. In the United Kingdom, for instance, banks such as the National Westminster Bank and Egg, offer their customers a number of WAP-based banking services.

Gaming/ Entertainment

Wireless gaming and entertainment is a potential "killer app" for WAP services, particularly for younger mobile users. There are already numerous WAP sites dedicated to gaming and entertainment e.g. Wirelessgames.com.

M-commerce Applications

M-commerce or mobile commerce involves buying and selling of goods and services through wireless handheld devices. It is unclear how much real commercial activity there is via WAP-based terminals. Nevertheless, there are many WAP-based m-commerce applications that are being developed, particularly in countries like Finland, which has the highest mobile penetration rate in the world (66.7% according to the ITU) [4]. In Finland, Computer Sciences Corporation (CSC) and Nokia have collaborated with a Finnish fashion retailer to use WAP to send clothing offers direct to mobile telephones.

Figure 7 FT.com WAP site (Source: FT.com, 2000)

Speech-recognition Applications

Applications incorporating speech recognition are one of the most exciting prospects for WAP. The ability to use voice input would increase the ease-of-use and convenience of almost any WAP application. Coupled with machine-translation techniques, speech recognition could even enable WAP applications that translate between different languages. In July 2000, Conversa announced that it had successfully ported its speech recognition and text-to-speech engine to Phone.com's WAP-compatible microbrowser [11]. This development enables a user to control the microbrowser through voice commands.

Conclusions

WAP could potentially become *the* standard for the delivery of advanced applications to wireless terminals. However, there are some points of concern:

+ **Competition from NTT DoCoMo's i-mode service.** NTT DoCoMo's hugely successful i-mode service [12], its recent aggressive expansion strategy outside the Japanese market and its rapid introduction of higher bitrate third-generation cellular networks may pave the way for i-mode to become the global standard for wireless applications and services.
+ **Competition from other Technologies.** In this category are GSM-specific innovations such as the SIM Application toolkit and the Mobile station application execution environment (MExE), and also handheld operating systems such as PalmOS, EPOC and Windows CE. All these technologies are rapidly evolving to incorporate features to enable wireless applications. For example, Microsoft has devoted considerable resources to enabling application development for the Windows CE platform.
+ **Limitations in the current release of WAP.** There are some serious limitations in the current release of WAP including lack of support for multimedia and inadequate security features. The next release of WAP (version 2.0) is scheduled for June 2001 [13] and it is supposed to address some of the current shortcomings of WAP. Notably, it will be based on xHTML, with backwards compatibility to XML.

Whether in the long-term WAP will succeed in becoming the standard for wireless applications standard worldwide is very uncertain. What is certain though is that WAP will continue to be, at least in the short-to-medium-term, a leading contender to become that global standard.

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Metro-North Railroad Telecommunications Infrastructure Project

R. Wayne Staley, Metro-North Railroad & Stephen Weiss, Clifton, Weiss & Associates, Inc.

Metropolitan Transportation Authority Metro-North Railroad (MTA MNR) is one of the largest commuter lines in the United States, providing more than 200 000 customer trips each weekday and some 62 000 000 trips per year.

MTA MNR has an existing voice and data communications infrastructure consisting of older fiber optic equipment, copper cable plant and leased lines used for voice and data transmission services that are central to the day-to-day operations of the Railroad. The existing infrastructure has exceeded its useful service life, and in some cases reliability of certain network elements is poor.

To accommodate existing and projected voice and data communications requirements of the railroad a hybrid telecommunications network has been engineered combining several widely deployed technologies.

The network design is standards-based and provides a scalable platform that will provide a migration path for the future.

This paper focuses upon the design process used at MNR and the rationale behind key decisions reached by the design team that led to the selection of the technologies and topologies utilized in this novel hybrid network.

1. Introduction

To address the need for a new voice and data backbone network to serve MNR's existing and projected communications needs, a dedicated project team was established, comprised of MNR and Connecticut Department of Transportation (ConnDOT) staff.

In May of 1998, MNR selected the joint venture of Railway Systems Design / Clifton, Weiss & Associates, Inc. (RSD/CWA) to join the project team and address the need for a new network. Collectively, the project team:

- ✦ Studied the existing voice and data network.
- ✦ Met with major bandwidth users.
- ✦ Developed design criteria.
- ✦ Projected future voice and data needs.
- ✦ Analyzed options to meet the needs.
- ✦ Engineered the preferred network option.
- ✦ Developed contract specifications and drawings for a Request-for-Proposal (RFP) for the new network and a systems integrator.

2. Existing Network

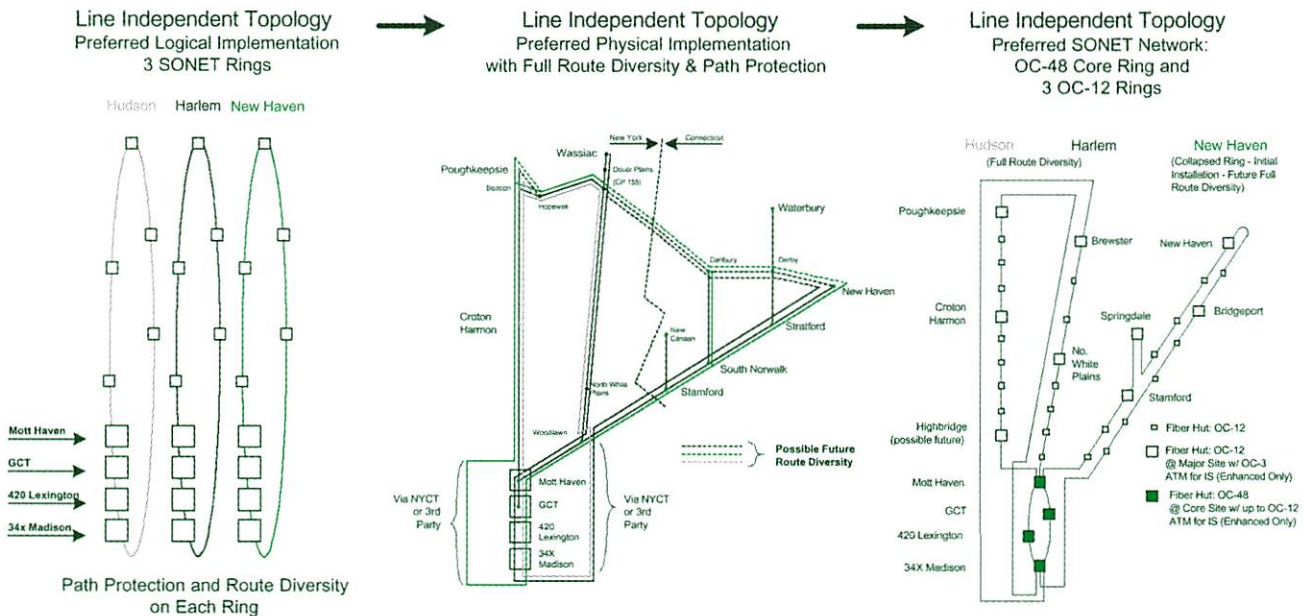Operations at MNR are essentially centralized (linear network) from Grand Central Terminal (GCT). Railroad op-

Figure 1 Network Topology

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erations at MNR rely on the communications systems to remotely control interlockings, substations and power systems. In addition, public address, radio and other information systems rely on the communication system for daily operation. It is therefore critical that all facets of MNR's communication systems be available for operation with no downtime.

The existing network has exceeded its useful service life and demands for additional channels have exceeded capacity. Several key elements of the network are no longer manufactured or available on the secondary market. The reliability of the network is anticipated to continue to deteriorate with its increased age. A single major network failure, or a series of modest events, would place critical elements of MNR's operation at risk.

Consequently, a new Network Infrastructure System was considered essential to meet the strategic and operational objectives of the Railroad.

3. Design Criteria

An extensive assessment of the existing infrastructure was undertaken in concert with a needs assessment throughout the organization, analyzing all aspects of the business. Traffic projections were performed and several network technologies and topologies were examined to solve immediate and long-term needs.

Factors that contributed to the final network topology included the current state and migration of the telecommunications transmission market, the need for a standards based network, operational and managerial requirements of the railroad, quality of service (QOS) demands, reliability and network life cycle.

The design effort undertaken was based on the following primary criteria developed by the design team:

◆ Redundancy in the design to ensure that the network would not fail if the fiber optic cable were cut or if a fiber optic node were to fail.
◆ Off-the-shelf standards-based technology available from multiple vendors.
◆ Continuous monitoring of all systems and alternate routes from a central point.
◆ Use of existing fiber optic and metallic cables with minimal modifications or additions.
◆ Provision of bandwidth to satisfy the estimated needs for a minimum of ten years.

Further, as a public entity, MNR was required to prepare a generic (non-vendor-specific) design that was suitable for procurement by a number of qualified contractors utilizing a wide variety of standards-based vendor equipment. MNR staff will be trained in the operations and maintenance of the new network. In addition, MNR personnel will install, test and provide transition from the existing system. The selected contractor will:

◆ Perform application and design engineering.
◆ Furnish, integrate, factory assemble and test the network.
◆ Supply field installation design and supervision.

4. Network Overview

To meet the existing and projected voice and data needs, desired network topology and required functionality, a network of Synchronous Optical NETwork (SONET) rings and a sub-network of Asynchronous Transfer Mode (ATM) switches will be installed. Reference Figure 1–Network To-
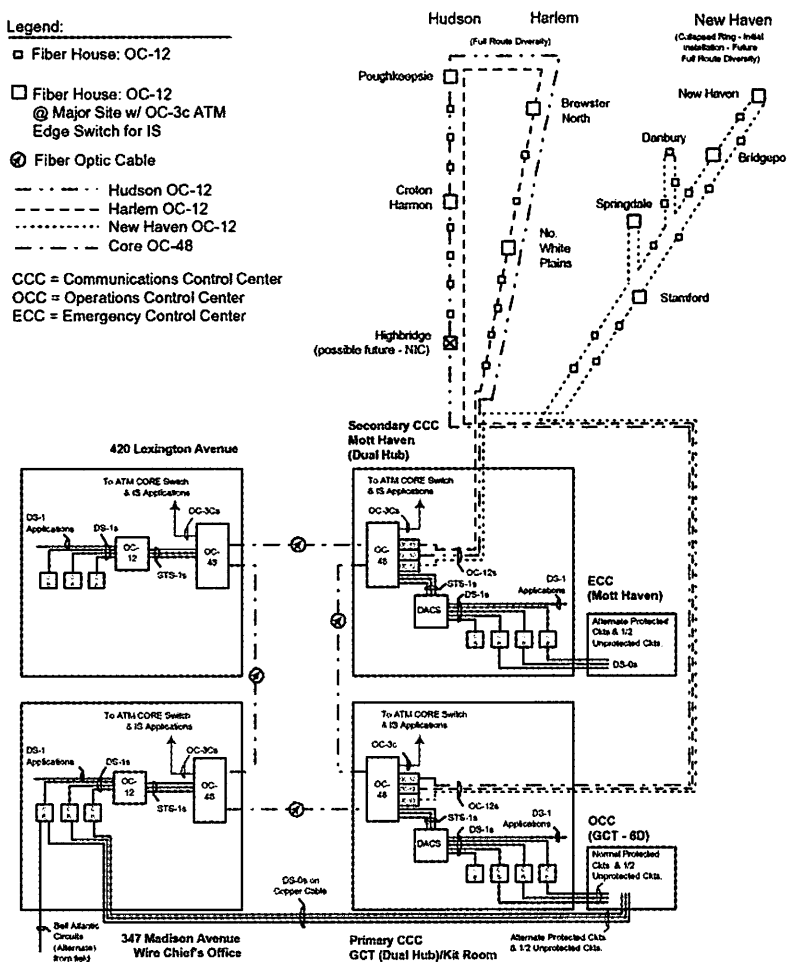
Figure 2 Network Overview

pology, Figure 2–Network Overview, and Figure 3–System-Wide Network, Equipment & Locations. Key features of the new network include:

4.1 Line Independence

For operational reasons the network will be physically partitioned to provide independent operations on each of the Hudson, Harlem and New Haven Lines. A catastrophic failure (cable cut, node failure or other) on any one line cannot be permitted to interrupt service on any other line.

4.2 Redundancy

The Railroad operates twenty-four hour day, seven days per week (24/7), year round. The network must provide automatic levels of redundancy and protection against service disruption, and maintain levels of operation that guarantee uninterrupted operation.

Therefore, in addition to line independence, the network must continue uninterrupted service upon the occurrence of certain events, to include:

◆ Loss of commercial or Railroad supplied ac power.
◆ A single fiber optic cable cut between any two nodes (except where configured as collapsed ring)on any ring.
◆ Simultaneous fiber optic cable cuts, with a maximum of one per ring on the Hudson, Harlem, New Haven or Core rings, where true path diversity is supplied.
◆ Loss of any single node (OC-48 or OC-12) in any ring (Hudson, Harlem, New Haven or Core).

- Loss of either DACS at GCT or Mott Haven (MO). Loss of any single ATM switch.
- Degradation of service from any single occurrence of one of these events on any Rail Division or ring (Hudson, Harlem, New Haven or Core) shall not degrade service on any other Division or ring.

4.3 Major Network Elements

Major Network Elements (NEs) and services of the network include:

- 35 new factory assembled and tested equipment houses for major nodes.
- Multiple, interconnected SONET rings (OC-48 and 3 OC-12s).
- Redundant network hubs (Dual Homing @ GCT and MO).
- Two load-sharing, fully redundant DACSs for inter-ring traffic, grooming and bridging.
- Time Division Multiplexing (TDM-PCM Channel Banks) for voice and data circuits.
- 70 Self-contained Digital Loop Carriers (DLCs) using HDSL-2 and low speed optics for end user sites.
- ATM sub-network (OC-12 & OC-3) of 12 ATM switches.
- Integrated Network Management Systems (Manager-of-Managers and Network Element Managers).
- Routers, CSU/DSUs, OCUDPs, and other related equipment for IT data services.
- Ethernet Inverse Multiplexers (EIMs) and 10 Mb/s Ethernet optical mulitplexers for local optical distribution of MTA Police circuits.
- Existing copper cable distribution of local DS-0s and HDSL-2 to DLCs between nodes.
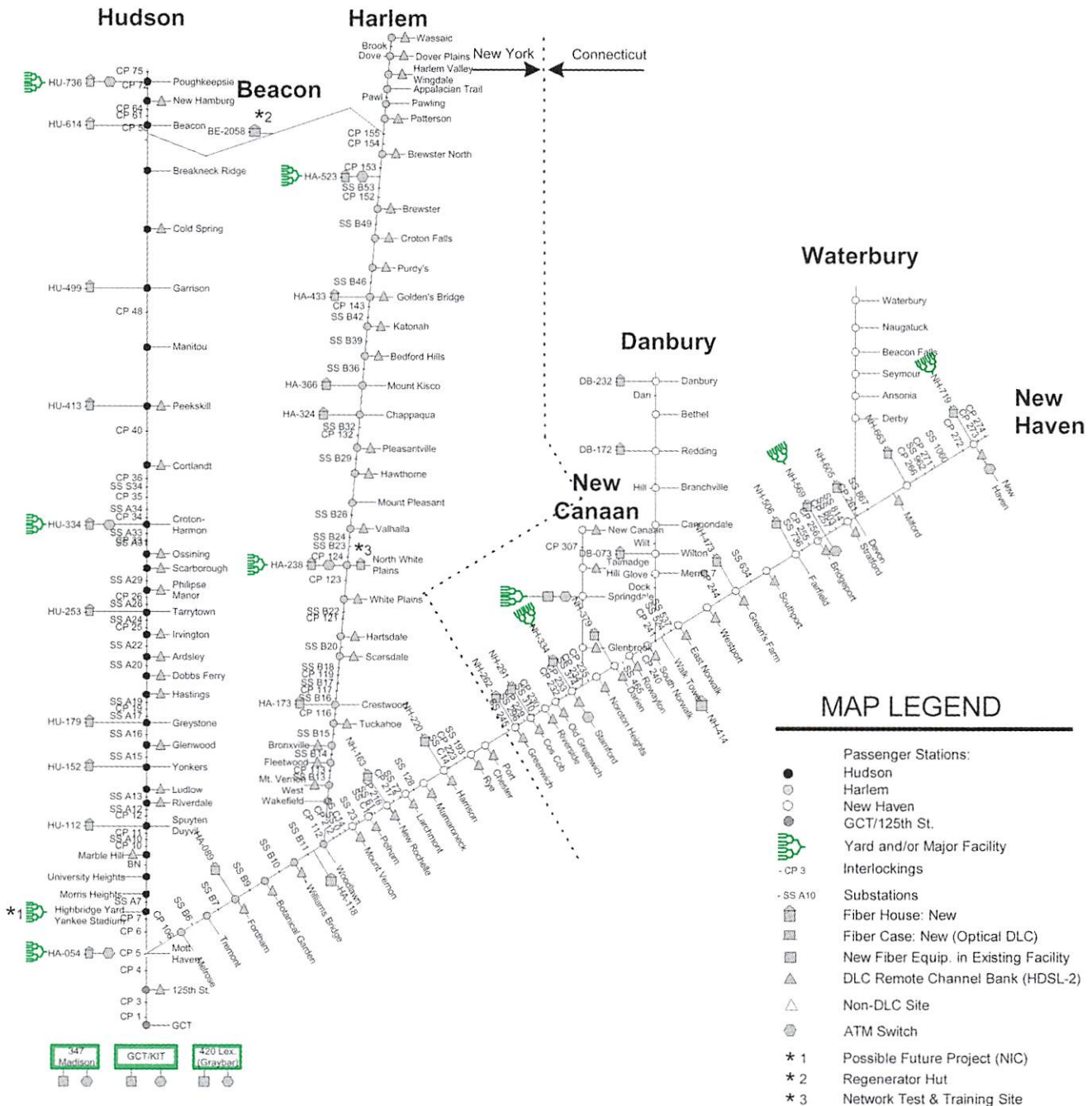
Figure 3 System-Wide Network, Equipment and Locations

♦ Centralized, redundant network synchronization and timing source.
♦ Primary and standby power systems.
♦ Test equipment for maintenance by Railroad forces.

4.4 Path Protection through Route Diversity

The SONET rings will be implemented via route diverse geography so that no two segments of any single ring occupy the same physical territory. This is essential in order to guarantee a self-healing topology that can survive either a single fiber cable cut or a nodal failure. In the design of the network, route diversity for the Hudson and Harlem lines has been identified. The New Haven will have to be implemented as a "collapsed" or "folded" ring until full route diversity is provided. In a "collapsed" ring, should a fiber optic cable be cut, the elements of the network beyond the cut would be isolated without communications.

4.5 Three OC-12 Rings and an OC-48 "Core"

Based upon operational requirements and the current state of the transmission equipment marketplace, three independent SONET OC-12 ring networks will be built, one each on Harlem, Hudson, and New Haven. A "Core" OC-48 ring will be installed among four central sites (MO, GCT, 420 Lexington and 347 Madison). This combination will yield the best economy and growth potential in areas expected to see the greatest increase in bandwidth demand.

4.6 Dual Hub

A Dual Hub network configuration will be implemented, with full duplication of circuits at both MO and GCT to insure operations from MO in the event of a catastrophic failure at GCT.

4.7 Mini-DLCs

Mini-Digital Loop Carriers (mini-DLCs) will be used for installation at a majority of passenger stations. Self-contained within weather proof, environmentally protected cabinets for outside installation, mini-DLCs function to extend the channel banks presently located in the fiber houses to the passenger stations by using HDSL-2 (High bit rate Digital Subscriber Line version 2) technology. HDSL-2 extends a DS-1 (24 voice and data circuits) over a single copper cable pair. This serves to transport the essential data circuits for the Ticket Selling Machine (TSM) network, and to reduce the circuit load from the existing 75 pair copper express cables by a 24:1 ratio, thus eliminating the need for new copper express cables.

4.8 Partitioning of the Network

The network will be partitioned in a manner that places backbone transport for all users under the responsibility of Communications & Signal (C&S) forces. In this fashion C&S becomes the "MNR Telephone Company" providing channel capacity to all "clients" as needed. Based upon operational requirements the IT network will be developed independently of C&S and clear demarcation between the two will be established. C&S will maintain all backbone SONET equipment, node houses, outside plant cable, DLCs and the Network Management System (NMS). IT forces will manage all data circuits to be transported by C&S over the backbone network, maintain data equipment, and will have exclusive management, maintenance and operational responsibility for all ATM equipment.

The NMS will be partitioned to give C&S and IT access and control of those portions of the network germane to each organization, provide management of network operations and perform diagnostics. The network will be physically and logically partitioned to provide physical separation between C&S and IT equipment, physical separation of demarcation (C&S and IT) and logical control over respective portions of the network.

Under this scenario, at least one-fourth of the OC-12 network capacity (an OC-3) will be dedicated to IT for implementation as an ATM sub-network on each of the three lines. Two OC-3s will be under the direct domain of C&S to meet all non-IS voice and data needs, and the fourth OC-3 will be available for network growth.

4.9 Digital Access & Crossconnect System (DACS)

A DACS unit provides savings in cost, power and space by reducing the quantity of PCM channel banks required. It accomplishes this by combining or "grooming" many low-fill DS-1s from various sites into fewer high-fill DS-1s. A DACS will be deployed at both GCT and MO in a load-sharing configuration.

4.10 ATM for IT

A standards based ATM sub-network will be deployed for IT applications. ATM provides a more efficient use of resources than the continued application of traditional TDM that applies a constant amount of bandwidth, irrespective of the application's utilization of the allocated channel. It is likely that future IT applications, such as the TSM project, with characteristic time-of-day dependant bandwidth requirements, will continue to increase. The dynamic bandwidth provided by ATM, will assist MNR in meeting increasing demands.

5. Network Functionality

MNR operates on a 24/7 schedule year round. Certain systems are required to maintain 24/7 operations including CTC (Centralized Traffic Control of trains), SCADA (Supervisory control of traction power) and other business systems that are considered essential to operations. These systems must be kept fully operational, and can tolerate only minimal network down time over the life span (ten years) of the network. The network design developed was therefore functional in nature, intended to guide the selected contractor in the final detailed design of the network. The contractor's design, based upon the specific application and configuration of their proposed hardware and software, will provide the levels and quality of services required as follows:

5.1 Primary/Secondary Comms. Control Centers

The primary Communications Control Center (CCC) will be located at GCT. A secondary CCC will be located at MO. Railroad operations are centralized out of GCT, predominantly from the Operations Control Center (OCC) located at GCT (physically separate from the CCC), and from other "client" sites, including facilities operated by IT. An Emergency OCC (ECC) is located at MO that will operate the Railroad in the event of a catastrophic loss of the primary OCC and/or other essential systems. During normal operations, the primary OCC and CCC will be the focal point for most network operations, with the ECC and secondary CCC to be operational, but unstaffed.

5.2 Protected and Unprotected Circuits

Two major categories of DS-0 circuits predominate at MNR: 1) protected circuits (with normal and alternate circuits –e.g. SCADA and CTC systems), and 2) non-protected circuits (e.g. PBX and Public Address). Protected circuits will be supplied with two distinct circuits (normal and alter-

nate) between the office systems and the field equipment. Protected circuits will be deployed in a manner that will provide physical path diversity between the normal and alternate circuits. Additionally, the network design will not present a common, single point of failure to both the normal and alternate circuits. Unprotected circuits will be equally distributed between the primary and secondary CCC DACS.

5.3 Network Reliability and Availability

Railroad operations demand real-time, continuous communications. The network will therefore provide high availability, reliability and rapid recovery time from failures. The network components must comprise a system design that will demonstrate an effective "continuous availability" of 99.999% for protected circuits and 99.7% for unprotected circuits. All network components, such as SONET Multiplexers, ATM switches, routing devices, PCM equipment, and DACSs will be required to supply individual reliability, mean time between failure rates, and first-year failure rates in accordance with Bellcore Standards.

5.4 Bridged Circuits

Several categories of DS-0 circuits at the CCC (e.g. SCADA, CTC and others) will be implemented in a bridged configuration that will permit the office systems to communicate simultaneously to all of the bridged sites. The DACSs will accomplish bridging of these circuits with automatic level adjustment and line matching.

5.5 Modes of Operation

All circuits will be distributed in the network in a manner that supports the CTC and SCADA systems and operations, and a minimum of four states as follows (Reference Figures 4, 5, 6 &7):

5.5.1 Normal Operations

The two DACS will present both normal and alternate path protected circuits to network "clients". The primary CCC DACS at GCT will groom the normal path protected circuits and present them to their destinations. The secondary CCC DACS will simultaneously groom the alternate circuits and present them over a path protected route to their destinations via the OC-48 node at 347 Madison Avenue (Wire Chief's Office) and bridged to the ECC at MO to keep the Emergency systems active. Unprotected circuits will be equally distributed between the two DACSs.

5.5.2 Failure Mode One

In this mode, a localized failure of the primary CCC has occurred (such as a contained fire) that does not require physical relocation of network "clients" or the primary OCC. During such an event, the secondary CCC will continue uninterrupted distribution of the alternate protected circuits, and one-half of the unprotected circuits to the primary OCC and network "clients", via the OC-48 node at 347 Madison Avenue (Wire Chief's Office). The normal protected circuits and the remaining one-half of the unprotected circuits that had been homed to the primary CCC will be re-routed to 347 Madison Avenue (the Wire Chief's Office) in an orderly,

timed transition via the secondary CCC DACS, executed under the automatic control of the NMS (Network Management System). The action of the NMS will be triggered by the failure of the primary DACS.

5.5.3 Failure Mode Two

In this mode, a major event has resulted in an evacuation of GCT and network "clients", with the loss of the OCC and the primary CCC. During such an event, the secondary CCC will continue uninterrupted distribution of the alternate protected circuits, and one-half of the unprotected circuits so that the ECC systems remain operational. An orderly timed transition of normal protected circuits and all of the unprotected circuits will occur from the primary CCC DACS to the secondary CCC DACS. All circuits that were previously homed to GCT will now be homed to the secondary CCC. (Local circuits terminating in the 347 Madison Avenue node, other than the GCT circuits routed through 347 Madison Avenue en-route to the OCC, will remain in service, uninterrupted). During this failure mode, the ECC at MO will become fully operational with all of the circuits required for full operation of the Railroad. The orderly, timed transition of circuits from the OCC to the ECC and related systems shall be executed under the automatic control of the NMS.

5.5.4 Failure Mode Three

In this mode, the secondary CCC has failed and the primary CCC remains fully operational. The primary CCC will continue uninterrupted distribution of the normal protected circuits, and one-half of the unprotected circuits. During this failure mode, the OCC will continue uninterrupted operation using the normal protected circuits. An orderly timed transition of alternate protected circuits and all of the unprotected circuits will occur from the secondary CCC DACS to the primary CCC DACS. All circuits that were previously homed to the secondary CCC at MO will now be homed to the primary CCC at GCT.

6. Project Status

Scientech, Inc. of Danbury, Connecticut was awarded the system integrator contract in April, 2000. The contractor's design has commenced, with a proposed system based upon network elements including Nortel fiber optic multiplexers and ATM switches, Tellabs DACS, Harris NMS, and Teltrend (Westell) DLCs.

The work was divided into three phases. Phase 1 will include the OC-48 Core and the New Haven Division equipment. Phase 2 will include the Harlem Division, and Phase 3 will add the Hudson Division.

The project is presently on schedule, with field installation of the first Phase of the network scheduled for July, 2001.

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Figure 4 Normal Operation

Legend:

- O = Standby Mode
- ✓ = Active Mode
- ✗ = Failure Mode
- → = Normal Circuits
- ⇢ = Alternate Circuits

OCC = (RR) Ops. Control Ctr.
ECC = (RR) Emergency Control Ctr.
CCC = Comms. Control Ctr.
(Primary & Secondary)
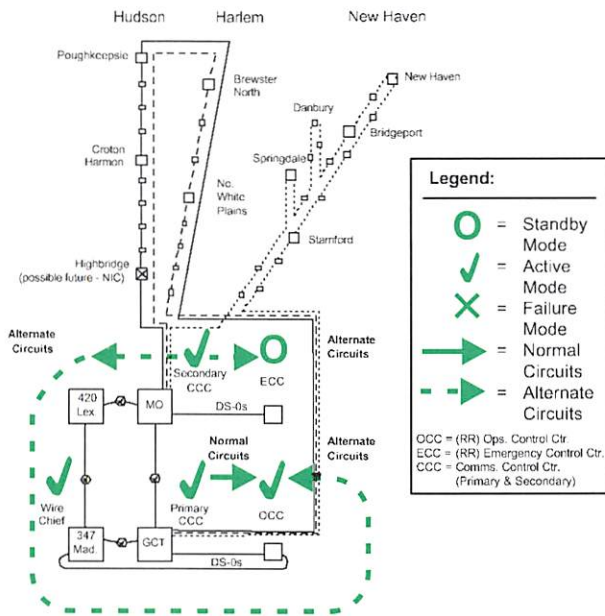
Scenario:	CCC Operational OCC Operational
- Primary CCC	DACS Active w/ Normal Ckts.
- Secondary CCC	DACS Active w/ Alternate Ckts.
- OCC	Active with Normal & Alternate Ckts.
- ECC	Hot Standby with Alternate Ckts.
- 347 Madison Ave.	Feeds Alternate Ckts. from ECC to OCC

Figure 5 Failure Mode 1

Alternate Ckts: Uninterrupted from Secondary CCC.

Normal Ckts: Orderly, Timed Transition from Primary CCC DACS to Secondary CCC DACS.
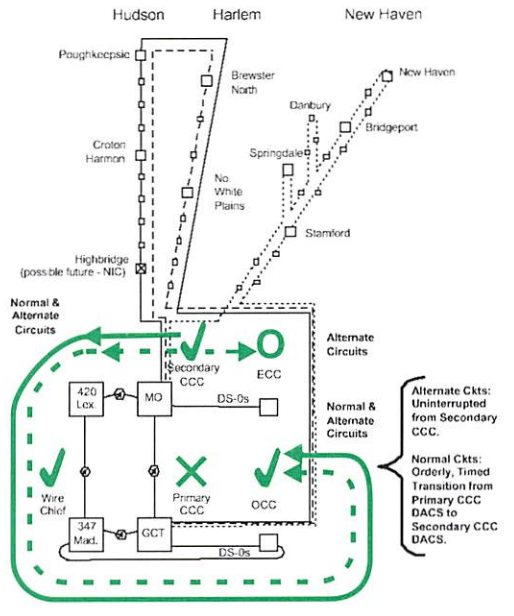
Scenario:	Primary CCC Failure OCC Operational
- Primary CCC	Failure - Non Functional
- Secondary CCC	DACS Active w/ Normal & Alternate Ckts.
- OCC	Active with Normal & Alternative Ckts.
- ECC	Hot Standby with Alternative Ckts.
- 347 Madison Ave.	Feeds Normals & Alternate Ckts. from Secondary CCC to OCC - w/ Uninterrupted Service

Figure 6 Failure Mode 2

Alternate Ckts: Uninterrupted from Secondary CCC.

Normal Ckts: Orderly, Timed Transition from Primary CCC DACS to Secondary CCC DACS.

Scenario:	Primary CCC Failure OCC Failure
- Primary CCC	Failure - Non Funtional
- Secondary CCC	Active
- OCC	Failure - Non Functional
- ECC	Active - with Normal and Alternate Ckts
- 347 Madison Ave.	Standby (Local Ckts Only)

Figure 7 Failure Mode 3

Normal Ckts: Uninterrupted from Primary CCC.

Alternate Ckts: Orderly, Timed Transition from Secondary CCC DACS to Primary CCC DACS.
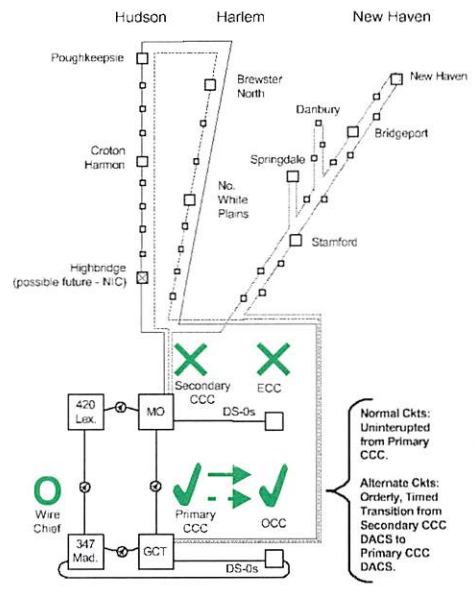
Scenario:	Secondary CCC Failure OCC Operational
- Primary CCC	Active
- Secondary CCC	Failure - Non Funtional
- OCC	Active - with Normal & Alternate Ckts
- ECC	Failure - Non Functional
- 347 Madison Ave.	Feeds Alternate Ckts from Primary CCC DACS to OCC

Power Electronics and Electric Machinery Innovations — U.S. Government's Role in PNGV

Donald J. Adams, Oak Ridge National Laboratory

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The U.S. Government plays an important role in the Partnership for a New Generation of Vehicles' (PNGV) electrical and electronics technologies with a program consisting of high-risk research and development (R&D) projects. The Department of Energy (DOE) plays the largest role in supporting these technologies to specifically address automotive needs.

DOE has three Automotive Integrated Power Module (AIPM) contractors and two Automotive Electric Motor Drive (AEMD) contractors working to become viable suppliers for PNGV. Materials development projects are working to improve materials and devices needed in automotive motors and drives, such as permanent magnets, capacitors, sensors, connectors, and thermal management materials. Advancements in inverters, controls, and motors and generators conducted at DOE's national laboratories are also presented.

Introduction

Power electronics and electric machinery research pervades almost all government research programs for the very reason that it is so important to PNGV. Some aspect of the technology is embedded within almost everything we do; so most government agencies are conducting work in the technology. Perhaps some of the most visible programs are those involved in supporting the electrification of military vehicles such as aircraft, ships, and tanks. There is synergism in all such research, and the power electronics research community is a relatively tight-knit group that is careful to ensure that advances in the technologies are quickly disseminated through technical and programmatic meetings.

Despite the synergism, each application has its own special needs, and PNGV is no exception. The only PNGV project sponsored by a federal agency other than DOE is sponsored by the Army Tactical Automotive Command (TACOM). All other PNGV work is sponsored by DOE's Office of Advanced Automotive Technologies (DOE-OAAT).

The Research Program

In the PNGV Electrical and Electronics program, the government supports a partnership among national laboratories, universities, and private industry in high-risk R&D to provide enabling technologies for automotive needs. The R&D efforts are focused on overcoming the critical technical barriers to achieving significant reductions in cost, volume, and weight while improving reliability, ruggedness, and performance.

The PNGV goals for power electronics and electric machinery are quite challenging and are listed in Table 1. The technical objectives are to achieve performance and reliability goals while reducing cost, size, and weight simultaneously. To accomplish these goals, the government has established a program to develop the enabling technologies that will be compatible with automotive-scale manufacturing and with other attributes conducive to wide-scale deployment in allied applications to ensure the lowest possible cost. The desired result is that these technologies are incorporated in the products provided by suppliers to the automotive companies. The government manages this program with peer reviews to ensure that funding resources are directed in a manner that is consistent with PNGV needs and to support the synergism of research in the industry and across federal agencies. Besides the review of the overall PNGV program that is conducted annually by an independent panel of highly qualified individuals, DOE-OAAT conducts it's own per review annually of the Advanced Power Electronics Program. The review panel consists of power electronics leaders from industry, universities, and other federal agencies and technical and management staff of Ford, General Motors, and DaimlerChrysler. This world-class panel conducts a project-by-project review of DOE-OAAT's program and visits some of the research laboratories. Each reviewer's comments are considered in planning or redirecting the research.

At the top level, PNGV needs are for electric machinery and power converters (motors and drives) and the integration of the systems. The electric machinery consists of various types of electric motors and generators, gearboxes, and

the materials that make up the parts such as magnets, wire, magnetic laminations, housings, and cooling circuits. Power converters consist of dc-to-variable frequency and voltage inverters, dc-to-dc converters to reduce or boost voltage, capacitors, inductors, transformers, filters, controllers, printed circuit boards, power switches, power diodes, digital signal processors, solder, sensors, etc. The government's R&D program supports the goals for the PNGV Electrical and Electronics Technical Team (EE/TT) by supporting development of enabling components as well as the systems.

Power Converters

AIPM

The PNGV EE/TT developed a specification for the primary traction drive inverter for both series and parallel hybrid vehicles. Subsequently, DOE awarded three cost-shared contracts to Satcon, Semikron, and Silicon Power to develop an AIPM. These contracts (along with the motor contracts discussed below) are by far the largest annual expenditure by DOE in automotive motors and drives. Each contractor has teamed with other companies in their approach.

The objective of this program is to encourage the establishment of advanced manufacturing capability to meet automotive requirements. The program seeks to integrate new developments in devices, packaging, and fabrication techniques to achieve the PNGV AIPM specification. Figure 1 shows the concept of the desired the AIPM in the vehicle system.

The contracts cover an approximate three-year period beginning in FY2000. As interim and pre-production prototype hardware is delivered, Oak Ridge National Laboratory (ORNL) will perform evaluations to verify the conformance of the AIPMs with the specifications.

The technical approach of each contractor is:

✦ Satcon – Thermal management and manufacturing with "flipchip" technology.

✦ Semikron – High volume, low cost manufacturing by applying industrial drive technology.
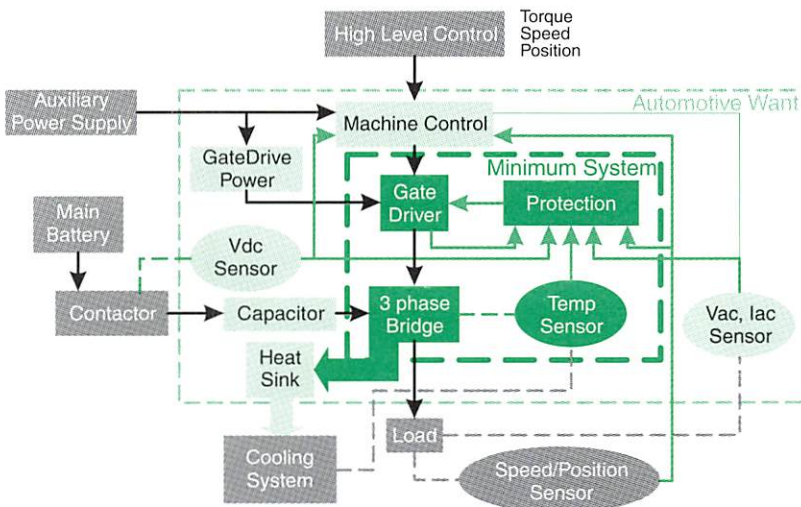
Characteristics	Units	Calendar year			
		1997	2000	2004	2006
Electric Motor/Generator					
Specific power at peak load	kW/kg	1.2	1.5	1.6	1.6
Volumetric power density	kW/l	3.5	4	5	5.5
Cost (100,000 units/year production rate)	$/kW	10	6	4	4
Efficiency (10% to 100% speed, 20% rated torque)	%	90	92	96	97
Power Electronics (Inverter/Controller)					
Specific power at peak load	kW/kg	2	4	5	5.5
Volumetric power density	kW/l	8	10	12	13
Cost (100,000 units/year production rate)	$/kW	25	10	7	6
Efficiency (10% to 100% speed, 20% motor shaft torque)	%	93	95	97 - 98	98

Note: These values are for a typical power level, but the values are not linear with respect to power level.

Table 1 Technical Targets: Power Electronics and Electric Machines (for 47.5-kW Hybrid Drive)

✦ Silicon Power – Device technology, packaging and thermal management.

Each of the contractors expects to meet the cost target.

Inverter Topologies and Packaging R&D

In an effort to achieve continuing improvements in inverter and converter technology, ORNL is engaged in exploring ways to increase efficiency and reliability and reduce costs. ORNL has already completed development and implementation of the Resonant Snubber Inverter and the Auxiliary Resonant Tank (ART) Inverter, demonstrating improved efficiency and performance. An ART inverter was installed in an electric bus, and self-sensing was incorporated in the unit. Currently, ORNL is developing a new soft-switching topology to minimize component count and costs called the Soft Switching Snubber Inverter. This topology achieves soft switching for increased efficiency, reduced electromagnetic interference (EMI), and reduced stress on the power switches without the cost of additional active devices.

Also under development is an advanced dc-dc converter that is required on fuel cell vehicles and also for use on dual voltage systems. The isolated bi-directional converter (safely delivers power in both directions) is much smaller and cheaper than existing conventional converters.

Multilevel inverters use isolated dc sources to deliver extremely smooth, EMI-free, highly efficient power, and can also isolate these dc sources for charging. Initial studies show that, due to recent developments at ORNL, these inverters can be designed so that their cost, size, and reliability is similar to or better than conventional pulse width modulated inverters. An additional safety benefit is that when the system is turned off, there is no high voltage potential present in the vehicle even though high voltage motors are used. Figure 3 shows one cell that is attached to each battery.

Figure 1 Schematic Description of the AIPM System
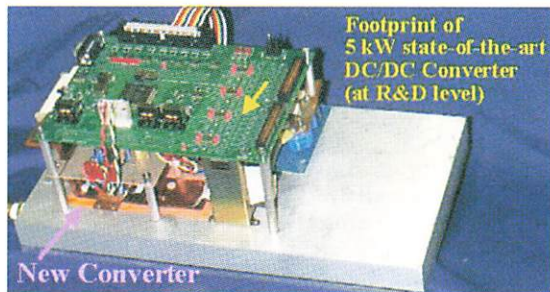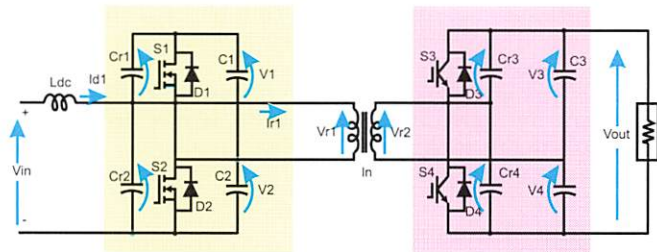
Figure 2 New Bi-directional DC/DC Converter

Soft Switching Inverters for Automotive Electric Drives

As mentioned before, the only other government agency outside of DOE that is sponsoring PNGV work is Army TACOM in a project jointly funded by USCAR. The two year program was initiated in 1998 by TACOM and PNGV partners to compare different soft switching technologies with standard hard switching topology and recommend the topology most suitable for automotive electric drives.

The work is being done at Virginia Polytechnic Institute and Soft Switching Technologies. The specific soft-switching topologies are a Zero Current Transition, an Auxiliary Resonant Clamped Pole Zero Voltage Transition, a low-cost Zero Voltage Transition, and the Resonant dc Link. A conventional hard-switched inverter will be used for comparison.

Field Weakening for Permanent Magnet Machines

Permanent magnet (PM) machines must be designed so that at top speed the required motor voltage cannot exceed the available battery voltage. If the field of the permanent magnets could be weakened, these compact efficient motors could be designed to deliver the required torque at low speed and the required power at high speed without oversizing the motor. Another undesirable aspect of this motor is that certain types of failures result in the motor uncontrollably applying full power. Lastly, as in any motor, there are tradeoffs in the design process. In PM machines, one of these tradeoffs is between low inductance and efficiency by way of eddy currents (spin losses).

ORNL has developed an inverter topology specifically for PM machines called the Dual Mode Inverter Control that directly addresses these issues. Laboratory tests have demonstrated a constant power region of five times base speed, the ability to drive motors with extremely low inductance, and to interrupt the circuit in motor failures to protect the inverter and the vehicle. Current research addresses the cost, size, and efficiency of this laboratory prototype.

Platform for the Evaluation of Real-Time Controllers for Hybrid Electric Vehicle (HEV) Motor Drive Systems

The University of Tennessee is developing advanced control and modeling algorithms for the various types of motor drives. Initially, the platform for the evaluation of controllers will address the switched reluctance (SR) machine to achieve sensorless control, automatic motor and inverter parameter identification, self-tuning of controller gains, and fault diagnosis to determine inverter and/or motor failure causes.

Fiberoptic Microsensors for Automotive Power Electronics

The high currents and voltages involved with inverter operation in conjunction with the extremely fast switching speeds provide a challenging diagnostic environment. Sensors are required which are immune to EMI as well as accurate. Although there are commercially available sensors, they are large, expensive, and power hungry. The goal of this project is to develop an effective means for measuring current and voltage by combining fiberoptics with micro-electromechanical technology.

Microcantilevers are coated with a magnetic material which, when placed close to a current source, flex in proportion to the induced magnetic field. For voltage sensing, the cantilever functions as one plate of a capacitor. The cantilever motion is sensed optically with an optical fiber in close proximity to the microcantilever. The device uses multiple sensors in each unit to account for vibration, temperature and proximity effects, and calibration.

Initial tests have demonstrated the feasibility of the device performance. Size and power requirements are within goals, and the cost is projected to be less than $5 per device.

Capacitors

The present price of capacitors is about five times that required to achieve the cost targets for inverters. Capacitor lifetime, reliability, temperature limits, and size are further

Figure 3 140A/60V (2kW) multilevel cell w/ self-powered gate drive

Present Al
Electrolytic
400 cm³

PPS Poly
K=3
310 cm³

Projected
SNI Poly Film
K=6;155 cm³

Ceramic
167 cm³

Projected
SNI Ceramic
84 cm³

1.25 µF/cm³   **3.2 µF/cm³**   **6 µF/cm³**
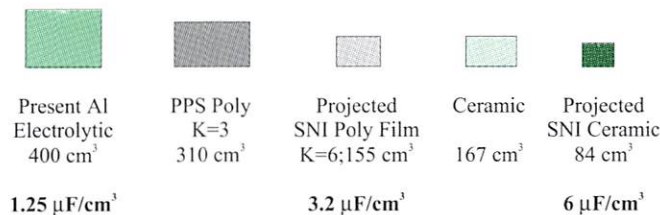
A capacitance density of 2.4mF/cm3 is required
for 2004 hybrid electric vehicles.

Figure 4 Capacitor Size Comparison
at 500 µF, 600 Volt

barriers to the AIPM. In fact, about 40% of the volume of to-day's automotive inverters is taken up by capacitors. The electrolytic capacitor is generally used for the dc buss capacitors today, but it is inherently limited in capability. Figure 4 shows the relative size and other characteristics of capacitors under consideration.

Three national laboratories and one university are developing improved capacitors. The technologies and challenges under consideration are:

1. Electrolytic
   ✦ Improve the operating life and reliability
   ✦ Reduce the cost and size
   ✦ Improve the ripple current handling capability

2. Polymer Film
   ✦ Develop low-cost higher dielectric materials
   ✦ Develop low-cost manufacturing techniques

3. Ceramic
   ✦ Develop fail-safe mechanisms
   ✦ Develop low-cost manufacturing techniques

Sandia National Laboratory is developing a replacement technology for the presently used aluminum electrolytic dc buss capacitors for automotive use. The approach is to develop a high-temperature polymer dielectric film technology that has dielectric properties technically superior to those of aluminum electrolytic dc buss capacitors and is of comparable or smaller size.

Argonne National Laboratory (ANL), in collaboration with Pennsylvania State University, has focused on developing ferroelectric ceramics. The objective is to develop a low-cost, multilayer ceramic technology which results in capacitors that are technically superior to presently used aluminum electrolytic capacitors.

Lawrence Livermore National Laboratory is developing materials and manufacturing processes for dielectric mate-

rials in nanostructure multilayer ceramic capacitors which have high breakdown strength, low loss, and low temperature dependence.
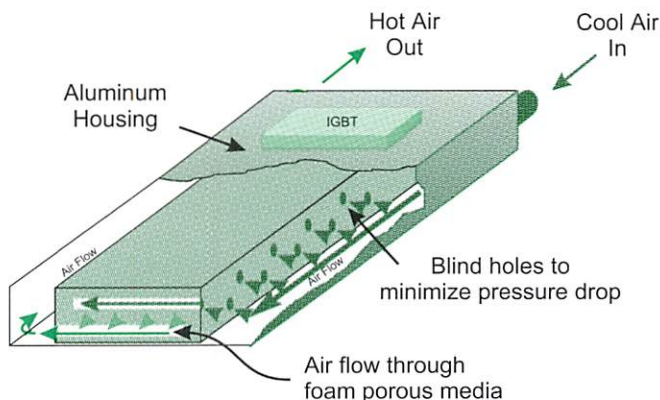
ORNL is supporting the development of ceramic capacitors by working with manufacturers to develop methods to improve the reliability, ruggedness, and cost of ceramic materials.

Thermal Management

ORNL has developed a carbon foam material with useful thermal management properties. The manufacturing process has been licensed to Poco Graphite. ORNL is developing manufacturing processes for further improvements and cost reduction for high-volume manufacturing by 2001. The material is an open cell carbon foam with very high thermal conductivity, considerably higher than that of presently used materials. The foam can be manufactured in practically any shape and is easily machined. The high thermal conductivity and very high surface area of the carbon foam result in order of magnitude improvements in heat transfer coefficients over conventional heat sinks. The improved heat transfer and low density of the foam reduce the size and weight of the heat sinks and shows a possibility of reducing the ancillary cooling requirements for inverters. The design is presently being optimized for heat transfer and pressure drop.

Electric Machinery

AEMD

As with the AIPM, the PNGV EE/TT developed a specification for the primary traction drive motor for both series and parallel hybrid electric vehicles. Subsequently, DOE awarded two cost-shared contracts managed by Electricore for Delphi and for Delco Remy to develop an AEMD. As previously stated, these contracts (along with the AIPM contracts) are by far the largest annual expenditure by DOE in motors and drives.

Delphi is developing methods for cost reduction of materials and manufacturing processes for geared induction motors. Delco Remy, teamed with Lynx Motion Technology and Visual Computing Systems, is developing direct drive axial gap PM motors (also called brushless dc motors). The contracts cover an approximate three-year period beginning in FY2000. Each contractor faces significant challenges to achieve PNGV performance and cost goals, but both anticipate meeting the goals. One of the design parameters, the power curve is shown in Figure 6.

Figure 5 Second Generation Carbon Foam
Heat Sink for Inverters

Figure 6 Torque-Speed Curves for AEMD
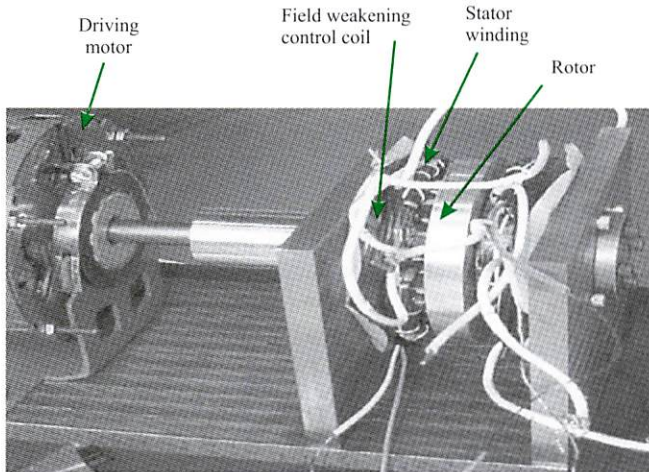
Figure 7 Axial Gap Field Weakening Permanent Magnet Machine Prototype

Figure 8 Rotor of a Soft-Commutated DC Machine

Electric Machinery R&D

Novel approaches to drive system cost reduction and performance are being pursued at ORNL. Five tasks focus on alternative options to reduce size, weight, and cost, to improve performance and reliability, and to simplify the drive system.

A laboratory prototype (Figure 7) of a directly controlled air gap flux PM motor has demonstrated the feasibility of field weakening of PM machines without damaging the magnets. A smaller auxiliary field coil is added to the stator, and a greatly simplified inverter is used. A 10:1 field weakening ratio has been demonstrated. A full-scale prototype is being constructed for a convincing demonstration of this technology with the objective of providing improved performance, decreased weight, and lower cost.

A soft-commutated dc motor (Figure 8) was developed to address system cost and simplicity. Brushed dc motors are heavier than induction or PM motors, and emit EMI from the brushes. Th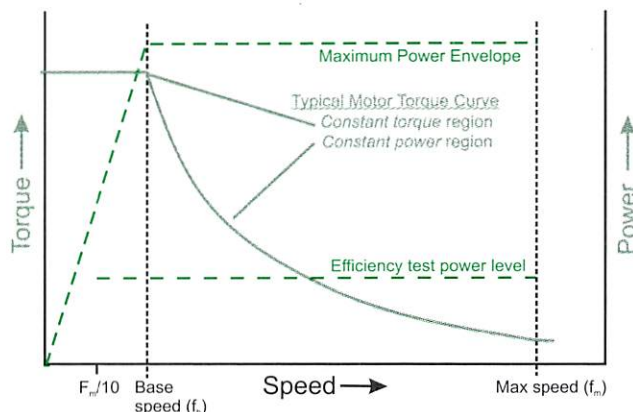is development has eliminated the EMI and increased brush life so that it is not a maintenance problem. Its lower cost and the elimination of a sophisticated inverter offset the increased weight of the motor.

Using copper rotor bars in squirrel cage induction motors yields a considerable improvement in motor efficiency. Unfortunately, copper die cast manufacturing of the rotor has not been cost effective. An inexpensive method of satisfactorily joining extruded copper bars to aluminum rotor end rings was developed. This technology allows the use of more efficient copper rotor bars in induction machines in a cost-effective manner. Figure 9

shows the result of the joining process accomplished in the laboratory.

Development of flux guides for PM machines has explored methods to reduce the volume of expensive permanent magnets or to reduce the volume of copper wire used in stators of PM machines.

Another motor development is a homopolar motor for automotive use that can run at low voltages for electrical safety with a simple power converter.

Switched Reluctance Machines

The SR machine is a cheaper, more robust traction drive, but commercially available units do not meet PNGV requirements. Furthermore, commercially available units have certain undesirable inherent characteristics such as harsh waveforms, EMI, and high torque ripple causing torsional vibration and audible noise. If these problems can be moderated or eliminated, the simplicity of this robust motor makes it an excellent candidate to meet cost, volume, weight, and reliability goals. To promote development of a viable commercial SR machine, ORNL provides independent evaluation of machines provided by industry. Am example is shown in Figure 10. Additionally, ORNL works with suppliers to develop innovations on SR technology. Although several suppliers have been approached and some evaluations have been made, there appears to be little interest by the industry in supplying such a motor until they are convinced of the size of the hybrid vehicle market.

Low Cost, High-Energy-Product Permanent Magnets

The rare earth permanent magnets used in PM motors are expensive. ANL and ORNL seek to develop a low cost process to fabricate NdFeB permanent magnets with up to 25% higher strengths. The higher-strength magnets will replace ones made by traditional powder metallurgy and enable significant cost, size, and weight reductions of traction motors for hybrid vehicles.

High-strength superconducting magnets are utilized to improve the magnetic alignment of grains prior to pressing and sintering, therefore producing higher-strength magnets. The work is presently focused on improving the process to optimize the magnetic properties and to develop manufacturing processes. Industrial partners have been identified and are collaborating in the project.

The Automotive Traction Drive as a System

The AIPM and AEMD projects allow an early start on the development of motors and drives, but ultimately the power converter and the electric motor must be integrated into a traction drive system.

Figure 9 A Defect-Free Aluminum-Copper Joint
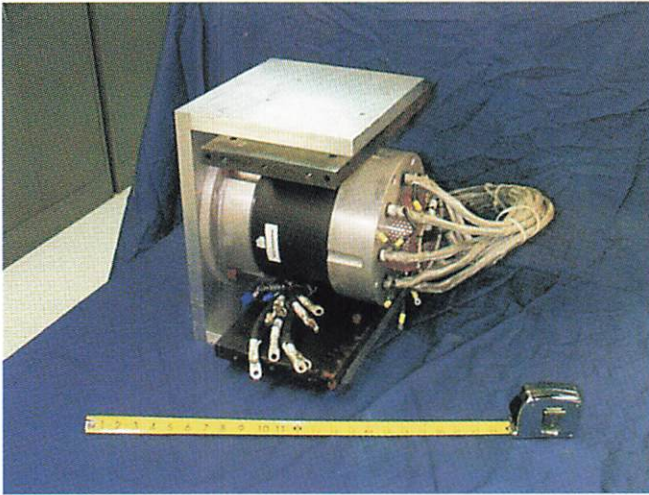
Figure 10 A Four Phase Switched Reluctance Machine with 8/6 Pole Configuration

DOE has several Small Business Innovation Research grants where small companies are funded to address certain aspects of integration.

HEV Motor/Inverter Modeling

ORNL is developing physics-based models of traction drive systems which consist of an induction, PM, or SR motor, an inverter, and a controller. These models will be verified, and structured to generate performance tables, which may be used by detailed DOE HEV simulation codes such as ADVISOR. An additional activity will be to estimate and compare economic benefits.

Interactive LabVIEW based models of PM motors have been produced. Figure 11 shows the main screen display of the model. SR motors will be developed next. Modules within the design code may be used for motor design, dynamic performance estimates, performance map generation, road test simulation, nameplate generation, and drawing generation. The models include temperature feedback effects on stator wire resistance and magnet performance.

Conclusion

The U.S. federal government is making a considerable investment to meet the electrical and electronics needs of PNGV. Funding contributions come from the Advanced Power Electronics and Electric Machinery Program, the Propulsion Materials Program, and the Vehicle Systems Program of

DOE-OAAT. Even though the funding levels have increased steadily in recent years, further increases are required to meet the needs of the AIPM and AEMD contracts.

DOE works closely with the PNGV EE/TT in determining the direction of research to be undertaken and overseeing the progress of the various projects. DOE and national laboratories actively participate on the PNGV EE/TT.

A well-coordinated collection of projects is focused on working towards meeting the PNGV electrical and electronics needs.

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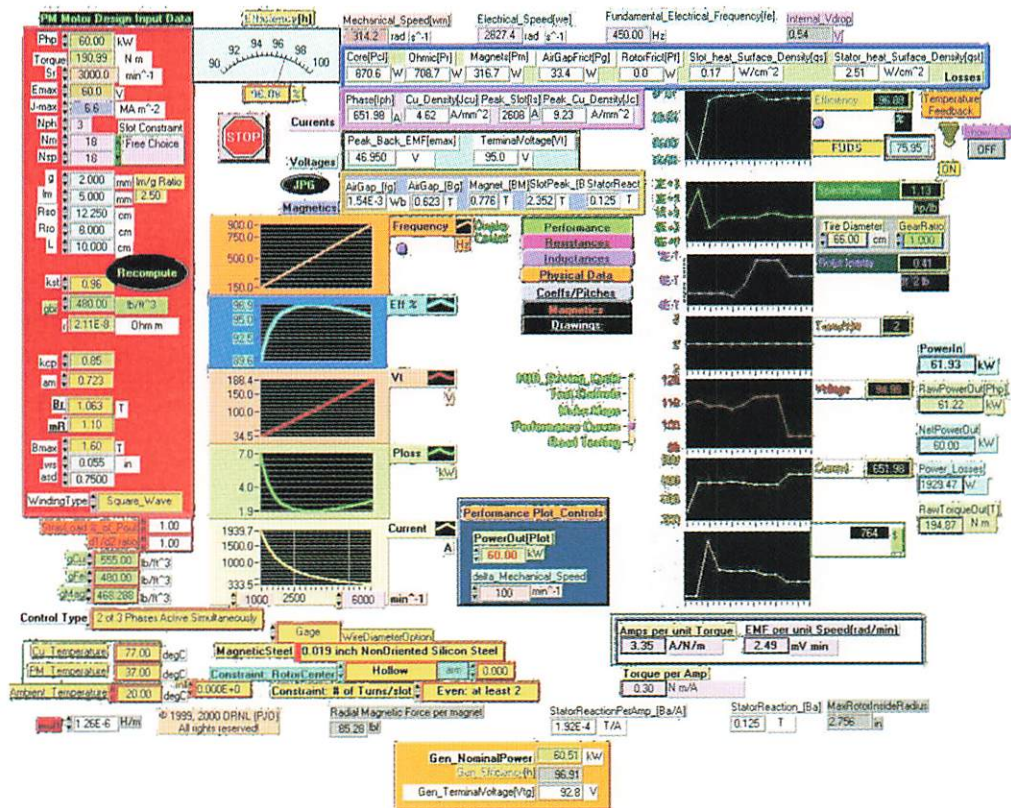
Figure 11 Main Screen of LabVIEW-Based Radial Gap Permanent magnet Motor model
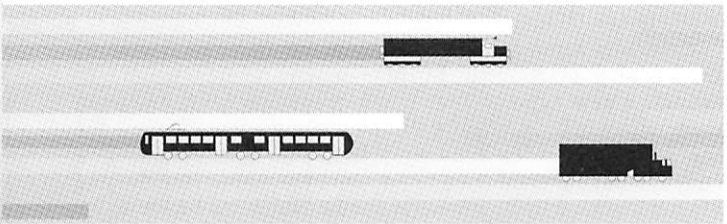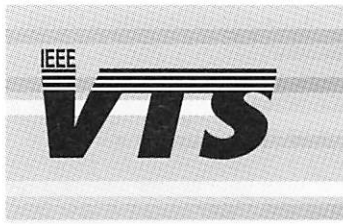
Mobile Radio

Javier Gozalvez, Senior Editor

FCC & US mobile market

Michael Powell has been named as new head of the Federal Communications Commission (FCC) by the Bush administration. Mr Powell was a commissioner at the FCC since November 1997. Mr Powell succeeds Mr William Kennard who has been in the post since 1997. Mr Kennard has now joined the Aspen Institute as a senior fellow.

The C and F Block broadband Personal Communications Service (PCS) spectrum (1900MHz range) auction ended raising $16.86billion. The auction ended after 101 rounds of bidding. A total of 422 licenses covering 195 markets across the country were offered. Verizon Wireless paid $8.78billion for 113 licenses ($4billion were paid for just two licenses in New York). Alaska Native Wireless, which has ties with AT&T, paid $2.89billion for 44 licenses. Cingular Wireless won 79 licenses bidding $2.35billion. The FCC raised another $20million for a 700MHz Guard Band auction. The Guard Band Manager is a new class of commercial licensee engaged solely in the business of leasing spectrum to third parties on a for-profit basis. The auctions of licenses in the 747-762 and 777-792MHz band, initially scheduled for March 6, were postponed until September 12, 2001. Verizon Wireless previously requested the Wireless Telecommunications Bureau for a postponement of the auction.

The FCC adopted measures to facilitate voluntary clearing of the 700MHz band to allow for the introduction of new wireless services and to promote the transition of incumbent analog television licensees to digital television (DTV) service. The FCC concluded that it is not necessary or appropriate at this time to adopt cost-sharing rules, cost caps, or cost recovery guidelines to assist in clearing the band, and leaves cost-sharing arrangements to voluntary negotiations among new wireless licensees.

The FCC adopted a Notice of Proposed Rulemaking to explore the possible use of frequency bands below 3GHz to support the introduction of new advanced wireless services, including 3G as well as future generations of wireless systems. The proceeding explores the possibility of introducing new advanced mobile and fixed services in frequency bands currently used for cellular, broadband PCS and Specialised Mobile Radio (SMR) services as well as in five other frequency bands: 1710-1755MHz, 1755-1850MHz, 2110-2150MHz, 2160-2165MHz and 2500-2690MHz. The move was criticised by the Wireless Communications Association International, which represents fixed broadband wireless operators, as clearing the 2.1GHz and 2.5GHz bands for mobile use would have a catastrophic impact on Multipoint Multichannel Distribution Service and ITFS licensees.

The FCC adopted a Notice of Proposed Rulemaking to re-examine the need for Commercial Mobile Radio Service (CMRS) spectrum aggregation limits. The CMRS spectrum cap restricts the amount of broadband CMRS spectrum that an entity can hold within a particular geographic area. At the moment, the limit of licensed broadband PCS or SMR spectrum, is 45MHz in urban areas and 55MHz in rural areas. Many believe the cap will inhibit the development of 3G services.

The FCC adopted an interoperability standard to ensure effective public safety communications, between different agencies, in the 700MHz band. The FCC adopted Project 25 Phase I as the voice standard for communications on the 700MHz band interoperability channels. The FCC also adopted the data standard incorporated in the Project 25 suite of standards for data communications.

Studies released by the FCC highlight the need for policy to promote wireless and broadcast license ownership among smaller firms as well as for women and minorities. The FCC's Wireless Telecommunications Bureau announced a "Best Practice Guide" that can be used to identify and alleviate radio interference between public safety and CMRS systems in the 800MHz band. The Guide describes the types and causes of such interference. The Guide is available at www.apcointl.org

According to a study by The Yankee Group, wireless use in the US is expected to grow to 41% of all conversations minutes by 2005. In 1999, only 6.5% of the 2.1trillion conversation minutes in the US consisted of calls from cell phones.

Technology and research news

Ten partners from the mobile communications industry, research and deaf organisations are working together in WISDOM (Wireless Information Services for Deaf people On the Move), a project funded by the European Commission. The aim of the project is to investigate the problems faced by deaf people when using mobile communications devices and to develop a software that will recognise the sign language used by deaf people and will translate these signs into voice and text files.

British Telecommunications said it is holding technical trials to test whether micro base stations placed in phone booths can help to improve network coverage in urban areas.

CNI of Korea recently introduced the smallest radio packet modem for Mobitex. The RM3 product weights 35grams; it has been certified by the FCC and has been approved for use on BellSouth Wireless Data network. The

RPM3 is available in a 900MHz version for use on Mobitex networks in Korea, North America and South America.

Ericsson announced it is teaming up with Stanford University (US) and Lund University (Sweden) to launch a new type of 'fast track' joint research program that will work on supply chain management issues for the telecommunications and Internet industries. The supply chain techniques to support the rapid build-up of 3G networks will be an early focus. Subjects likely to be initially addressed would be capacity planning and forecasting. Ericsson also announced it is developing GSM/GPRS/EDGE for the 800MHz-frequency band.

Hewlett-Packard and NTT DoCoMo announced they will jointly develop multimedia delivery and network applications over 4G wireless broadband networks.

Blue Wave Systems launched a new Comstruct wireless platform that will allow, according to the company, a more than four times increase in 3G radio channel density through a combination of higher performance DSPs (the TMS320C6415 and TMS320C6416 from TI) and Blue Wave's specific architecture for wireless infrastructure. High bandwidth datapaths on the platform can offer up to 6Gb/s data rates to support multiple receivers.

SnapTrack has been awarded a broad-based wireless location and asset-tracking patent by the US Patent and Trademark Office. The patent describes methods for remotely locating or tracking a wireless device via client-server systems that use a computer network or web browser to initiate a request of a wireless device position.

Airslide Systems has introduced the first IP-based solution for SMS traffic and SS7 signalling networks. Airslide's Gateway off-loads the increasing SMS traffic, that is clogging SS7 signalling networks, onto IP-based networks, relieving then network congestion.

Researchers at Bell Labs and Harvard University have demonstrated a way to increase channel capacity, in a scattering environment, by a factor of three. According to the researchers: "the extra capacity arises because there are six distinguishable electric and magnetic states of polarisation at a given point (in a scattering environment) rather than two as is usually assumed". To demonstrate the benefit, the researchers used an "antenna system consisting of three standard sleeves arranged orthogonally". The full paper, entitled "Tripling the capacity of wireless communications using electromagnetic polarisation", was published in Nature (18 January 2001).

Dieceland Tech has developed what it claims is the first disposable cell phone. The phone is made from paper, is about three credit cards thick and it is about the size of a credit card. Two models will be launched; one that will only be allowed to make phone calls (at a price of $10) and another that will also receive incoming calls. However, the product still needs to receive regulatory approval and the issue of all the phone numbers that these phones would need has also to be resolved.

A group of researchers from the Hong Kong University of Science and Technology said they have developed a cheap new material that can absorb up to 70% of the radiation emitted by cell phones (the exact amount depends on the type of phone used). The material is about as thick as four sheets of paper put together.

A Professor from the University of Warwick (UK) has developed a new antenna that would cut the energy passing through a user's head by 97% while also doubling battery life as the radiation is redirected away. The antenna is a novel design based on a combination of electro-optics and conventional RF antenna structures. The techniques used can permit a range of radiation patterns to be developed,
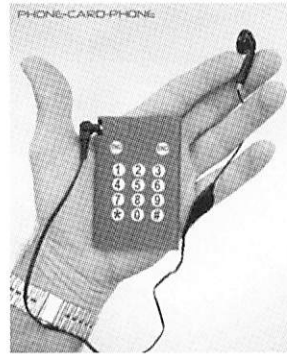
Dieceland Tech's disposable mobile phone
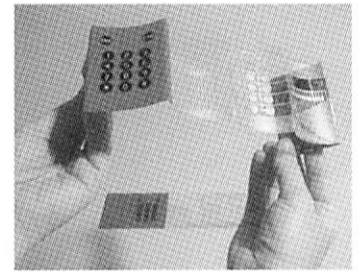
Photos by Dieceland Tech

based on both electrode geometries and electro-optical principles being combined.

Ascom has launched wireless DECT services for ISDN data and voice transmission, removing the need for cables. The service has a range of up to 300 metres in the open and up to 50 metres indoors.

Researchers from the University of California at Berkeley and the firm Zero-Knowledge Systems have reported security flaws in the wireless networks, known as Wi-Fi or 802.11. The flaws allow to eavesdrop or even disrupt the network by overpowering a security system called Wired Equivalent Privacy.

M-commerce and location-based services

Sonera SmartTrust and Europay have teamed to embed digital signatures into mobile phones. This will allow costumers to use their mobile phone to electronically sign a Eurocard-Mastercard payment transaction made over the Internet. Europay has integrated Sonera SmartTrust's Wireless PKI technology into its remote payment solution. The WPKI is embedded within the SIM card of the mobile phone. The system works by sending an SMS to the cardholder's phone when a transaction is made. The cardholder can then validate it by sending a digital signature. The solution will be offered to Europay's member banks as an extension of the existing 3D-SET (Secure Electronic Transaction) payment solution.

AirFlash Inc has launched what the company claims is the first two-way location-based service using SMS technology. The application, SmartSMS, enables GSM users to access the Yellow Pages and street guides. A recent study commissioned by AirFlash revealed that in the UK, 65% of mobile phone users would change carriers in order to gain access to location-based services. The figures were 54% and 44% for Germany and France, respectively. 59% of French users considered the services to be valuable compared with 52% in UK and 42% in Germany.

According to a report from Analysys Ltd, Mobile Location Services and Technology, location-based services will not be the "killer application" for future mobile communications but will be an essential part of future mobile packages. The report claims that the biggest opportunity will initially lie in the youth market and that the market should take off around 2004. The report highlights that there will not be a dominant location technology. Cell-ID should continue to be used in the immediate future but operators will eventually move to technologies such as Enhanced Observed Time Difference (EOTD). Other more accurate technologies, such as A-GPS, are too expensive as it will increase handset costs by around 40%.

Nokia announced what it claims is the first industry standardised E-OTD location technology, a solution for use in 3G networks. The company has already signed a commer-

cial agreement with AT&T Wireless for the delivery of the E-OTD technology.

Forums activities

Alcatel, Ericsson, Nokia and Siemens announced the creation of the Wireless World Research Forum (WWRF). According to its members, WWRF's objective is to formulate visions on strategic future research directions in the wireless field, among industry and academia, and to generate, identify and promote research areas and technical trends for mobile and wireless system technologies. The Forum is intended to closely cooperate with the UMTS Forum, ETSI, 3GPP, IETF, ITU and other relevant bodies regarding commercial and standardisation issues derived from the research work. The WWRF is a further development of work started in 2000 in the Wireless Strategic Initiative (WSI), a project under the Information Society Technologies program of the EU. You can find more information at www.ist-wsi.org

The GSM Association and the Universal Wireless Consortium (UWCC) reached an agreement to include TDMA interoperability with GSM as a core component of the GSM Global Roaming Forum. This Forum is the central body representing the interests of mobile operators and suppliers working towards interoperability between GSM and other technologies. The Forum members already provide products and services from GSM, iDEN, CDMA and TETRA.

The Cellular Telecommunications & Internet Association (CTIA) announced the launch of its new Wireless Internet Caucus (WIC), a forum to address the issues affecting the development of the wireless Internet. This forum is created by the merger of the Wireless Data Forum and CTIA.

The MeT initiative released its first specifications for secure mobile transactions. In addition to the specifications, a document on ticketing and usage scenarios was released. The specifications can be downloaded free of charge at www.mobiletransaction.org

The Consumer Electronics Association has formed the Wireless Communications Division, which will address retail training, specialised market and consumer research, promotional programs and issue advocacy.

Wireless LAN

Alcatel, Colubris Networks and WaveLink have joined the Wireless LAN Association (WLANA) as Sponsor members. The Association is a non-profit educational trade association, whose aim is to increase awareness among users and the industry that Wireless LANs is a very promising technology for interconnecting computers.

Texas Instruments is to offer royalty free licenses for its high-speed wireless LAN technology. The offer will depend on whether TI's proposal as the new IEEE 802.11g standard for WLAN in the 2.4GHz band is accepted. The offering extends to the IEEE 802.11b standard. The move from 802.11b to 802.11g will double data rates (it will reach 22Mbit/s) and will allow to offer applications such as streaming video and HDTV. TI's technology is also compliant with all existing requirements from the Federal Communications Commission. It is also intended for use in Wireless Fidelity (Wi-Fi) certified applications. Intersil is proposing a competing 22Mbit/s implementation.

Ericsson demonstrated a Wireless LAN network built on prototypes based on the HiperLAN2 standard. HiperLAN2 operates in the 5GHz frequency band and allows data rates up to 54Mbit/s. A cost-efficient chipset, with ASICs designed and developed by Ericsson, has been used to build a PC-card sized client terminal and an Access Point. The radio uses Orthogonal Frequency Division Multiplex (OFDM). A Link Adaptation scheme optimising the transmission

speed according to existing radio conditions is also part of the radio features. Ericsson's prototype also includes Dynamic Frequency Selection, which realizes Automatic Frequency Planning.

3GSM World Congress

The 3GSM World Congress took place in February at Cannes (France). This year's attendance increased to 24000 with the number of delegates up to 7200. The number of exhibitors also increased up to 468 compared to 276 in 2000.

During the Congress, Test Specialist Anite demonstrated what it claims is the world's first comprehensive protocol test system for 3G terminals. The system includes a host test product for protocol and application software testing and a stand-alone tester for protocol and applications testing of terminals through the RF interface.

3G Labs launched a development platform for 3G applications. The platform includes prototyping tools that allow development of graphics and web functions. It also incorporates a testbed for checking that proposed applications confine to the UMTS standard.

Texas Instrument and Analog Devices announced chipsets for 2.5G and 3G handsets. TI presented its latest DSP for GPRS handsets, based on its programmable DSP-based OMAP architecture. The processor is a dual-core architecture, based on the TMS320C55x DSP core and an ARM7 microcontroller. Analog Devices presented its programmable DSP core, jointly developed with Intel, called Frio. TI also announced during the event an investment fund of $100m to target development of 3G applications. According to TI's CEO, the money will be invested, in the next 12 to 18 months, into 2.5G and 3G applications software. The investment is also being used to support TI's 3G DSP platform, OMAP.

Some companies warned during the event that 3G will take longer than expected to arrive. French manufacturer, Alcatel, said UMTS mobile phones launch will be delayed to 2004 due to the time and investment needed to develop the technology. According to Alcatel UMTS will take over in 2007 and not 2005 extending the GPRS lifecycle. Dr Irwin Jacobs, CEO of Qualcomm, also said that 3G services are not likely to become commercially available until late 2004-early 2005. Qualcomm demonstrated during the event its alternative technology, cdma2000 1xEV. This technology supports peak data rates up to 2.4Mbit/s in a standard 1.25MHz frequency channel. The demonstration consisted of a base station and small, trial wireless modems attached to laptops, notebook computers and pocket PCs, performing Web browsing, email, file downloads and other applications such as streaming video, games and telematics. The US manufacturer is trying to attract European operators with the 1xEV technology due to the UMTS delays. 1xEV is not an IMT-2000 family member; however a Qualcomm executive revealed that the company has submitted a proposal to ITU to bring it under the IMT-2000 family.

3G roll-out

Nortel Networks has installed for Airtel in Spain what it claims is the world's first commercial radio equipment based on the UMTS standard. The company plans to launch the service in August 2001 in 23 cities. The two companies also completed what they claim is the first UMTS voice and data test calls in Spain.

The high cost of 3G licenses and infrastructure is making operators to think about jointly developing and maintaining 3G networks. In Germany, several operators have been considering this option despite statements from the German regulator insisting that the license holders are required to build out their own networks covering at least 50% of the

population and that they "must ensure their competitive independence". In Sweden, Telia announced it is planning to form a joint venture with NetCom to build and operate a UMTS network. Europolitan and Hi3G previously agreed to jointly build part of their UMTS infrastructure. In UK, Hutchison 3G UK reached an agreement to lease space (4000 sites) managed by Crown Castle UK, an outsourced network solutions provider. The Israel Antitrust Authority has said that it will not permit 3G license holders to have investments in infrastructure suppliers that wish to work with multiple networks.

Manx Telecom, a subsidiary of BT, has decided to overlay the existing 2G system with 3G technology rather than building a new one. This strategy could allow considerable savings; analysts suggested the savings could represent at least 50% of roll-out costs. However, the extent of resulting interference problems cannot be known until the method is thoroughly tested. Manx Telecom is planning to commercially launch its 3G network by the end of May.

Quintel S4, a joint venture between the UK government's Defence Evaluation and Research Agency and the group Rotch, is offering operators technology that will allow them to reduce considerably the network roll-out costs by significantly reducing the number of masts and antennas. The technology uses antennas that can receive up to five radio signals at once, combining services for different operators to a single roof-top or mast antenna. The solution would also provide a considerable environmental benefit.

Japan Telecom has announced it will delay the launch of its 3G services using WCDMA technology to July 2002. The company said that the delay is due to a change in the specifications of the international standard and to the need to spend more time on trials.

Ericsson has developed, in order to help operators to roll out 3G networks quickly, a new intelligent radio network planning tool for its Tools for Radio Access Management (TRAM) software package. The package supports planning, testing during tuning, optimisation and troubleshooting, and performance evaluation of WCDMA Radio Access Networks. The tool also supports the integration of GSM and WCDMA by importing data relating to 2G systems and allowing co-siting and re-use of existing infrastructure.

Qualcomm

An arbitration panel from the International Court of Arbitration, ruled that Qualcomm must share royalties on sales of wireless CDMA phone equipment in South Korea with the Korean Electronics and Telecommunications Research Institute, as the two parties signed in 1992 a technology development agreement.

Qualcomm announced the company's first generation of IMT-2000 WCDMA Power Amplifier modules, the PA5200 device. The module was jointly developed with RF Micro Devices Inc. The module includes features such as an advanced bias control and compensation, an integrated power detector, and a power step feature that allows it to be switched to low-power mode under low-output power conditions extending then the handset's overall talk-time performance. The device in conjunction with Qualcomm's MSM5200 Mobile Station Modem baseband, RFT5200 transmit processor, RFR5200 receive processor, PM1000 power management device and SURF52000 Subscriber Unit Reference development platform forms a WCDMA integrated circuit solution. Qualcomm announced that Samsung Electronics Ltd and Sanyo Electric Co. Ltd. have selected Qualcomm's MSM5200 integrated circuit and system software solution for their 3G handsets. The solution supports data rates of 384 kbps and it includes SnapTrack position-location technology, Bluetooth connectivity capabilities, UMTS Sub-

scriber Identity Module and multimedia features. Qualcomm also launched a new family of MSM integrated circuit and system software, the MSM6xx family, which will support multimode, multiband 2G and 3G technologies allowing then global roaming. Another product, a 3G cdma2000 1x Removable User Identity Module (R-UIM) handset solution, was also announced. The demand for R-UIM smart card capabilities and services has been driven by Korean and Chinese network operators to allow their subscribers to roam across CDMA and GSM networks.

Qualcomm and Motorola entered into a cdma2000 1xEV design transfer agreement for the development and design of cdma2000 1xEV infrastructure modem card equipment.

Satellite mobile communications

Iridium Satellite LLC is planning to market airtime at less than $1.50 a minute to companies in aviation, maritime services, oil and gas, mining, heavy construction, forestry and emergency services. Africa is considered a big potential market as it was second only to North America in use of the original Iridium service. Other important markets would be China, Russia and India. The company also announced it has signed agreements with 13 service providers to offer worldwide distribution capabilities.

North American satellite operators TMI Communications and Motient Corp announced they plan to merge their mobile satellite operations. The newly formed Mobile Satellite Ventures will have combined assets of more than $1billion.

Globalstar launched Globalstar Internet Access (GIA), a data service with Internet Access. GIA is the second satellite-based mobile data facility after Inmarsat. GIA operates similarly to terrestrial mobile data services and allows users to plug their notebook computers into the Globalstar GSP-1600 mobile, for Mobile Web surfing at 9.6kbit/s. So far the service is only available in the Americas region but the company plans to roll out the service in other areas during 2001.

The European Commission declared that EU-backed satellite systems can go ahead as additional spectrum needed for satisfactory operation has been allocated after the WRC2000 Conference. The systems include Galileo, a satellite navigation project and satellite broadcasting systems. However, there are still some technical conditions to be agreed in 2003.

Mobile phones and health

A study published by the American Health Foundation claims there is no link between cellphone use and brain cancer. The report has been published in the Journal of the American Medical Association. The study was partly funded by Wireless Technology Research LLC, a research group established by the wireless industry. The study was conducted between 1994 and 1998. It looked at 469 people, aged between 18 and 80, who had brain cancer and compared them with 422 people who did not have brain cancer; all subjects used regularly mobile phones. However, the authors insist in that future studies still need to be conducted as cell phones have been around only for a few years. George Carlo, former head of Wireless Technology Research, added controversy to the study as he claims that the original data indicated a statistically significant link and that the data has been altered. The authors of the report indicated that they reanalysed the data in response to feedback from other scientists.

Another study, by Dr Inskip from the National Cancer Institute, released in the New England Journal of Medicine, reached the same conclusions.

A Danish epidemiology research has found no connection between mobile phones use and brain cancer. The study, published in the Journal of the National Cancer Institute, has been conducted by the Danish Cancer Society and the International Epidemiology Institute in Maryland. The study tracked 420,000 Danish mobile phone users from 1982 until 1995 and found no difference in the rates for these afflictions among mobile phone users and the population-at-large.

Another study, conducted at Essen University Clinic (Germany), showed a possible link between eye cancer (in particular, a rare cancer called uveal melanoma) and RF-transmitting devices. The study found critics in the wireless industry, as the study didn't ask the subjects which specific kind of RF devices they used. The methodology used was also strongly criticised and even the authors of the study noted that there were several limitations due to the methodology.

The UK Government and industry are funding a £7m independent research programme into the possible health effects of mobile phone use. Industry will fund 50% of the programme over the next three years.

Japan is proposing reforms to its cellphone regulations in order to reduce exposure of users to radiation. The Japanese Government will modify its Ordinance for Executing the Radio Law, the Ordinance for Regulating Radio Equipment and the Ordinance concerning technical regulations conformity certification of Specified Radio Equipment. The new regulations should be available in June.

The Taiwanese Government will require mobile phones to carry health warnings starting in July. The phones will also have to disclose the Specific Absorption Rate (SAR).

Peter Angelos, the lawyer that won the lawsuit against tobacco manufactures, has launched an amended complaint against the wireless industry alleging fraudulent and conspiratorial conduct and failure to warn consumers about possible health risks from using mobile phones.

Some more information about the subject of mobile phones and health risks can be found at www. wow-com.com/consumer/health/

Wireless industry forecasts

Alexander Resources, a consulting company in wireless communications, has revealed the results of its research on key 3G services. According to the report of the 32 services evaluated only a few would achieve a high level of acceptance; and only 13% of those require the high bandwidths provided by 3G. Messaging, physical locations and addresses, product/service description, pricing and availability were the better-accepted services.

Dataquest Inc reported that worldwide cell phone sales totalled 412.7million units in 2000, representing a 45.5% increase compared to 1999. Nokia remains as the number one vendor. However, according to the company, a market slowdown appeared towards the end of 2000.

The Strategis Group claims in a new report that the US penetration rate for mobile data will reach 60% by 2007 compared to 2% nowadays. The mobile data subscriber base will increase from 5m in 2000 to 172m in 2007. The company also predicts that 2.5G and 3G network build-out revenues will surpass 2G revenues in 2003. According to the study, the GSM platform (GSM, GPRS, EDGE and WCDMA) will account for 70% of all base stations worldwide in 2007, with WCDMA accounting for 30%. 1xRTT and 3xRTT/1xEV will have the largest presence in North and Latin America with these two regions accounting for 53% of the total number of base stations for these technologies.

The GSM Association predicted that 200billion SMS messages will be sent in 2001, with monthly global SMS vol-

umes achieving the 25billion mark. During December 2000, 15billion SMS messages were sent over the world's GSM/PCS networks.

A report from Analysys claims that Mobile Virtual Network Operators (MVNO) will accelerate the mass-market take-up of 3G services. Key parameters for the success of MVNOs will be the regulatory climate and whether the MVNOs own the relationship with their customer base.

The ARC Group has predicted that the worldwide market for mobile entertainment will grow from 19million users in 1999 to 775million in 2005. According to the report, the vast majority of these users will use their phone as a game platform. However, whether games would be an important revenue generator remains unclear.

A research from Ovum predicts that m-commerce will be the main source of revenues in the mobile location services market, which should be worth $20billion by 2006 (the Strategis Group values this market to $819billion by 2005). The mobile connections for location services will increase from 2m in 2001 to 560m in 2006.

Spectrum licenses

Israel has awarded MIRS Communications Ltd a full general operator license making MIRS the fourth cellular operator in the country. The Communications Ministry is planning to call a tender for 3G licenses later in March. Israel is also going ahead with the LMDS license tender which has attracted 5 bidders for the pre-qualifying round.

Yemen has launched the country's first GSM mobile phone service and is expecting to cover the whole country by the end of the year. Syria has awarded two 15-year GSM licenses in the 900MHz band.

Brazil awarded its three regional licenses in the "D-Band" to Telecom Italia (won 2 licenses) and Telemar, a local operator. Previously, the Brazilian government had to cancel the auction of three licenses in the "C-Band" due to a lack of qualified bidders. Brazil has then decided to reschedule this tender and it still has three more licenses in the "E-Band" to sell, all operating GSM technology. Venezuela is auctioning 15 Wireless Local Loop (WLL) licenses in five regional blocks. Genesis Telecom, Digitel, Telcel and Millicom have been awarded licenses in this auction. Conatel, the Venezuelan telecoms regulator, is also planning an auction for Local Multipoint Distribution Systems (LDMS) in April or May. Chile's auction of WLL licenses, expected to take place in May, has already attracted 39 bidders. Nuevatel won a license tendered by the Bolivian government to operate mobile telephone services.

Canada's auction of radio spectrum in the 2.5GHz band ended raising $1billion. The three established operators Bell Mobility, Telus and Rogers Wireless and two new entrants W2N Inc and Thunder Bay Telephone won the licenses. 40Mhz of spectrum in 16 markets across Canada were available for the auction.

South Korea awarded only two of the three 3G licenses that were offered on the tender. SK Telecom and Korea Telecom won the two licenses based on WCDMA. The government has been insisting that it wanted at least one operator to choose the cdma2000 standard. The bids from LG Telecom (WCDMA) and Hanaro Telecom (cdma2000) were rejected. The bidding for the third license has been indefinitely postponed to provide more time for applicants to prepare. LG Telecom already announced that it will not participate. On the other hand, Hanaro Telecom will reapply for the license in a consortium participated by Qualcomm. The South Korean government announced it will provide incentives to companies willing to operate the cdma2000 standard. Singapore announced it has reduced the minimum bid for its 3G licenses by one third (the auction is expected to

take place in April). The government also announced that the nationwide rollout of 3G services was delayed by one year until December 2004 due to concerns over availability of 3G equipment. Taiwan's telecom regulator is planning to issue its 3G licenses in December after an auction planned to begin in October. Hong Kong announced it will issue four 3G licenses by mid-year. The interested companies will have to pass first a qualification process before entering an auction.

Australia has received seven bids for its 3G auction. Four of these seven bidders have opted to pay the maximum eligibility payment, which indicates they are looking for maximum spectrum. Qualcomm is among the seven bidders. The 2G and 3G auction in New Zealand ended raising a total of NZ$139.38 million.

India has announced the award of licenses for a fourth wireless operator in four metropolitan cities and 17 telecom areas. The license will be for 20 years and could be extended for ten more. The bidder must be an Indian company. The Indian government also revealed that fixed operators will be allowed to operate WLL technology.

Nigeria awarded four GSM licenses for a $285million price each. MTN Nigeria, Econet Wireless and CIL were awarded a license through an auction process while the mobile subsidiary of the state telecoms company, Nitel, received the license ahead of the auction. However, the Nigerian government revoked the license to CIL as it failed to meet the deadlines for the payment of the license. The company is fighting to retain the license. South Africa has finally awarded its third cell phone license to Cell-C after a year of legal battles.

France announced it will call a second round for its 3G auction after receiving only two bids for the four licenses offered. Established operators France Telecom and SFR won a license. France planned to award its licenses via a beauty-contest with a fixed fee of $4.6billion per license. Belgium awarded three 3G licenses to the three incumbent operators for the minimum price per license, raising a total $419million. Belgium also awarded four WLL licenses after receiving 11 applications. Portugal has awarded four UMTS licenses via a beauty-contest. The winners are the three incumbent operators (TMN, Telecel and Optimus) and the new entrant OniWay. Telia (Sweden) became the first leading national operator not to be awarded a UMTS license in its own country The licenses were awarded to the other two existing operators, Tele2 and Europolitan, and to Orange Sweden and Hi3G. Telia has launched an appeal over the result of the contest. Denmark has awarded two new GSM licenses to Telia and Mobilix in the 900MHz; both companies already operate in the 1800MHz band.

OTE Telecom has been awarded a 15-year GSM license, in Bulgaria, for $135million. Panafon Hellenic Telecom was awarded the second GSM license in Albania. The license operates in the 900MHz band. The Czech government announced it will offer the three existing GSM operators a UMTS license (each with a price of $135million). A fourth license will be auctioned in June or July. Slovenia has opened a tender for three UMTS licenses. The tender is expected to last until mid-May. Belarus has revealed it intends to offer a second GSM license later this year.

WAP & i-mode

The CEO of the GSM Association backed WAP technology and pointed to forecasts for Europe that predict that a
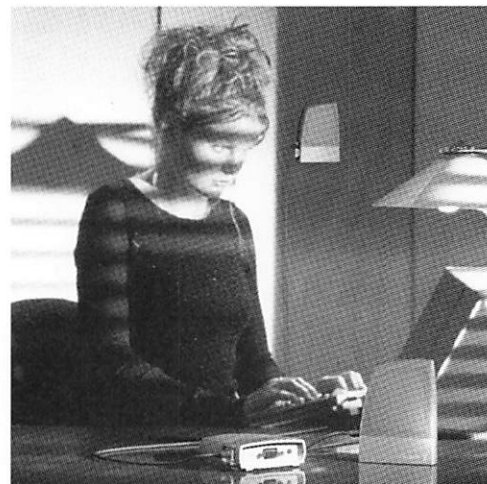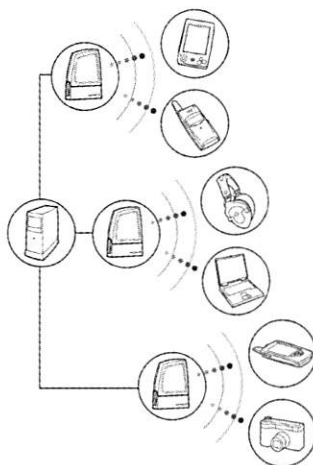
Ericsson's Bluetooth Local Infotainment Point (BLIP) System

100million WAP-enabled phones will be in the market in 2001. According to the executive, GPRS will be the "real catalyst for the re-birth of WAP". A study from Frost & Sullivan also says that GPRS and Bluetooth technologies will push forward WAP adoption. Of particular importance for this expansion will be the new billing models introduced by packet-switched technology. WAP is also said to benefit from the fact that the new specifications, WAP 2.0 will be based in X-HTML, which will allow the standard to be more open and flexible. According to Mr Goldman, CEO of the WAP Forum: "WAP and i-mode are on a convergence roadmap towards XML".

Equant NV has launched an international WAP roaming service (reaching 22 countries) integrated with its international fixed network. At the moment, WAP phones are usually locked to a single WAP portal through the use of short codes, which are meaningless to all networks except the user's home network.

OpenWave Systems Inc (company created after the merger of Phone.com and Software.com) unveiled its last version of its mobile browser designed for GPRS and 3G networks and compatible with i-mode.

NTT DoCoMo, KPN from the Netherlands and Telecom Italia Mobile announced they will work together to bring i-mode technology to Europe. The companies will launch the services first in Belgium, Germany, Italy and the Netherlands. The companies have also extended DoCoMo's agreement with Sony to develop jointly technology and services to link cellphones and the PlayStation console. AT&T, Hutchison (in Europe and Hong Kong) and KG Telecom are also part of this last agreement. DoCoMo also signed an agreement with Sega to combine i-mode and Sega's arcade games.

Last February, i-mode celebrated its second birthday reaching a total of 20million users with 40000 to 50000 new subscribers per day. However, DoCoMo has been having problems with its Java-based mobile phones launched in late January. DoCoMo announced it will replace 230,000 units manufactured by Matsushita Communication Industrial Co Ltd. The handsets had software glitches that caused the phones to suddenly lose power when accessing certain web sites and then erase saved data when the phones are switched back on.

Another "curious" service, a virtual lover game, has gained quick acceptance among i-mode users, having grown to more than 300,000 subscribers per month. The users

have to win the love of his/her chosen lover by exchanging emails via the mobile phone. FunMail Inc announced the start of Beta testing of animated wireless instant messaging on i-mode. The service will use FunMail's language independent text-to-animation technology.

Bluetooth news

TDK systems unveiled a Bluetooth product, Bluetooth PC card that can operate at distances five times greater than required by Bluetooth specifications. The device can reach 50m thanks to new ceramic antenna and input technology.

Ericsson launched Bluetooth Local Infotainment Point (BLIP), a stand-alone local platform which communicates through Bluetooth technology and enables users to gain access to information through their mobile phone, PDA or other mobile devices. BLIP will be launched globally in 2001 and the exchange of information will be free of charge for end users. The device is expected to be sold for less than $510 and it has a range of 10 metres. Potential applications exist in public transports. Each line could provide information or gather information through BLIP. Users should use BLIP server stations to access instant web information.

The Bluetooth Special Interest Group has started working on higher-speed versions of the Bluetooth specs that will run at 2 and 10 Mbit/s and that could be released by the end of 2001.

Infineon Technologies announced an integrated system development platform, System Platform 2001, for dual band and triple band GSM phones with GPRS and Bluetooth functionality. Three versions will be available: a 900/1800MHz configuration, a 900/1900MHz configuration and the tri-band configuration 900/1800/1900MHz.

Toshiba, Taiyo Yuden and IBM Japan have established a joint venture company that will authorise use of the Bluetooth logo. The company is expected to make it much quicker for Japanese manufacturers to obtain qualification of Bluetooth-enabled products.

Other news

Finland's Ministry of Interior launched its nation-wide VIRVE network based on the digital TETRA standard. The installation that began in 1998 has been carried out by Nokia. Nokia also revealed a new TETRA handset, the R580, allowing push-to-talk communications for instant group and individual calls, full duplex calls and status and short data messaging. The Finnish manufacturer was also awarded a contract to supply an 800MHz TETRA system to CLP Power in Hong Kong.

Photo by Nokia

Nokia's R580
TETRA handset

The Integrated Public Safety Commission (IPSC) announced the first phase installation of Project Hoosier SAFE-T Communications system. This initiative was created to develop a statewide voice and data radio communications capability for public safety agencies throughout Indiana.

Motorola and Creature Labs announced they will jointly develop and market artificial life pet nurturing games that consumers can play with on-data enabled handsets connected to 2.5G and 3G networks. Motorola also teamed with T-Motion (Germany) to deliver a mobile virtual pet dog using a WAP phone and T-Mobil's GPRS service.

The European Parliament's committee on industry, external trade, research and energy has accepted proposals for cost-based pricing regulations to be imposed on international roaming and mobile termination calls in the form of amendments to a major network access law. The move has been strongly criticised by operators that claim the move could bring uncertainty to the market.

Ericsson announced it will stop handset manufacturing and will outsource the production to Flextronics. However, the company will continue its R&D and marketing activities and phones will continue to be sold with the Ericsson brand name.

Marconi PLC and ArrayComm reached an agreement under which ArrayComm's smart antenna technology will be built into Marconi's equipment for WCDMA systems. Metawave announced it entered an agreement with Samsung to jointly develop a commercial CDMA Base Station that will incorporate Metawave's smart antenna technology.

The Canadian government has started a 90-day public comment period on whether to license technology used to prevent the use of cell phones in places like restaurants, theatres and concert halls. A decision on the issue will be taken by the end of the year.

The results of Sonera's Mspace's Personal Multimedia Assistant pilot trial were released. The trial's aim was to simulate next generation multimedia services. Two hundred users were provided with a PDA and a GSM phone supporting HSCSD (providing speeds between 20 and 30kbit/s). The PMA pilot services consisted of news flashes and weather, movie information and trailers, music videos, sport highlights, directory and map services. The users were able to set their own profile, determining what contents they wanted to receive. 60% of the users considered the experience to be enjoyable and 90% of them would use the service at least several times a week. The most popular services were news and movies while games were not among the most desired applications.

Mobistar N.V (Belgium) has launched a self-care service over the Internet that will enable mobile users to change their rate plans, add new services, view and pay phone bills and report problems.

More than 30million people in Japan are using cell phones to connect to the Internet. NTT DoCoMo has over 20 million users, KDDI's EZweb service has 6.11m users and Japan Telecom's J-sky service has 5.52m subscribers.

DoCoMo revealed its plans to offer international roaming services in Europe, Asia, Africa and Oceania. The company will also introduce new handsets compatible with both GSM and PDC standards. DoCoMo also announced it would launch a joint wireless music distribution service over its PHS system.

China has become the world's second largest mobile phone market after reaching 75million subscribers at the start of 2001. China Unicom, the second wireless operator in China, confirmed that it plans to build a 10million-subscriber, 160-city network using CDMA technology.

Chunghwa Telecom, a Taiwanese operator, said it has decided to abandon an investment in CDMA and focus on developing a GPRS system instead.
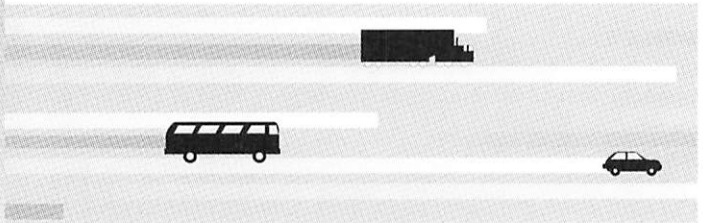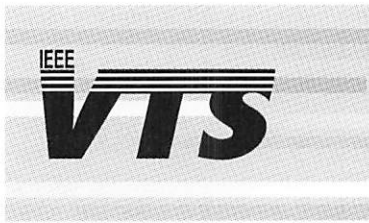
Automotive Electronics

Bill Fleming, Senior Editor

In-Vehicle Navigation Systems Consumer Satisfaction

There was only 25,000 in-vehicle navigation systems installed in seven different 1998 model-year U.S. cars. Today, there are more than 135,000 factory-installed navigation systems in 26 different late model-year U.S. vehicles. J.D. Power and Associates found that the Alpine Electronics DVD-based navigation system claimed four of the top six spots in the study (because it's included in Acura RL, Acura TL, Jaguar XK8, and Honda Odyssey vehicles). The remaining two spots in the top six went to Lexus GS (with a Denso navigation system) and Infiniti QX4 (with a Xanai system). The Cadillac Seville and Deville (Denso systems) were the highest-ranking navigation-equipped domestic vehicles, holding 7th and 9th top-rated places [1]. Below-average systems were not identified in the news article. The J.D. Power survey found that consumers were dissatisfied with those non-DVD-based systems that had limited geographic coverage. Systems that displayed reduced screens, or eliminated maps, also scored poorly. It was noted that although navigation systems are of interest, their demand continues to lag behind the demand for safety features like side-impact air bags, or daytime running lights.

Telematics Products Pre-Tested For Distraction

The number of electronic distractions inside vehicles is increasing as automakers respond to younger buyers demand for mobile Internet connection. Ford Motor is spending $10 million on a driving-simulator laboratory to study the safest ways to deliver information. The simulator, nearly complete at Ford's Dearborn Michigan headquarters, surrounds a driver with realistic sights and sounds and tests their reactions to using electronic devices while coping with normal and unexpected traffic situations. The simulator moves on its mounting pod to recreate the feeling of bumps, panic stops, collisions and skids. Ford claims it will duplicate 90% of the motions encountered in driving [2].

Mobile Phones Provide Data for Traffic Prediction

Traditional in-road devices like magnetic-field loop detectors get the job of counting cars and measuring their speeds done, but because they are buried in the pavement, installing and maintaining them is costly and time-consuming. It's thought that the tracking of cellular phones that many drivers have in their cars might be a better method of data collection. The tracking data would come from mobile phones equipped with global positioning system receivers, or through triangulation from nearby cell base station towers. It was stated that, *"tracking mobile phones in cars will revolutionize traffic monitoring at a fraction of the cost of loop detectors."* An important test for mobile phone tracking is upcoming in Europe (eighteen regions across five countries are participating in the test) [3].

Track Your Own Car — No Matter Who Is Driving

Soon you'll be able to use the Internet to monitor the speed, location and direction of your car while it's driven anywhere in the world. This could ease the nerves of worried parents with teenage drivers and put an end to unapproved joyrides. GeoSpatial Technologies, based in Santa Ana, California; plans to begin selling a vehicle-tracking device, called GlobalTrax, next fall. It will cost $150 for installation, and $50 to $70 in monthly fees. GlobalTrax will be the first device that lets someone monitor movement of their vehicle from any Web browser without downloading a bunch of files. GlobalTrax can either be permanently installed in a vehicle, or it can be purchased as a portable unit that can be carried to different vehicles. A map display appears with an image of a small vehicle moving along a street identified on the map. Next to the vehicle will be its speed and direction. The unit can also be used on school buses where an automated call to a student's home, particularly useful for special-needs students, tells them when the bus is within, say, 10 minutes of their home [4].

Harsh Reality for Electric Cars in California

Rolling electric-utility blackouts in California are damaging the convenience factor of electric cars. Soaring electricity-rate price hikes are causing harm, too. This was a shocker. One of the key selling points of all-electric vehicles was the presumed ready availability, and relatively low price of electric power. *"Drive your electric car. Park it. Power up while you work or sleep. But it's hard to do when the power is off [5]."*

At the same time, CARB, the California Air Resources Board, is considering weakening the state's zero-emission-vehicle mandate. Lukewarm consumer demand for all-electric vehicles was beginning to undermine the mandate; and now, with the on-again-off-again shenanigans of Southern California Edison and Pacific Gas & Electric, it could be lights out for all-electrics altogether. Furthermore, since the June 2000 launch of Toyota Prius (a low emissions, hybrid electric vehicle), only 5,500 have been sold nationally; and the Honda Insight (a similar hybrid electric) has only sold 4,000 vehicles since its launch in December 1999 — see Refs. [5-8].

Interesting New R&D Devices

While reading the current issue of an engineering journal, three articles were noted because of their high potential for further development — these articles were as follows:

1. **3-Axis Accelerometer** — For intelligent crash detection, especially for rollover detection, a new type of

3-axis (x-y-z) low-g accelerometer was reported [9]. Researchers from the Technical University of Braunschweig, Germany, have fabricated a 3-axis accelerometer by created masses suspended on different-geometry flexure stems. The stems are anisotropically etched to form differently angled cross-sections (stiff in one direction, soft in another). As a consequence of the different directional sensitivities of the stems, it's possible to resolve three components of acceleration even though the seismic mass elements are micromachned in one plane.

2. **Micro Turbine Generator** — Micro (2 × 2 × 0.4 cm) turbine gas generators are under development at M.I.T. (Massachusetts Institute of Technology, Cambridge, MA). Ultimately, they will produce 10-to-50 W of electrical power while consuming 7 gram of fuel per hour. Deep reactive ion etching was used to make turbine structures of height 3,800 micron (3.8 mm). A 180-pole induction motor-generator is fabricated integral to the turbine (to start it, and to generate electricity once its running). It's hoped to be able to operate the turbine on ordinary hydrocarbon fuels [10].

3. **Micro Gas Analyzer** — Previously, low thermal mass micromachined silicon diaphragms have had a thick film of porous tin oxide used to detect ambient air gas concentrations. As gases adsorb on the exposed surfaces of the tin oxide, the tin oxide's electrical resistance varies according to the gas concentration. In a new development, The University of Bremen, Germany, has embedded the gas sensing elements in a micro-fluidic MEMS-structure that contains microvalves and micropumps [11]. The micro-fluidic structure also incorporates gas filtering and pre-treatment stages.

With an internal micro-chamber gas volume of only 45 micro-liters, complete gas exchange is achieved within a few milliseconds. Samples of ambient air are pumped in, and then enclosed in a micro-chamber by closing micromachined inlet and outlet ports. Closing of the chamber allows the sensor to operate as a micro-reactor.

Alternating between constant-flow (pumping) and no-flow (reacting) modes of operation, gas concentrations are individually measured. These sensors presently detect ozone and nitrogen dioxide gases. The authors state that, *"they have a vision that these micro-reactor devices may evolve into miniaturized gas analyzers, replacing the expensive and bulky optical instruments presently used for monitoring of atmospheric gases."* Potential automotive applications include engine closed-loop emissions control, and automatic recirculation gas-filtering operation of climate control systems.

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VTC2001-Fall in Atlantic City

Atlantic City will host the Fall Vehicular Technology Conference will be held from the 7th to the 11th of October in the Atlantic City Convention Center, with accommodation and some events in the Sheraton Atlantic City Convention Center Hotel.

The theme of the conference is 'Mobile Technology for the Third Millennium', and over three days of technical sessions on the 8th, 9th and 10th of October approximately 700 papers and posters will be presented on mobile radio technologies such as antennas and propagation, wireless access, transmission, networks, applications and mobile satellite, as well as transportation technologies such as intelligent transportation systems and vehicular electronics. Fifteen invited papers on topics of Vehicle Systems will be presented in two special sessions on Monday. In a new feature this year, the last morning of the conference will be devoted to workshops of 'hot' topics to supplement the technical presentations. The conference begins on Sunday 7th October with a day of tutorials, which are becoming an increasingly popular way of keeping up with the latest developments in our fast-moving field.

Atlantic City is conveniently located only one hour from Philadelphia, and NJ Transit offers a rail service from the North East corridor. The Atlantic City terminus is connected to the convention center making transportation by train convenient. Those coming by air have a choice of flying to the city directly, or flying to Philadelphia and travelling on from there by convenient rail service from the airport.

Advance registration is available until the 30th of August 2001. The cost of registration for members is $500 ($575 for non-members), rising to $575 and $635 respectively from the beginning of September. Registration includes lunches and the banquet. Students and life members may attend the conference for the reduced fee of $75.

Atlantic City is a world famous vacation city that offers a wide range of activities and boasts top-quality entertainment. It is family oriented as well as a gaming mecca and has affordable accommodations. It is only one hour from Philadelphia, and is accessible to Baltimore, New York and Washington, DC.

Further details of registration and the conference programme itself can be found on the VTC2001-Fall web site, http://www.fallvtc2001.org, which also contains useful information on Atlantic City itself. If you can't wait until October, it is possible to take a virtual tour of the convention center at http://vc0.tscentral.com/vt/accc/ Additional information on the locality is available at the state government's official site, http://www.atlanticcitynj.com
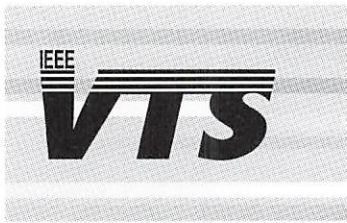
The first stage of the Newark-Elizabeth Rail Link (NERL) is under design. This line will eventually link the Broad Street commuter rail station of New Jersey Transit to Elizabeth, New Jersey with stops along the way at the Amtrak/New Jersey Transit Penn Station in Newark and at Newark Airport.

The first stage, the minimum operable segment-1 (MOS-1), will operate between Newark Broad Street and Newark Penn Station. Trains will join the existing Newark City Subway just north of Penn Station, operate around the existing loop, and then continue out to the existing terminal of the subway. The future extension to Newark Airport and on to Elizabeth has not yet been funded for design. When it is built, all trains from Broad Street will enter the subway, proceed south and around the loop at Penn Station, and then head north to Mulberry Street. There will be an underground station in that area before the trains leave the subway operating west towards the airport.

The bulk of MOS-1 is at grade. After it leaves the subway portal near St. John's Church, it will travel on the existing right of way of McCarter Highway. The highway is being relocated east toward the Passaic River. NERL will serve Newark's Performing Arts Center, its new minor league ballpark (Riverfront Stadium), and terminate at the Broad Street commuter rail station.

The cars for the NERL service have been procured under the Hudson Bergen Light Rail Project. They are low floor articulated cars. These cars are scheduled to replace all of the existing Newark City Subway cars in May 2001, before the first stage of NERL goes into service. A new maintenance facility for the new cars has been constructed in Bloomfield, beyond the present end of the Newark City Subway Line at Franklin Avenue. Eventually passengers will be carried to a new station near the maintenance facility, but that station won't go into service until later this year. In order to accommodate the new cars, which only provide entrance doors in the 70% low floor section in the middle, the Newark City Subway was converted from a pay as you enter system to a proof of payment system, similar to the Hudson Bergen Light Rail system.

The Long Island Rail Road (LIRR) has advertised a Request for Information for Communications Based Train Control (CBTC). The purpose of this ad was to receive industry comments on a proposed installation of CBTC from Babylon to Montauk, a distance of 78 miles. Included in this territory are eleven interlockings and 98 rail/highway grade crossings equipped with automatic warning systems.

The LIRR provided a set of Preliminary Technical Requirements for comment. These requirements will provide the basis for a Procurement Specification after LIRR review of the Industry comments.

The requirements, which were based on both the Canarsie CBTC project now underway on New York City Transit (NYCT) and other railroad industry CBTC initiatives, include train detection without the need for track circuits, constant warning time for rail/highway grade crossings including some provision for limiting acceleration that may cause short warning times, flexible block lengths based on the speed and stopping capabilities of each train, and the ability to interface with trains either not equipped with CBTC or whose CBTC apparatus has failed en route.

The LIRR encouraged suppliers to include proprietary information in their Letters of Interest and agreed to keep any items so marked confidential.

The sole purpose of the solicitation was to obtain information as to the feasibility of the different items in the Preliminary Technical Requirement in order to enable the LIRR to prepare Specifications for a formal procurement. Response to the RFI would not affect evaluation of any proposal submitted as part of the final procurement.

Two different units of Mew York's Metropolitan Transportation Authority (MTA) have ordered new equipment of Bombardier. The LIRR has ordered 100 electrical multiple unit (EMU) commuter rail cars. This is a second option on a previous order for 192 M-7 cars that was awarded in May 1999. The first option, for 34 cars was exercised in October 1999. The contract has options for an additional 674 cars that have not been exercised. The 1000 cars called for under the base contract and all of the options will
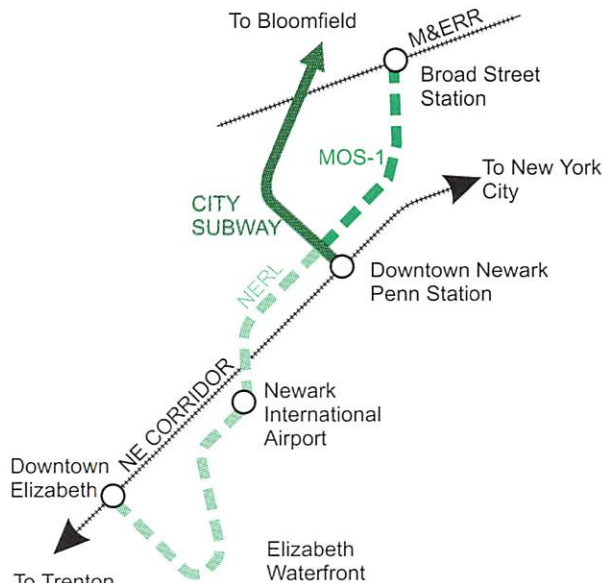

Figure 1 Proposed Newark-Elizabeth Rail Link

be split between the LIRR and Metro North Commuter Railroad, the other commuter railroad operated under the MTA umbrella.

The cars are married pairs with full-width cabs at each end of the married pair. All cars are motored. Final delivery of this latest option is scheduled for fourth quarter of 2003.

The New York City Transit (NYCT) has ordered 350 heavy rapid transit vehicles. These vehicles are arranged in five-car sets with a fully motored car at each end and three intermediate cars with only half the trucks being motored.

The cars are designated R-142 by the NYCT. The order consists of 200 cars that represent exercise of an option under a contract awarded in 1997 and 150 cars that represent a totally new order. Final delivery of this order is scheduled for 2003.

Car bodies for both orders will be fabricated at Bombardier's plant in La Pocatière, Quebec, with final assembly at their plant in Plattsburgh, New York.

The Italian State Railways (FS) have awarded a contract for up to 200 new trainsets to Alstom. The first phase consists of 20 EMU trainsets and 16 Diesel multiple (DMU) trainsets for regional services. FS will take 14 EMU trains and 10 DMU trains for its own services. Trento Province will receive six DMU trainsets, Arezzo Province will receive four EMU trainsets, and Salerno Province will receive two EMU trainsets.

Each trainset will consist of three cars with full floors for handicapped access. Top speed for the EMU trainsets will be about 100 mph, while top speed for the DMU trainsets will be about 80 mph.

The first phase contract, which amounts to 115 million euros, calls for the first trainsets to be delivered in 2003.

The Minneapolis Metropolitan Council has ordered 18 low floor light rail vehicles for the Hiawatha Corridor Light Rail system. The $56 million contract includes options for as many as 24 additional vehicles. If the options are exercised, the total value of the contract would be $112.4 million.

The Hiawatha Corridor, which is currently under design, consists of 12.2 miles with 15 stations. It connects downtown Minneapolis, the Minneapolis/St. Paul International Airport, and the Mall of America in Bloomington.

Bombardier will manufacture the shells for the cars at their plant in Sahagun, Mexico, while final assembly will be at their plant in Barre, Vermont.

The TGV Méditerranée is scheduled to open for revenue service in June 2001. The line extends TGV service south to Marseille and Nice. Opening of the line will cut the travel time on the 465-mile trip between Paris and Marseille to 3 hours. The 600-mile trip from Paris to Nice will take just over five and one-half hours, almost an hour saving over the current travel time. On January 17 the French Transport Minister, Jean Gayssot, operated a test train at speeds which reached 220 mph on the run between Aix-en-Provence and Valence. In revenue operation, however, top speed on the TGV Méditerranée will be 185 mph.
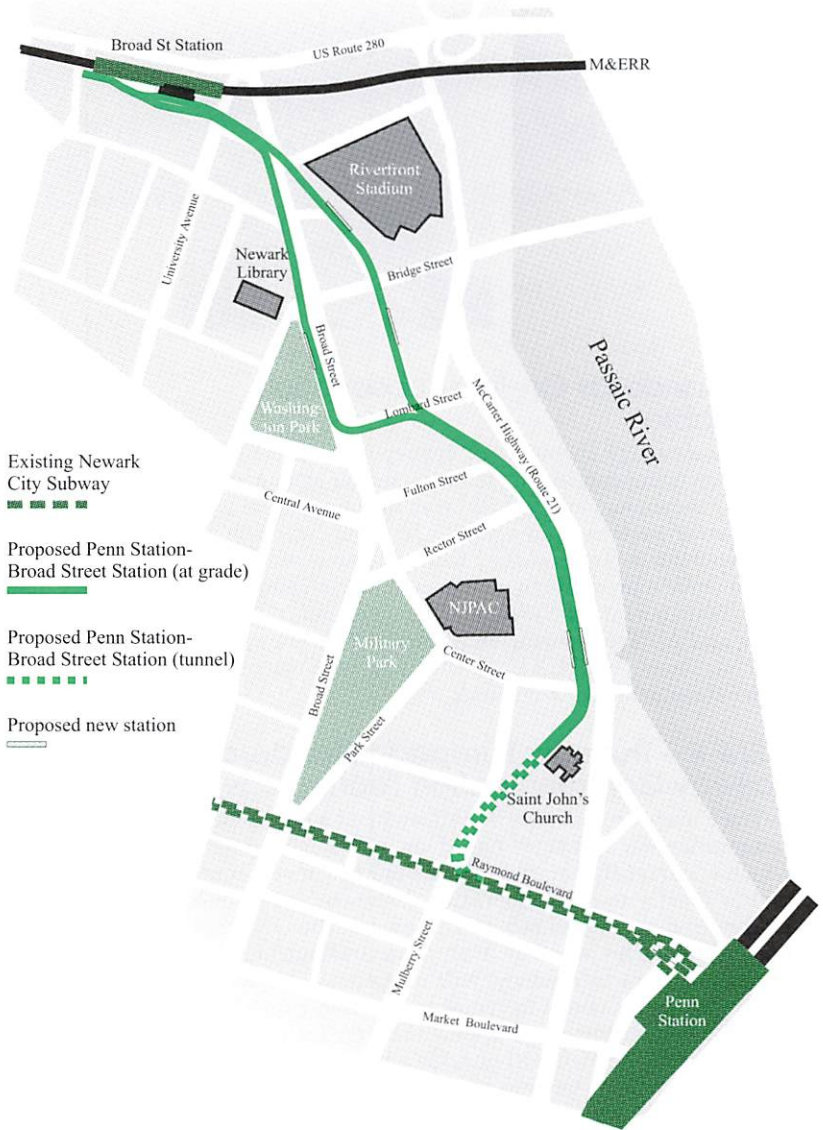
Figure 2 Newark-Elizabeth Minimum Operable Segment 1

Shanghai signed a contract in January with the German Consortium Transrapid for a line linking the city with the new international airport at Pudong. While full details are not yet available, the 20-mile long line is planned to be in revenue service by the end of 2003. Top speed on the line is expected to 267 mph, with a total running time end-to-end of seven minutes. China is also considering extending the line 125 miles to Hangzhou, and eventually all the way to Beijing in the future.

France and Italy have agreed to build a new tunnel under the Alps in order to provide high speed rail service between Lyon and Turin. This is part of an agreement that was announced in January to provide for improved rail service in this corridor. An existing tunnel would be widened and dedicated to freight service only.

When the new tunnel is completed in 2015, passenger trains between the two cities would be able to make the run in one and one half hours instead of the four hours it presently takes.
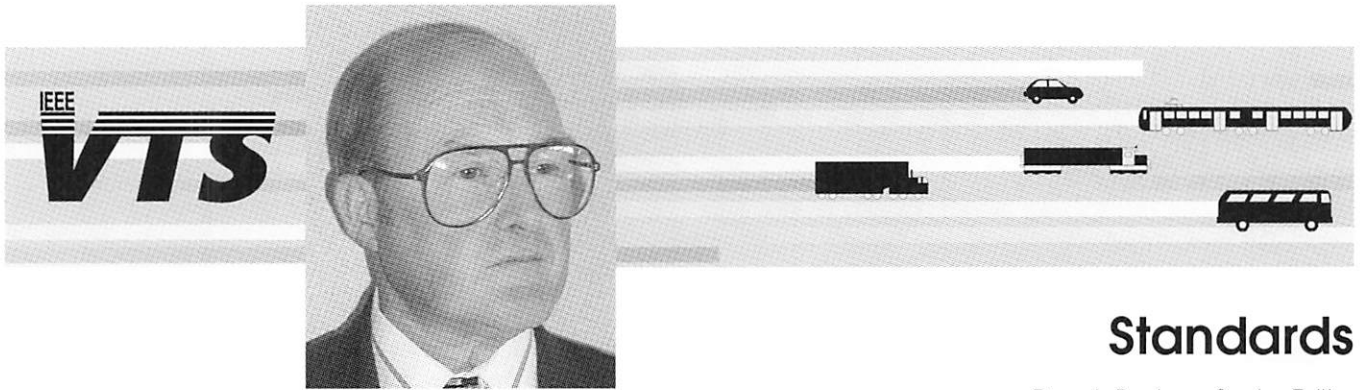
Standards

Dennis Bodson, Senior Editor

VTS Standards On-line Subscription Available

As technology meets with transportation, IEEE standards covering intelligent transportation systems and vehicular technology play a vital role in the creation of better or smarter systems and vehicles for today and the future. Transportation Technology Standards area of IEEE Standards Online provides three types of subscriptions, Intelligent Transportation Systems (ITS), Vehicular Technology (VT), and All Transportation (ITS and VT). For more information, see the IEEE Standards web site area at http://standards.ieee.org/catalog/olis/.

GSM-R – The new European Standard for Railway Communication Technology

The European railways have developed a new generation communication network based on GSM, called GSM-R, which is currently being implemented in various countries and is shortly to enter operational service in Sweden, the Netherlands, Switzerland, Germany and the UK. This system, which relies on a new European Standard for railway communication technology, will integrate all existing mobile radio applications for railway use and provide a platform for new services and applications for future evolution. In particular, GSM-R will provide a harmonized communication platform to enable the interoperability of railway traffic and provide a bearer service for the European Train Control System.

Existing services are based on a multitude of different operator-specific specifications, resulting in considerable incompatibility. European Council Directives require a fully interoperable Control and Command System on the international high-speed lines of European Union railways, and GSM-R will enable this.

GSM-R brings together in a single system most, if not all, of the applications needed by the railways, including: digital technology, the integration of services based on a standardized open system, interworking with railway and public mobile and fixed communication systems, Europe-wide roaming and mobility management appropriate to railway specific services and performance, and the optional use of public networks to supply a system offering complex roaming and mobility management tasks for the disposition, management and control of national and international railway processes.

The advantages of GSM-R are numerous and benefit all concerned. By standardizing the system platform, GSM-R operators will be able to make significant inroads into maintenance and operating costs. Investment will be reduced to a minimum. Passengers travelling abroad will no longer waste time unnecessarily at borders as locomotives have to be changed. In addition, the wide application of GSM in the public domain will provide great potential for the addition of further services in the future.

Applications for railway operation include :
+ Logistics (tracing cargo coaches, containers, goods etc, polling of status information on goods)
+ Enhanced operational services for railway staff (Intranet access to operational data bases, customized news services for time scheduling and tariffs, automatic seat reservation with display)
+ Telematic applications for rolling stock and fixed equipment
+ Optimized freight load and on-line sale of free capacity.

Examples of new applications for railway customers include:

On-line passenger information systems on trains and platform
+ Internet terminals for reliable on-train WWW services
+ Train journey specific car rental, taxi ordering, hotel reservation etc
+ Special tourist and holiday services.

Interest in GSM-R is also increasing outside Europe, particularly in Asia and North America.

Members may be interested to know that an article on GSM-R is currently being written for the *VTS News*, to appear late 2001/early 2002.

ITU Moving Quickly on the Convergence of 3G Mobile Networks

The first meeting of the Special Study Group on IMT-2000 and beyond closed with the adoption of a roadmap for the future development of third generation network standards. The Study Group, which met in Geneva under the chairmanship of John Visser, Nortel Networks, from 11 to 15 December, agreed on an appropriate structure that reflects the market dynamics in this area, the scale of wireless penetration and the need to prepare and deliver timely results. The meeting also agreed on the work structure and work plan, setting out clear objectives, deliverables and target dates.

"It is essential that global IMT-2000 network standards be available in time and in a form that meets industry needs", said John Visser on the outcome of the meeting.

Less than two months after its creation, the Special Study Group participants swiftly crafted an aggressive strategy aimed at delivering results in the shortest possible timeframe. They agreed on principles that will guide the work of the Special Study Group in the next four years based on the overriding objective of building on the results of activities carried out by regional organizations and industry groups while adding value and providing a global perspective in the medium to long-term.

"We are serious both about the work we are proposing to do and about filling an important role which will provide on-going value", Visser said.

One of the goals of the Special Study Group is the definition of a converged set of requirements for the medium to long term which will stimulate harmonization and convergence of the various technologies and solutions presently being deployed. In addition, with several members of the Management Team representing developing regions of the world, the Special Study Group will work to ensure the relevance of its work to their needs and to assist them in developing their mobile telecommunications infrastructure.

The work plan provides for the adoption of standards on service capability requirements including the Virtual Home Environment by mid-2002 and completion of most of the work on network capabilities, mobility management and interoperability for global roaming between various IMT-2000 networks by the end of 2002. Other critical aspects such as interworking with fixed voice networks, packet data networks and requirements for convergence between fixed and IMT-2000 are also set for end-2002. The network architecture and interface requirements to facilitate the evolution of existing fixed networks towards a converged IMT-2000 compliant core network will first be carved out in early 2003 while the full architectural and network interface requirements that will facilitate service transparency to users across different access arrangements will be addressed over the following two years. Guidelines to assist countries in the deployment of existing and evolving IMT-2000 systems are also being prepared for the end of 2002.

"While much of the attention has so far focused on the radio aspects of IMT-2000, the core network infrastructure is equally important to interconnect mobile users", said Houlin Zhao, Director of ITU's Telecommunication Standardization Bureau. "In order to deploy full 3G networks that will deliver on the promises of global roaming and virtual home environment, a great deal of work remains to be done. A roaming user will want to see as little difference as possible between the service experience provided in the home network and in a visited network and this implies a very high degree of harmonization of network and services capabilities worldwide together with a convergence of approaches. I am confident that ITU can play a very successful role in this area", Zhao said.

The Special Study Group on IMT-2000 and Beyond is one of the 14 Study Groups of the ITU Telecommunication Standardization Sector (ITU-T). Established last October by the World Telecommunication Standardization Assembly, it is responsible for the harmonization of different IMT-2000 family member standards as they evolve beyond IMT-2000 as well as the evolution of network aspects of IMT-2000 from the existing fixed network by utilizing the IMT-2000 radio transmission technologies as fixed wireless access. It is also responsible for providing a migration path regarding network aspects and mobility from existing IMT-2000 systems towards systems beyond IMT-2000 specified by ITU-T and external standards development organizations (SDOs), 3G Partnership Projects (3GPPs), IETF, and relevant external forums. The mandate of the Special Study Group also includes addressing near-term IP-based internetworking and the development of a long-term common IP-based network architecture as applicable to IMT-2000.

Better Avalanche Beacons on the way...

Improving the safety of skiers due to avalanches is a clear need covered by the use of portable radio systems called avalanche beacons. These radio systems comprising of a transmitter and a receiver operating at 457 kHz enable a person who has been buried in an avalanche to be found by rescue services.

The European Commission have agreed to adopt a decision requiring avalanche beacon equipment to meet the requirements of the R&TTE Directive (Radio equipment and Telecommunications Terminal Equipment) – Article 3.3e (access to emergency services), in addition to Article 3.2 (avoidance of harmful interference), which is compulsory for all radio equipment. Although the decision has not yet been published in the OJEC (Official Journal of the European Communities), ETSI ERM has responded to a request of the Administrations of Austria and France in particular, and has made available an updated three part version of the standard which is currently undergoing ETSI One-step Approval. The original Avalanche Beacon standard was published by ETSI in 1997 and operated on two frequency bands: 457 kHz and 2275 Hz. In the new version the later frequency has been deleted to ensure all equipment operates on the 457 kHz frequency band.

The three parts of this EN covering Avalanche Beacons; Transmitter-receiver systems are as follows:

Part 1: "Technical characteristics and test methods";

Part 2: "Harmonized EN covering essential requirements of article 3.2 of the R&TTE Directive";

Part 3: "Harmonized EN covering essential requirements of article 3.3e of the R&TTE Directive".

Parts 2 and 3 are intended to become Harmonized Standards, the reference of which will be published in the OJEC referencing the Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on Radio equipment and Telecommunications Terminal Equipment and the mutual recognition of their conformity.

Public Safety Organizations Advance Work in a Global Partnership with Industry

Two of the world's leading standards development organizations, the European Telecommunications Standards Institute (ETSI) and the Telecommunications Industry Association (TIA), met in Mesa, Arizona, USA, on 30th January to fine tune their Partnership Agreement and to welcome the South Korean Standards Organization, the Telecommunications Technology Association (TTA), into the Partnership as an Observer. This remarkable Public Safety Partnership Project (PSPP) has been established to meet the advanced mobile broadband needs of public safety users and to develop new standards within a global context.

Dan Bart, Senior Vice President, Standards and Special Projects at TIA, comments:

"The PSPP represents a unique opportunity for Industry to absorb and understand the specific harmonized requirements of Public Safety Organizations across the world's regions. PSPP will produce the Technical Specifications and the participating standards organizations will produce the official standards. We strongly encourage Industry and Public Safety organizations to join this Partnership. Registration takes a minute by clicking onto the PSPP Web Site". (www.ps2p.org)

Signing of the agreement (from left to right) Mr. Strandberg (ETSI), Ms. Rosado (TIA), Mr. Bart (TIA), Mrs. d'Esclercs (ETSI) and Mr. Lee (TTA)

Kjell Strandberg, Head of ETSI's Standards Making Support, says:

"More than ever standards are playing a key role in the success of the global economy. PSPP Members can now look forward to the creation of a harmonized market for Mobile Broadband products and services, where competition and economy of scale will benefit both users and suppliers."

The Mobile Broadband Specifications are intended to meet a variety of public safety applications, including the expanded use of wireless and remote robotics that could be used for the containment of chemical spills, the disarmament of bombs or explosives, fire management and control, the identification of hazardous conditions within a fire, locating fire hot spots, pinpointing the locations of victims and firefighters, and many other audio, data, visual and robotic operational functions which are needed in law enforcement and the Fire/EMS (Emergency and Medical Services) sector. This new PSPP technology has been named MESA (Mobility for Emergency and Safety Applications) after the city where the final agreement was signed.

Steffen Ring, Chairman of the PSPP Steering Committee, adds:

"We are confident that the combined strength of industry across many of the world's regions is able to deliver a standardized technology which will offer mobility in a secure, wireless megabit environment. The requirement for radio frequencies in this vital field was recognized at the recent World Radiocommunication Conference (WRC) in Istanbul, and the International Telecommunication Union Radiocommunication Sector (ITU-R) is now preparing the matter for the next WRC in 2003."

UWC-136 Update Approved for Inclusion in ITU-R Recommendation

The International Telecommunications Union Radiocommunications Sector (ITU-R) Working Party 8F meeting has approved an update to the Universal Wireless Communications Consortium's option for IMT-2000 wireless services, UWC-136. The update, which includes EDGE technology as a wireless data delivery standard, was officially approved for inclusion in Revision 1 of ITU-R recommendation M.1457 at the Working Party 8F's fourth meeting in Rabat, Morocco, on February 27, 2001. This approval positions the UWC-136 documentation to meet translation and publication goals for ultimate finalization of ITU-R recommendation M.1457 by October 2001 at the Working Party 8F meeting in Japan. The IMT-2000 radio interface specifications for TDMA Single-Carrier technology are developed by TIA TR45.3 with input from the Universal Wireless Communications Consortium (UWCC). This radio interface is called Universal Wireless Communication-136 (UWC-136), which is specified by American National Standard TIA/EIA-136. Ericsson's Jim Ragsdale, Chairman of the UWC-136 Radio Interface Specifications (RSPC) group, commented, "At this time, of the five radio interfaces in the ITU family, the UWC-136 update, Section 5.4, is the only one to be approved for inclusion in Revision 1 of the ITU-R recommendation." He added, "It was important to capture EDGE classic and EDGE COMPACT as part of this approved documentation to proceed towards full service transparency and the future goal of Revision 2, which includes wireless multimedia and data transmission."

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6. "UWC-136 Update Approved For Inclusion In ITU-R Recommendation". UWCC Press Release, March 8, 2001.

Transactions in Vehicular Technology Ranked First in Field

The Vehicular Technology Society's Transactions on Vehicular Technology was ranked first in its field in the most recent IEEE 1999 Journal Citation Report. The study conducted by the Institute of Scientific Information™ (ISI) ranked 205 electrical engineering periodicals on the number of times they were cited in scientific literature. The IEEE as a whole recorded its best journal and magazine citation performance ever in the category of electrical engineering and related technologies.

The most highly cited IEEE journal, ranked second overall, was Proceedings of the IEEE, and in total nine of the top ten publications belong to the IEEE.

The top rated scientific journal was Elsevier's Progress in Quantum Electronics.

Rankings are related to the number of citations articles in a journal has over the previous two years. In 1999, Progress in Quantum Electronics published four articles and the journal's articles were cited 196 times. In contrast, Proceedings of the IEEE published 126 articles and recorded 8810 citations. Transactions in Vehicular Technology published 198 articles in 1999, and the journal was cited 2050 times.

Other journals ranked first in their field included Aerospace and Electrical Systems and Transactions on Microelectromechanical Systems.

Intelligent Transportation Systems Data Registry

IEEE Standards has released the Intelligent Transportation Systems Data Registry, a centralized dictionary for all formally specified ITS terms and messages. It currently con-

tains data elements and concepts from the Traffic Management Data Dictionary (TMDD), Transit Communications for ITS Profiles (TCIP), and the National Transportation Communications for ITS Protocol (NTCIP). The primary objective of the registry is to support the interchange and re-use of data by recording unambiguous definitions of the data concepts.

As part of the inauguration of this new registry, subscription fees for access to the ITS DR will be waived in 2001. For more information and to access the ITS DR, visit: http://standards.ieee.org/regauth/its/index.html

IEEE VTS Propagation Committee

The mission of the IEEE VT-S Propagation Committee is to promote effective exchange of information concerning propagation measurement and modeling for wireless communications system design. To this end, the committee has established both an Internet mailing list (which

has grown to nearly 400 subscribers, including many well known members of the community) and a website devoted to propagation issues (which has received over 5,700 visits since it was unveiled).

The mailing list has proven to be a very effective way to poll those active in the field concerning proposed committee activities and initiatives. Based on discussions initiated via the mailing list, the Committee plans to organize and host a special issue of IEEE Transactions on Vehicular Technology concerning Wireless System Planning Tools with publication slated for late 2002.

For more information concerning the committee and its activities, please contact committee chair Dr. Dave Michelson <dmichelson@ieee.org> or visit the Propagation Committee's website at http://propagation.vtsociety.org/

David G. Michelson,
Propagation Committee Chair

Chapter News & Meetings

Gaspar Messina, Senior Editor
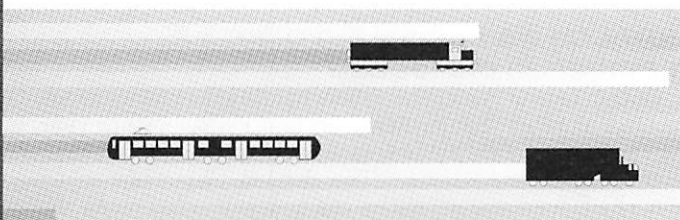
Japan

Dr. Tadashi Matsumoto held weekly, periodic work team administrative meetings, in preparation for the Spring Vehicular Technology Conference 2000 in Japan. Each meeting was attended by 20 IEEE members.

February 17-19, 2000, Dr. Tadashi Matsumoto chaired a Joint Technical VTS meeting with the Institute of Electronics, Information and Communication Engineers in a Mobile Communication Workshop setting, wherein 80 papers were presented. The attendees were 60 including 30 IEEE members.

May 15-18, 2000, VTS Japan hosted the VTC 2000 Spring Conference. Dr. Tadashi Matsumoto, VTS Japan Chapter Secretary and one of the principal Conference Organizers, was responsible for approximately 500 papers being presented. The attendees were approximately 1000 of which approximately 800 were IEEE members.

May 19, 2000, Dr. Tadashi Matsumoto arranged the VTC 2000 – Spring Technical Tours in conjunction with Yokosaka Research Park R&D Committee to visit the Yokosaka Research Park and the T R Maglev Test System. The attendees were 100, all IEEE members.

On December 14, 2000, Dr. Ryoji Kawasaki on behalf of the Institute of Electrical Engineers of Japan presented a paper entitled: "A study on Communication Networks and Information Technologies for the Future of ITS". The attendees were approximately 30.

3rd Generation Infrastructure and Services

Last call for this event being run by the joint Vehicular Technology Society / Aerospace and Electronic Systems So-

ciety chapter in Greece. The Symposium runs from 2-3 July 2001 in Athens, Greece. For further details, contact Mrs. Penelope Koutroubi (email: piko@egnatia.ee.auth.gr) or see their web site: http://newton.ee.auth.gr/3GIS/

Denmark

A new chapter has been formed in Denmark (Æblekrogen) under the chairmanship of Tom Høholdt (tom@mat.dtu.dk).

Benelux

Luc Vandendorpe (vdd@tele.ucl.ac.be) is the new chairman of the Benelux chapter, taking the position over from Professor Ramjee Prasad, who has now moved to Aalborg University in Denmark.

Note to VTS Chapters

VTS Chapters world-wide are eligible to receive $100.00 U.S. at the end of the calendar year for submitting L-31 Meeting Attendance Forms reflecting their Chapter's periodic meeting to VTS Chapter Activities Chairman.

Gaspar Messina,
9800 Marquette Drive,
Bethesda, Maryland 20817, U.S.A.

Opportunities for New VT Chapters

Are you benefiting fully from your membership in VTS?

Part of the benefit can be the opportunity to network with other members in your area at local meetings, to bring in speakers on topics of interest, and to host seminars or even invite annual conferences to your section's location.

What is required to form a society chapter?

If there are at least 12 VT Society members, other than students or affiliates, in the section, a new chapter can be formed. If a joint chapter is to be formed from members of societies having similar interests, a total of 12 members is still required, but only at least 3 members of each forming Society must be included in the signatures on the petition to the local section. The organizer must be of member, Senior Member, or Fellow grade, but the other society members signing can include also Associate Members.

How can we identify the other VTS members in our locale?

Obtain lists of Society members holding the grades of Associate, Member, Senior Member, and Fellow within your Section. The Section has access to the Membership Information Program (SAMIEEE). The Section Chair can assist you. IEEE Regional Activities can generate a list using the IEEE List Management System. The contact information is as follows:

IEEE Regional Activities
Section/Chapter Support
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331
Tel: +1 732 562 5518
Fax: +1 732 463 3657
E-Mail: d.mcclelland@ieee.org

Questions about chapters of the Vehicular Technology Society can be sent to the VT Chapters Coordinator, Gaspar Messina, at gmessina@fcc.gov.

Is there a special form for the petition to form a chapter?

IEEE Section/Chapter Support has a kit that they will send to new Chapter organizers which contains several helpful documents including the "Petition for the Establishment of an IEEE Society Chapter". The request for the kit can be sent to:

IEEE Regional Activities
Section/Chapter Support
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331
Tel: +1 732 562 5513
Fax: +1 732 463 9359
E-Mail: p.kovacs@ieee.org

What is the procedure to form a joint chapter?

Contact the Chair of a technically-related Chapter already in existence to see if there is interest in forming a joint Chapter. It is also recommended that this activity be done on a multiple Society basis, as the work needed is essentially the same. If there is interest, advise the Chapter Chair that when forming a new joint Chapter a member of the Section Executive Committee must write a letter to IEEE Regional Activities approving the joint chapter, but in the case of Chapter expansion, the current Chapter Chair must indicate whether the current Chair will remain in office. It is not necessary to complete a petition to expand the sponsorship of an existing Chapter.

You will find that making personal contacts in the given location can enlist assistance to possibly help with the Chapter formation.

After the new chapter is approved, you can get financial assistance to cover startup costs by a letter request to the VTS president, through the chapters coordinator.

The website, http://www.ieee.org/organizations/tab/ciaguidelines.html, has further tips on forming a chapter.

Electric & Hybrid Electric Vehicles Committee

Professor Mark Ehsani, P. E. and Fellow of the IEEE has taken over chairmanship of the Electric & Hybrid Electric Vehicles Committee. Professor Ehsani is Director of the Advanced Vehicle Systems Research Program at the Department of Electrical Engineering at Texas A&M University. He has been active over a number of years within the Vehicular Technology Society in vehicle power and propulsion areas, for example by organizing a session on Electric and Hybrid Electric Vehicles in the Spring 1999 Vehicular Technology Conference in Houston, Texas. He has served as the Associate Editor for Transactions in Vehicular Technology on Electric and Hybrid Electric Vehicles, where he has encouraged papers in the area of electric and hybrid power train systems.

As Professor Ehsani points out, electrotechnology is revolutionizing the automobile, not only in information processing, signal processing and controls, but also in electric power system, actuation, and propulsion. Some prominent examples of the later are electric vehicles and hybrid electric vehicles, which are emerging as the next generation cars. Some less well known examples are steering by wire, brake by wire, active suspension, 42V power system, integrated starter generator, and electromagnetic engine controls. Most of these systems are closely coupled with the computer controls and information processing systems of the vehicle. He plans to use the Electric & Hybrid Electric Vehicles Committee to provide a focus for such topics.

Currently, these technologies are scattered among several professional societies. These include Society of Automotive Engineers (SAE), IEEE Industry Applications Society (IAS), IEEE Power Electronics Society (PELS), IEEE Industrial Electronics Society (IES), and IEEE Power Engineering Society (PES).

According to Professor Ehsani, there is no clear scope and cohesion for the topics that each society will present. All that we can observe is that the number of papers, short courses and sessions on vehicle power related papers are expanding in these societies and their scopes are shifting. It

would make sense to bring these vehicle power and propulsion related papers and interests within VTS, so that electrical engineers could find deep and specialized papers on these topics in one place.

Such a service would be of interest to engineers in automotive manufacturing and supplier industries, such as Ford, GM, Daimler Chrysler, Delphi, Visteon, Dana, Bosch, Valeo, Siemense, and many others. It would also be of interest to universities, where research and education in automotive electrical systems is a topic of specialization. These include Texas A&M University, MIT, University of Maryland, University of Tennessee, Ohio State University, west Virginia University, University of California at Davis, Virginal Tech, Pennsylvania State University, and others.

Some examples of technical topics that Professor Ehsani would like to consider include:

+ Electric and Hybrid Electric Propulsion Systems,
+ Vehicle Electric Power Systems,
+ Vehicle Load Systems,
+ Vehicle Power Management and Control Systems,
+ Vehicle Fuel Cells,
+ Direct Engine Injection Systems,
+ Electric Engine Variable Valve Control,
+ Engine Starter/Generators,
+ Vehicle Energy Storage Systems,
+ Vehicle Actuators and Motor Drives,
+ Vehicle X by Wire Systems,
+ Integration of Vehicle Power, Control and information Systems.

Some initial thoughts on these matters include a number of possible activites:

+ Specialized paper sessions in Vehicular Technology Conference
+ Solicitation of high quality papers for Transactions on Vehicular Technology
+ A special issue of the Transactions on Vehicular Technology the above topics
+ Tutorial sessions in VTC
+ Joint sponsorship of conferences and workshops with SAE, IAS, IES, PES, PELS and other interested societies
+ Expansion of VTS Distinguished Speakers on the above topics

To assist in these developments, Professor Ehsani is looking for volunteers to serve on the Committee. If you are interested, he can be contacted on ehsani@ee.tamu.edu, or at the Department of Electrical Engineering, Texas A&M University, College Station, Texas 77843.

9th February 2001 VTS Board of Governors Meeting Report

George F McClure, VTS Board Member

Summary

The main focus of the board meeting was on conferences and periodicals. The committee on electric and hybrid electric vehicles has been reactivated by Dr. Mark Ehsani of Texas A&M University. A new medal is being considered to upgrade the stature of the Avant-Garde award. Current emphasis is being placed on membership, and on the formation of new chapters in Regions 8-10. VTS membership at the end of 2000 stood at 5,511.

Details

Eighteen were in attendance at the board meeting, as Past President Kent Johnson reported that the five-year review of the Society and its publications by the Technical Activities Board's review committee went very well, and the Vehicular Technology Society was pronounced in good health. The VTS charter, including mobile communications, vehicle electronics, and land transportation, was reaffirmed, although the Personal Communications magazine published by the 55,000-member IEEE Communications Society plans to add "Wireless" to its name.

Treasurer Charles Backof noted that the VTS is in sound financial condition, although last year's return from the IEEE long-term investment fund was only one percent. It is essential that past conferences close out their accounts promptly, because a financial penalty is levied against the Society every quarter beginning a year after the conference dates for conferences that have not closed out their books and submitted their final reports.

Dr. Essam Sourour, who has served faithfully as VTS Secretary for the past four years, submitted his resignation owing to relocation and a change in employment. His service was applauded with gratitude. Dr. Eric Wang from Ericsson will be the new secretary.

Dr. Mark Ehsani was introduced as the new chair for the Committee on Electric and Hybrid Electric Vehicles. He served previously on the board for the Industry & Applications Society when the Power Electronics Society was born. Those two societies, with 12,185 and 6,092 members, respectively, now hold joint technical conferences. The 4,800-member Industrial Electronics Society is also active in the same technologies. As reported in the article above, Dr. Ehsani is looking for VTS members interested in working on the committee. He can be contacted by e-mail at ehsani@ee.tamu.edu.

Standards for fuel cells are covered by IEEE Standards Coordinating Committee 21. This was an area identified by George McClure as one where VTS had an interest, as fuel cells are being developed for mobile and even for personal communications applications. Dr. Ehsani will add fuel cell standards to the activities covered by his committee.

Conference Coordinator Mel Lewis reported that a change in venue for VTC-01 Spring, from Tel Aviv to Rhodes, was accomplished without penalty. Ten authors, out of 700, have cancelled their papers.

As our conferences continue to grow, the paper conference records become more unwieldy and more attendees prefer to receive the papers in CD-ROM format. The Board established a policy that the paper records would be available only to those who request them with pre-conference registration. All others ordering a conference record will receive the CD-ROM version. Those who pre-order the paper copy will receive it at the conference with their other registration materials. At the option of the conference committee, a digest of abstracts of papers could be distributed to attendees along with the CD-ROM, for ease of reference while attending technical sessions.

VTC-02 Spring, in Birmingham, Alabama, will include a tour of the nearby Mercedes-Benz assembly plant. Mel Lewis reported that a new hotel has been selected, the downtown Sheraton Birmingham, for this conference.

President J. R. Cruz appointed Board member Gordon Stuber to chair the Fellows committee. Sam McConoughey will serve on the committee. Another Fellow is sought for the committee.

The Propagation Committee is planning a special issue of the VT Transactions on Wireless System Planning Tools. A call for papers will be issued later this year.

President J.R. Cruz noted that the backlog of papers awaiting publication in the VT Transactions has been eliminated. Papers approved for publication are printed in the next issue that is published. This is an advantage to VTS authors, compared with some other societies where a publication delay of more than two years may be encountered.

Sam McConoughey presented a history of the Avant-Garde medal, first awarded to Jim Evans of the Michigan State Police for pioneering work in two-way mobile radio. This award is intended to recognize pioneers in our field. A new medal and/or plaque for the award was proposed. Ideas to broaden and formalize the award criteria are solicited: to recognize years of service to VTS by corporate industry supporters as well as by individuals. Patents awarded and papers published could be among the criteria for individuals. Awards chair Ray Trott will work with Sam McConoughey to flesh out the ideas for later presentation to the board. President Cruz and Ray Trott will prepare a specific proposal for an expanded overall VTS awards program.

A discussion of a follow-on to the earlier VTS-sponsored videotape about the Intelligent Vehicle-Highway System resulted in board approval for Bob Barrett, VTS delegate to the Intelligent Transportation System Council, to pursue development of a new videotape on ITS, perhaps cost-shared with other members of the 17-society ITS Council.

Bob Mazzola reported that a new technology area, "telematics," received considerable attention at the Conver-gence 2000 conference in Dearborn. An example is the GM On-Star system, where Qualcomm is developing a capability to locate a vehicle within five meters using a cell phone. Anil Kripalani is heading development of a technical committee on telematics, at the direction of President Cruz. Members interested in serving on this committee should contact Anil (akripalani@qualcomm.com).

George McClure is coordinating the up-date of our list of technical experts for contact by the media. The technical areas covered include wireless, vehicle electronics, telematics, ITS, and other land (rail) transportation. Members interested in participating are requested to contact George (g.mcclure@ieee.org).

A new initiative has expanded the focus of the Aerospace Policy Committee of IEEE-USA to include land and marine transportation. VTS past-president Eric Schimmel has agreed to represent VTS on this committee, which advocates technology policy for the U.S. government. Other areas of interest include air transportation and the development of civil uses of space. Land transportation improvements in the United States will benefit from the Intermodal Surface Transportation Efficiency Act (ISTEA), funded heavily in the last Congress.

Membership development and the establishment of chapters are dual initiatives receiving VTS emphasis. Anil Kripalani is charged with new member recruitment while George McClure is assisting Gaspar Messina in chapter development, with priority in Regions 8, 9, and 10. Chapters are sought now for the Finland and Germany sections, following the recent establishment of a joint chapter in Denmark. Details on the annual chapter activity competition, the distinguished speakers' program, and opportunities for chapter projects with support from VTS will be included in the new VTS Chapters Best Practices manual, now being prepared, as well as being listed on the VTS web site.

Avant Garde Award

The origins of the VTS date back to 1949, when the Institute of Radio Engineers (IRE) formed the Professional Group on Vehicular Communications, led by James Evans of the Michigan State Police, with a Chapter in Detroit, MI with 184 members. The First IRE – Professional Group on Vehicular Communications (PGVC) conference was held in Detroit, MI at the Book Cadillac Hotel. Approximately 35 persons attended to hear 8 technical presentations, and visit about a half-dozen exhibitors.

To commemorate this event, the Avant Garde award was created in 1980 to recognize the founders of the then IRE Professional Group on Vehicular Communications (PGVC) which later became the IEEE VTS. The first Avant Garde awards were made at our conference in Detroit that year. It was later agreed that the award be made permanent, to be awarded to those members of the Vehicular Technology Society who should be recognized for their work, leadership and other contributions to VTS and its activities.

Do you know anyone who fits this description? If so, please fill out the form on the opposite page and send it to Awards Committee Chairman Ray Trott, to begin the process whereby your nominee will receive recognition from peer members in the Vehicular Technology Society.

The award itself consists of a certificate that states: "Be it hereby known that The Institute of Electrical and Electronics Engineers, Inc., Vehicular Technology Society, Proudly recognizes (name of award recipient) for the pioneering leadership and continuing contributions in promoting new technology in the field of vehicular communications and electronics and hereby designates the aforenamed as a member of its AVANT-GARDE thus bestowing the Honor and Respect of this Society in grateful recognition thereof, on (date) by its officers (signed by the President and the Secretary)."

In addition, the recipient receives a pewter medal on which are depicted a hand holding shafts of lightning, a lamp, an ancient microscope and a diagram of electrons flowing around a nucleus. Attached to the medal is a blue and white ribbon with the words 'IEEE VTS AVANT-GARDE' in gold letters and a pin for attaching to one's suit or dress.

Surely you know someone in the Vehicular Technology Society who is deserving of recognition by becoming a member of the Avant-Garde. Take the time to fill out the form on the opposite page and send it to Raymond C. Trott. Trott Communications Group 1425 Greenway Drive, Suite 350 Irving, TX 75038.

Vehicular Technology Society

AVANT GARDE AWARD RECOMMENDATION

Nominee (Must be VTS member)

Name_____

Address_____

City, State, Zip _____

Telephone No. Business _____

Telephone No. Home _____

Title_____

Company _____

Nominator

Name_____

Address_____

City, State, Zip _____

Telephone No. Business _____

Telephone No. Home _____

Signature & Date_____

Justification for Award: (Attach printed or typed text) _____

_____

_____

_____

VTS Contributions: _____

_____

Action by VTS Awards Committee

Approved _____ Yes _____ No _____ Returned for More Justification

By _____ Chairman, Awards Committee

Date: _____

Conferences of Interest

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

DATE	CONFERENCE	LOCATION	WEB PAGE	
20-22 May 2001	2001 Radio Frequency Integrated Circuits Symposium	Phoenix, AZ	http://www.ims2001.org/rfic	
6-8 June 2001	3Gwireless 2001	San Francisco, CA	http://delson.org/3gwireless01	
11-15 June 2001	ICC2001	Helsinki, Finland	http://www.icc2001.com	
8-13 July 2001	APS International Symposium / URSI Radio Science Meeting	Boston, MA	http://www.ieeeaps.org/ 2001APSURSI/	
15-18 August 2001	3rd Int. Workshop on Mobile Wireless Comms Networks	Recife, Brazil	http://www.cin.ufpe.br/~mwcn2001/	
19-22 August 2001	RAWCON 2001 Radio and Wireless Conference	Boston, MA	mailto:heutmaker@lucent.com	
25-29 August 2001	ITSC 2001	Oakland, CA	http://www.ewh.ieee.org/tc/ its/2001/	
9-12 September 2001	WPMC'01	Aalborg, Denmark	http://www.wpmc01.org	
25-28 September 2001	IVEC2001 Veh. Electronics Conf.	Tottori City, Japan	http://www.kankyo-u.gr.jp/	
26-28 September 2001	3rd Int. Workshop on Multi-Carrier Spead Spectrum	Oberpfaffenhofen, Germany	http://www.dlr.de/kn/kns/mcss2001	
30 September – 3 October 2001	PIMRC 2001	San Diego, CA	http://www.pimrc2001.org	
7-11 October 2001	VTC 2001-Fall	Atlantic City, NJ	http://www.fallvtc2001.org	
28-31 October 2001	MILCOM 2001	Washington, DC	http://www.milcom.org/2001	
30 October – 2 November 2001	CIC 2001 6th Int. CDMA Conf	Seoul, Korea	http://www.kics.or.kr/cic.html	✓
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	✓
28 April – 2 May 2002	ICC2002	New York, NY	mailto:d.kingston@comsoc.org	
6-10 May 2002	VTC 2002-Spring	Birmingham, AL	http://www.ieee.org/vtc02spring	
16-21 June 2002	APS International Symposium / URSI Radio Science Meeting	San Antonio, TX	http://waves.tamu.edu/2002/	
2-5 September 2002	ISSSTA 2002	Prague, Czech Republic	http://www.ure.cas.cz/isssta2002	✓
24-28 September 2002	VTC 2002-Fall	Vancouver, BC	mailto:bhargava@engr.UVic.CA	
Spring 2003	VTC 2003-Spring	Seoul, Korea	mailto:m.lewis@ieee.org	
Fall 2003	VTC 2003-Fall	Orlando, FL	mailto:m.lewis@ieee.org	
Spring 2004	VTC 2004-Spring	Northern Italy	mailto:m.lewis@ieee.org	

Conferences marked '✓' have open calls for papers as of 31 May 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.