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FEATURES

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Typical American North-East Corridor Train. See the article on Amtrak's Richmond Static Frequency Converter Project. Photo Andrew L. Jones

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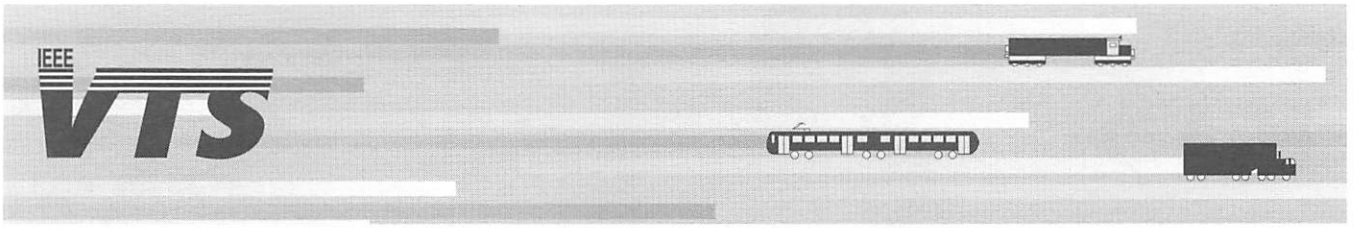

FOREWORD

James Irvine, Editor

If you attended VTC '99-Fall last September and listened to almost any of the keynote speakers, you could be forgiven for thinking that all the problems of 3rd generation had been solved, the systems were commercially successful, and interest was now firmly with 'fourth generation', whatever that may be.

The money-men seem to agree. Vast sums are being invested — some would argue gambled — on 3rd generation licenses. In the UK, at the time of writing at the end of March, the estimated price in the auction had been exceeded by more than three times and none of the parties bidding had pulled out. A fortnight later, as we close for press, the total is more than *eight* times the estimate, and at least one 'lucky' bidder will have to pay more than £5 billion (about $8 billion) for their licence, and that's without deploying a single base station. The auction will finish by the end of April, and you can see the result on *http://www.spectrumauctions.gov.uk/* Germany plans similar auctions, and France is also now reconsidering whether it should not have an auction.

As Iridium has shown, throwing large sums of money at the problem is no guarantee of commercial success. To recoup the sort of sums being spent (over £1000 for every man, woman and child in the UK for a 20 year license) will require mobile operators to persuade their users to open their wallets on new products and services they do not, as yet, know they need.

If users embrace mobile technology as a part of their lives, and in particular use it for e-commerce, then spectrum is cheap at almost any price. However, if all users really want is a simple communication device for voice calls, then the prices being paid for spectrum could be amongst some of the worst investments ever made. Complex, multipurpose terminals do not come without a price — larger phones with more features are harder for users to understand. We report in this issue that CTIA research suggest that Americans are not yet ready for 3rd generation services (see page 17).

The financial markets have made up their mind. The model they look to is the PC leading to the Internet, not the transistor radio leading to the handheld TV. Four million *i*-mode terminals have made NTTDoCoMo the largest company in Japan in terms of stock market valuation, although *i*-mode accounts for a mere 1% of its business.

In the last issue we published a slightly sceptical opinion piece from John Bush on 3rd generation systems. Given that this questioned some of the received wisdom about the desire amongst customers for data services, I was expecting to receive many letters putting the opposite view. Given that my job depends on mobile communications research, I will go further and say that I was hoping for such an outcome. However, so far the postbag has remained completely empty. Does this mean that the engineering view is that non-voice services will be slow to start? What do you think? Answers on a postcard, or even an email, to the address opposite.

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AMTRAK'S RICHMOND STATIC FREQUENCY CONVERTER PROJECT

Andrew L. Jones, Project Manager, Amtrak

On December 1, 1999, Amtrak held a groundbreaking ceremony for its $140 million static frequency converter station in the Port Richmond section of Philadelphia. Under construction adjacent to Peco Energy's Richmond Generating Station, the Richmond Static Frequency Converter (SFC) Station will be the largest such installation in the world.

Amtrak's Washington-Philadelphia-New York line had been electrified by the Pennsylvania Railroad between 1915 and 1938. The New York, New Haven and Hartford Railroad electrified its New York to New Haven line between 1908 and 1929. Amtrak inaugurated electric train service between New Haven and Boston on January 31, 2000, which finally makes it possible to travel from Boston to Washington without a change of locomotives.

While the New Haven to Boston electrification and the new "Acela Express" high speed trains have been getting a good deal of attention lately, improvements continue to be made to the sections of the Northeast Corridor which were electrified years ago, and the most basic of these improvements are those to the power supply.

A Railway Electrification Primer

Electric automobiles have been the subject of much attention and some commercial activity in the past several years, but the railway industry has been using electric vehicles for more than a century. The "external combustion" steam locomotive was an environmental nightmare, and the operation of large numbers of steam locomotives was obnoxious even in the open air. Operation in tunnels of any length was out of the question. Electric trains emit no exhaust gasses and require air only for cooling. Today, steam power is obsolete. Diesel locomotives replace steam where electric did not, and particularly in the United States, many railroads found that using diesel traction universally was more attractive than maintaining small stretches of electric operation in an otherwise diesel operation. Virtually all "diesel" locomotives used are actually diesel-electric, wherein a diesel engine turns an electric generator. The output of that generator is used for traction motors in a manner very similar to an electric locomotive. The exhaust of a diesel locomotive is less obnoxious than that of a steam locomotive, making some tunnel operations at least tolerable with diesel. The maximum power of a diesel locomotive is limited to the maximum power of its diesel engine, whereas an electric locomotive can draw more than its 100% rating for a short period of time. If the supply is adequate, an electric locomotive will accelerate a given train faster than a diesel locomotive of comparable continuous rating, and therefore electric traction is preferred where speed and performance are primary considerations.

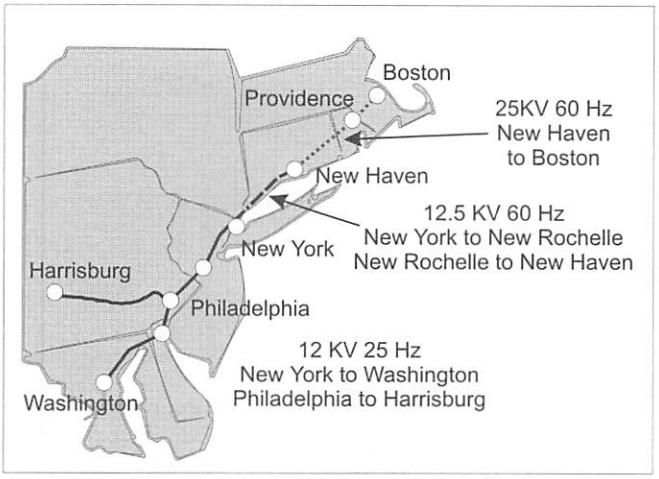

Figure 1. Various voltages and frequencies used for traction power on the Northeast Corridor.

With the possible exception of bumper cars at an amusement park, an electric automobile has to carry its supply of electric energy with it, in the form of a battery. Since trains operate on fixed guideways, the supply of electric power to trains is much less of a problem than with automobiles, as the fixed guideway can be augmented with power distribution apparatus, using in many instances, apparatus common to utility or industrial facilities. Unlike an electric automobile, an electric train does not have to carry the energy supply with it. The rails are an obvious conductor. A third rail can provide the other power conductor, or an overhead wire can be strung.

The earliest railway electrifications were done with direct current, both because the earliest power systems were dc, and since a series dc motor has the desirable quality of very high torque at start, necessary to overcome the considerable inertia of a train. Practical dc motors are limited to between 600 and 1200 volts, however, because the full power of the motor must be carried by brushes and a commutator. It is not a simple matter to change dc voltages, either, and so transmission and distribution of significant power at dc is problematic.

Alternating current allows the use of transformers to change voltages from transmission level to distribution level and lower. Generally, however, ac motors have two problems which make them less desirable than dc for rail-

way service: The speed of an ac motor is a function of the frequency of the power applied to it, and the torque of an ac motor is substantially less than that of a series dc motor.

In the early part of the 20th century, however, it was found that a series dc motor with a very low inductance armature would work reasonably well on low frequency alternating current [1-2]. Such a motor made the initial alternating current railway electrifications possible. The solution that is obvious today – rectify the ac supply to provide dc for the motors – was not practical in the confines of a locomotive until the 1950s.

Parallel developments in the electric supply industry are relevant to this story. The initial load served by the electric utilities was lighting, in the form of incandescent lamps. Incandescent lamps work on either ac or dc, and when on ac, will work on a broad range of frequencies. The earliest alternating current system were often run at frequencies of 125 or 133 Hz, with little regard to frequency stability, as they were isolated. It quickly became apparent that standardization was desirable. Two major contenders developed: 25 Hz and 60 Hz. 25 Hz was attractive for industrial purposes, since rotary converters to produce dc for industrial work or for railway loads worked well on 25 Hz systems, the low speed of high-pole-number motors run on 25 Hz was often attractive for industrial purposes, and because the slow speed of 25 Hz machines hid some of the stability issues that were apparent with higher frequencies, but not well understood at the time. One major problem with 25 Hz was that many people can perceive the flicker of the low frequency when 25 Hz is used to supply incandescent lamps. And the amount of iron required in motors and transformers decreases with increasing frequency. 60 Hz is more attractive for lighting, and as the engineering body of knowledge increased, the reasons for preferring 25 Hz diminished [3].

However, the ac railway motor worked well on 25 Hz, and that became the preferred frequency for railway electrification. In addition to the Pennsylvania Railroad electrification, 25 Hz railways included the New York, New Haven and Hartford; the Reading Railroad, and the Great Northern.

Considerations of Single- and Three-Phase Power for Railway Electrification

Commercial power is always generated and distributed as three phase, for reasons of economy and of mechanical advantage in the machinery. In a balanced three-phase system, the power does not vary in time, as it does with a single-phase system, meaning the machinery (generators and motors) are free of vibration that would be present in a single-phase (pulsing power) system.

Single-phase power requires two conductors between the generator and the load. In the case of a railway electrification, this is usually realized as a single "hot" leg overhead (the catenary, or trolley wire), and the running rails either singly or together as the return leg. Neglecting for the time being the use of the rails as signal circuit conductors, the rails could be grounded, and thus the single-phase railway electrification is similar to any other single-phase power circuit.

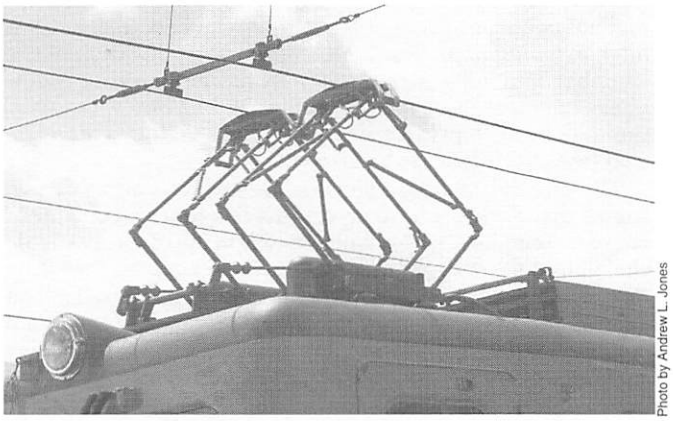

Figure 2. Dual pantographs of a three-phase train on the Jungfrau Railway in Switzerland.

Three-phase power requires at least three conductors between the generator and the load. If a railway were to be electrified at three-phase, then either three overhead lines would be required, or if the rails could be used as a grounded conductor, then two overhead lines and the rails together would be the three conductors of the circuit.

Three-phase electric traction is widely used for traveling cranes and amusement park rides, where the matter of switching the vehicle from one track to another is either absent or trivial. In such cases, the tractive power of the vehicle is small, and three-phase busbars of, for instance, 480 volts can be positioned along the right-of-way without difficulty.

Electrifying a mainline railroad at three-phase is problematic. With a single-phase electrification, the trolleys of adjacent tracks are held at the same voltage and (obviously) the same phase, and so they can be wired together at crossovers, either directly or through section breaks which are bridged by the passing train. This cannot be done with two overhead wires of different phase, nor can a passing train be allowed to bridge two phases. Therefore, crossovers of a railway electrified at three-phase must be wired as dead sections, and the train must coast across the crossover. This opens the possibility of stranding a train on a crossover, effectively blocking not only the crossover, but both tracks as well.

Less obvious, perhaps, is the limitation on the possible catenary voltage. With a rail gauge of 1435 mm, the maximum allowable potential between the wires is about 7000 volts. With only one wire above the tracks, the maximum allowable voltage is much greater – 50 KV single-phase electrifications have been built. Higher voltage leads to greater transmission efficiency, and to greater power available at the locomotive.

Another difficulty with three-phase electrification is no longer with us. Alternating current motors of the usual types – induction or synchronous – rotate at a speed dependent on the frequency of the applied voltage, and the number of poles in the motor field. Single-phase electrification became practical when a motor was developed which had the speed-torque characteristic of a series dc motor, that is, a suitable variable-speed motor. In theory, such a three-phase motor could be built, but the three-phase electrifications which were built used three-phase induction motors to drive the wheels, and thus they would run at a fixed speed, or with pole switching, either of two fixed speeds. This was considered acceptable, and possibly an advantage, in mountain service, where the train speed would automatically be regulated to the synchronous speed of the motor. Should the train exceed synchronous speed even slightly, the motors automatically become generators, regeneratively braking the train. But fixed speed would be a severe limitation in routine mainline railway service. The matter of a three-phase motor running at fixed speed has been made obsolete with the advent of variable-speed drives using power electronics technology. The speed of the motor is still a function of the applied frequency, but the power electronics equipment makes changing the frequency possible, yielding a variable speed system.

Three-phase railways have been built. The first electrification of the Cascade Tunnel route of what is now the Burlington Northern Santa Fe railroad was electrified at 6600 volts line-to-line, three-phase, 25 Hz [4]. Photographs of that electrification show locomotives with two trolley poles, indicating that the system was a grounded-delta.

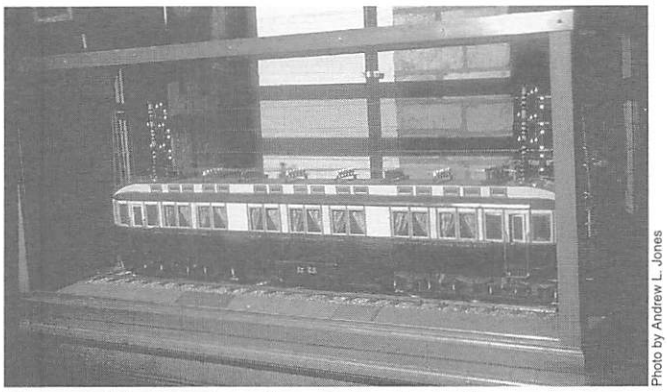

Photo by Andrew L. Jones

Figure 3. Model of another design for a three-phase train. Photographed by the author at the Berlin (Germany) Technical Museum.

That, which was said by Westinghouse to be "the only example of three-phase electrification in this country," was eventually replaced with a single-phase system (11 KV, 25 Hz) [5], and finally gave way to diesel traction. In Italy, a route across the Apennine Mountains from Genoa to Milan, which featured grades of 3½%, was electrified at three-phase [6]. Trains were operated at a fixed speed of 28 miles per hour. There are at least two working instances of three-phase electrification in Switzerland. The Jungfrau railway operates at 3-phase, 1125 volt, 50 Hz. There are two varieties of vehicles now in service, which have speeds of 12 or 24 kilometres per hour, or 14 or 28 kilometres per hour. Descending trains provide about 50% of the energy used in ascending, through regenerative braking [7]. The Gornergrat railway works at 725 volts, 50 Hz, 3-phase, on grades as much as 20%, at a fixed speed of 14.5 kilometres per hour [8].

Figures 3 and 4 show a train which apparently ran in Germany in the 1930s, using a side-wiping three phase catenary system. The author does not know the details of this design, but it does not seem to have been repeated.

These examples notwithstanding, practical mainline railway electrification must be done at either dc or single-phase ac. Direct current electrification actually offers a number of advantages: if one is prepared to put ac to dc converters (rectifiers) at each substation, then the input to that rectifier can be almost any local power source, because the power electronics required for a rectifier are quite simple. Voltage regulation in a dc trolley is quite good, there being no reactive component of the voltage drop. But direct current circuit breakers are not practical at such voltages, and a rectifier is still more expensive than a transformer of comparable size. Direct current is useful for rapid transit work, but single-phase ac is the power supply of choice for mainline electrification.

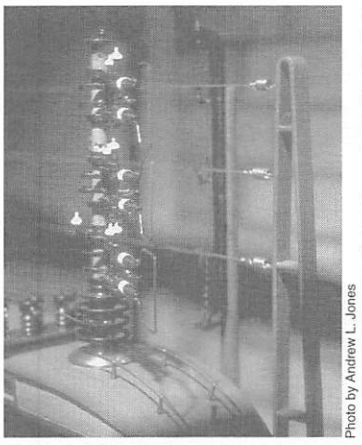

Photo by Andrew L. Jones

Figure 4 Pantograph detail from Figure 3.

Power is generated commercially at three- phase, and must be delivered to the train at single-phase – a significant engineering problem. Single-phase power pulses at twice the line frequency. In a balanced three-phase system, power is steady. Balanced power means essentially no vibration of the machinery, which is a highly desirable condition, considering the huge size, and momentum, of steam-turbine generators used for commercial power generation. While a number of small single-phase loads can be distributed among three phases to effect a balanced system, a railway load is large enough that unbalancing the three-phase system is a very considerable concern.

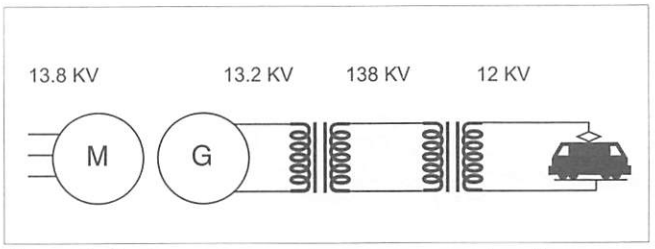

Figure 5. Basic power supply arrangement on the ex-PRR Electrification on the Northeast Corridor. Three phase 60 Hz power is converted to single-phase 25 Hz power, which is stepped up to 138 KV for transmission to distribution substations. At the substations, the power is transformed to 12 KV for distribution to the trains.

At the time the New York to Washington electrification was installed, the size of the railroad relative to the size of the utility made direct application of the railway load to the utilities impossible. These days, the utilities are sufficiently large that a limited railway load can be directly applied to the three-phase network, and technology has made it possible to run trains on 60 Hz.

The need for 25 Hz at the time of the Pennsylvania Railroad electrification did originally raise a question of phase balance, because the Philadelphia Electric Company in the years before World War I operated a three-phase 25 Hz network. The railroad drew 25 Hz power from this network at single-phase. It was recognized at the beginning of the electric era that "converting" a single-phase load to a three-phase load required storing energy somewhere. There is no possible transformer configuration which will turn a pulsing power into a steady power, because doing that requires storing energy, which transformers do not do. At the time, a rotating machine was developed which accomplished the trick of distributing a single-phase load to a three-phase system, and the necessary energy storage was achieved by the flywheel effect of the machine [9].

Tapping a commercial 3-phase power grid for single-phase railway electrification often appears to be advantageous, since it avoids requiring that the railway purchase a lot of high voltage power equipment. Doing so inevitably limits the amount of railway load which can be handled. At present, for example, the 25 KV 50 Hz electrification in the United Kingdom puts so much unbalanced load on the commercial power grid that rush hour acceleration restrictions have to be imposed. The 25 KV 50 Hz electrification of the Channel Tunnel so strains the UK power grid that a new phase balancer has been required [10]. In France, the solution has been to provide dedicated high voltage transmission lines to railway substations.

The amount of single-phase power which can be drawn from a given three-phase power line is a function of a number of factors, but is often taken as 2% to 5% of the available short circuit power at the point of connection.

The whole issue of balancing a large single-phase load on a three-phase power system vanishes if one has instead a single-phase power system. Amtrak does. The frequency converters inherently are also phase balancers.

Amtrak's 25 Hz Traction Power System

Amtrak took over the fixed facilities of the Northeast Corridor, including the 25 Hz electrification, in 1976.

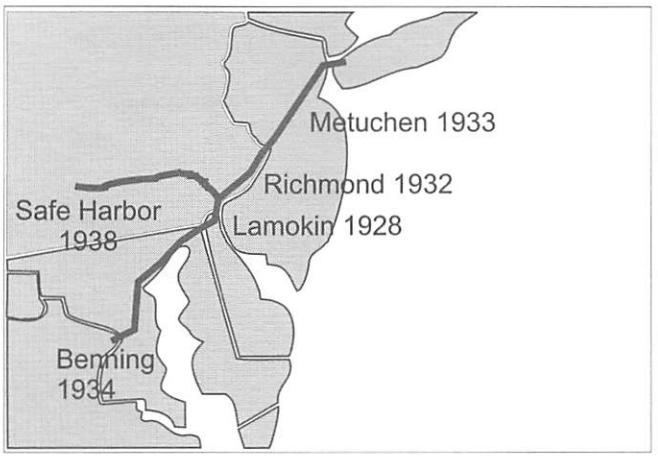

Figure 6. 25Hz supply in 1986

The basic power flow arrangement is as shown in Figure 5. Amtrak's Northeast Corridor Improvement Project originally intended to replace the 25 Hz electrification with 60 Hz, but concerns about the cost, performance, and staging of that work lead to a conclusion that modernization and upgrading the existing low frequency system was more desirable. By 1986, the power supply to the 25 Hz railroad was as shown in Figure 6. All of the generation or converter facilities dated from before World War II. Much of the equipment was in remarkably good shape, but as with any equipment of such age, remaining life was uncertain. And, the total load to be carried by the 25 Hz system was expected to increase. The new Acela trains are projected to use considerably more energy than the trains they replace, and total traffic – especially commuter traffic – is growing.

Any form of energy conversion involves losses. Specifications for the Richmond rotary converters indicate that a peak efficiency of 93% was guaranteed by the manufacturer. Efficiencies on the order of 97% appeared possible with power electronics technology. By the late 1980s, static frequency converters, an application of large variable speed drive technology widely used in industry, were well developed, and a number had been deployed in Europe. The Southeastern Pennsylvania Transportation Authority, operator of the former Reading Railroad commuter lines in the Philadelphia area (among other transit services), had purchased three cycloconverter-type static frequency converters to replace the c. 1930 rotating converters on that railroad, and the installation was successful [11-12].

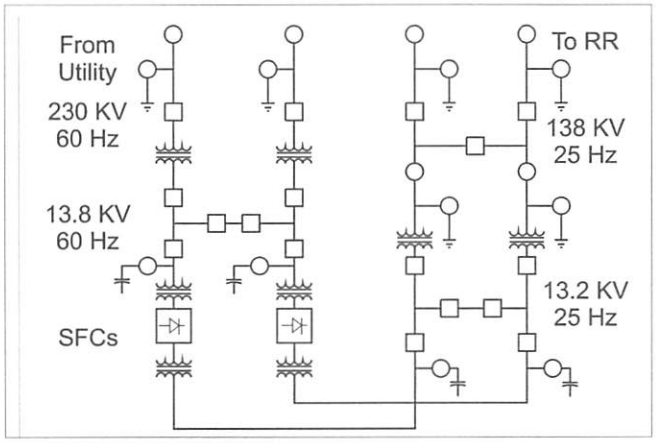

Figure 7. Single Line Diagram of the Jericho Park Static Frequency Converter Station

In 1989, it became necessary for Amtrak to replace the rotating frequency converter at Benning Station in Washington DC. Baltimore Gas & Electric Company (BG&E) offered to build a new converter facility for Amtrak, and an agreement was reached to do so at Jericho Park, Maryland, which is about halfway between Baltimore, MD, and Washington, DC. The location was ideal for the purpose, as BG&E's existing 230 KV Jericho Park switching station could be tapped for the power, and the railroad and its 138 KV single-phase transmission lines were adjacent. A turn-key project was awarded by BG&E to the General Electric Company for two 10 MW cycloconverter-type static frequency converters. The project was commissioned in 1992. Amtrak subsequently bought the facility from BG&E.

As the Jericho Park project was coming to a close, Amtrak and New Jersey Transit initiated a series of projects to increase the capacity of the railroad between Newark, New Jersey, and New York City. Among these was a new static frequency converter station at Sunnyside Yard, in Queens. Although this project was plagued by a number of difficulties, the station was placed into service in 1999, with four 7.5 MW dc-link type static frequency converters.

The existing Richmond rotating converter facility, shown in Figures 8, 9 and 10, has two nominally 30 MW generators feeding into a ring bus. Three small (6 MW) converters at an older facility called Somerset also feed into the ring bus. Six of Amtrak's 138 KV transmission lines radiate from the ring bus to feed towards New York and towards Philadelphia.

The 25 Hz traction power system had very few high voltage circuit breakers. Virtually all of the circuit protection was realized on the 12 KV (trolley) or 13.2 KV (generator bus) side of the transformers. This saved a lot of money initially, and has worked very well over the years. A very good description of this arrangement is found in [13].

Starting in 1992, Amtrak engaged PECO Energy and Stone & Webster to plan the replacement of Depression-era rotating converter stations in the Philadelphia area. The Somerset, Richmond, and Lamokin rotating converter stations had a collective capacity of 126 MW, and provided the bulk of the energy to the trains. Amtrak originally planned to build new static frequency converter stations at or near the present-day Richmond and Lamokin rotating stations. In 1996, an inspection of several European railway static frequency converters, including a single-unit 100 MW converter at Bremen, Germany, convinced us that combining these two projects into one at Richmond made engineering and economic sense. Apart from sheer size, the other major technical advance from the Jericho Park and Sunnyside projects was the decision to forego intermediate voltage buses, and apply the 60 Hz service voltage directly to the high voltage winding of the converter input transformer, and draw 138 KV directly from the high voltage

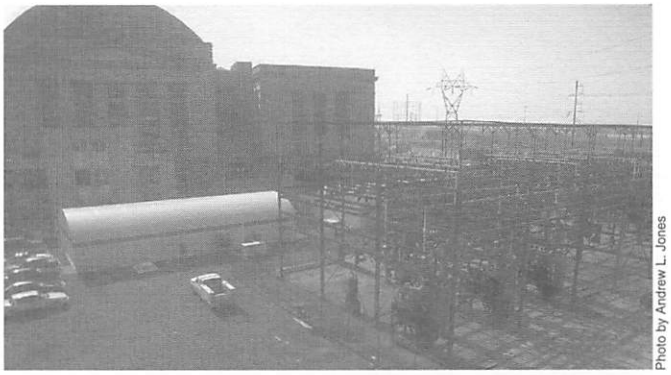

Figure 8. Existing Richmond rotating units are housed in the Quanset huts pictured. Behind the huts is the old steam turbine generating plant. In front of the converter huts is the generator ring bus.

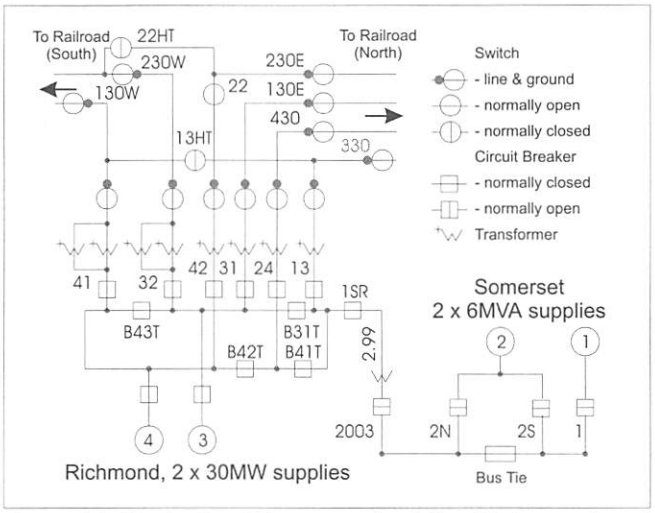

Figure 10. Single Line Diagram of existing Richmond and Somerset Rotating Frequency Converter Stations.

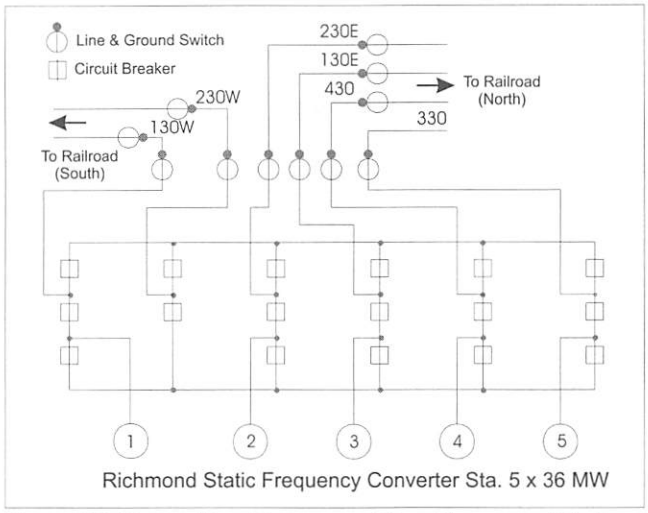

Figure 12. Single Line Diagram of the Richmond Static Frequency Converter Station, under construction.

windings of the converter output transformer. As the losses of the transformers are comparable to the losses of the power electronics bridges, eliminating the intermediate transformers results in a considerable reduction in the plant losses. A major change to the 25 Hz traction power system overall will arise from the breaker-and-a-half switching matrix (see Figure 13), which for the first time will tie all six transmission lines together at Richmond. The normal configuration will be with all seventeen circuit breakers in the breaker-and- a-half matrix closed.

The Richmond project has the following major features:

1. Five 36 MW (45 MVA) water cooled, dc-link static frequency converters
2. Dual 60 Hz services for traction power, each service capable of 100% of the station load
3. Separate, dual 60 Hz services for station service (auxiliary) power, each service capable of 100% of the station load.
4. A breaker-and-a-half network to mate the five static frequency converters to the six railway transmission lines which converge on the Richmond site
5. Six solid-dielectric, 138 KV cable circuits to connect the existing railway transmission lines to the static frequency converters

The static frequency converters themselves consist of the following: (a) three-phase input transformer, (b) twelve-pulse controlled rectifiers using silicon controlled rectifier type thyristors, (c) a polarity switch, (d) a dc-link with capacitors and inductors, etc., to smooth the current, (e) a pulse-width-modulation inverter, and (f) an output transformer. The inverter works in several stages, and the individual stages are "knitted together" in the output transformer. A recognizable 25 Hz voltage is only present at the high voltage terminals of the output transformer.

The inverter is a voltage-source inverter, rather than a current-source inverter, as Amtrak requires that the converter be capable of energizing a dead line, or working by itself. A current source inverter depends on other generators being on line to commutate, and that would not be satisfactory for Amtrak's purposes.

The five static frequency converters will be controlled by a station-wide computer, which will determine the number of converters on line at any moment to both be sufficient for the load, and to optimize the station efficiency. The control system, and the balance-of-plant systems generally, have been designed so that no single point of failure results in a loss of more than one converter block.

The contractual arrangements are different than Amtrak used on prior projects. Jericho Park and Sunnyside were handled as design-build projects, wherein one con-

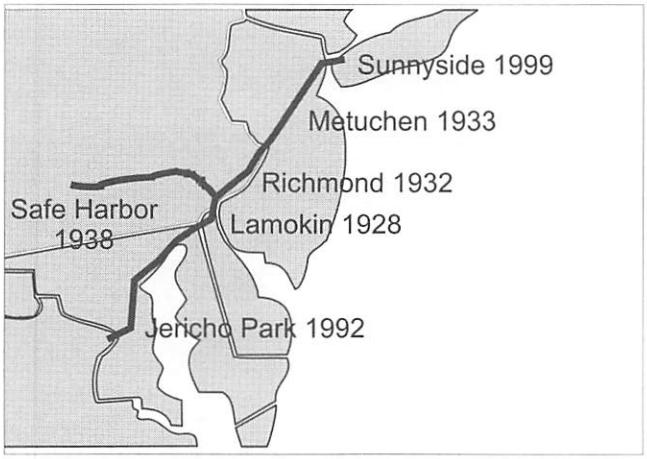

Figure 11. 25Hz supply in 1999.

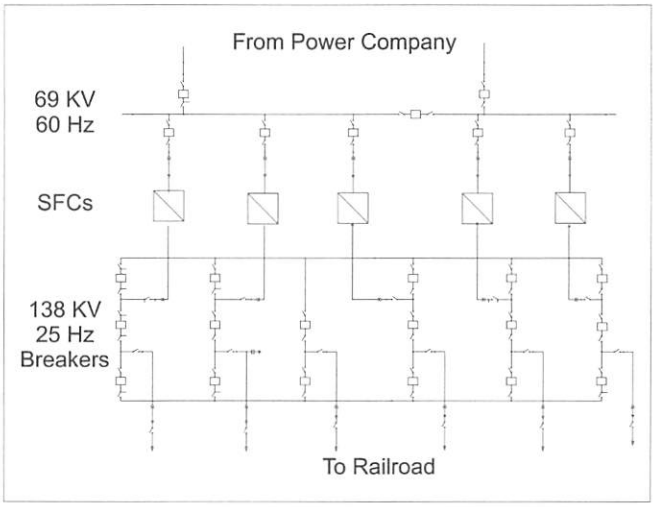

Figure 13. Detail of the Single Line Diagram of the Richmond Static Frequency Converter Station, under construction.

tract was awarded to a firm to provide engineering design services, and then to build the approved design. For Richmond, Amtrak elected to first solicit proposals for the static frequency converter equipment, that scope of supply being from the high voltage terminals of the incoming transformers, to the high voltage terminals of the outgoing transformers, including cooling systems and controls. The detailed design of this equipment was passed on to another contractor, who is responsible for designing the buildings, switchyards, and ancillary facilities around the approved design from the SFC contractor. That second contractor is also responsible for installation. Amtrak awarded the SFC contract to Siemens Transportation Systems, in November 1998, and the general station development contract to Stone & Webster in early 1999. Amtrak will contract separately for the supervisory control and data acquisition (SCADA) system.

The total project value is approximately $140 million, and is expected to be in service in the spring of 2002.

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Types of Static Frequency Convertors

There are generally two types of static frequency converters used for railway service: cycloconverters, and dc-link converters. These are broad categories within each of which varieties have been developed by the several manufacturers, but it is possible to make general distinctions between these two categories.

The dc-link converter is the easier of the two to visualize (Figure A). The three-phase supply is transformed to a voltage suitable for the power electronics, usually in the region of 2 to 4 KV. Twelve pulse rectifiers are usually used to take this lower voltage and convert it to direct current, which is smoothed by capacitance and sometimes inductance in the dc-link itself. The dc voltage is applied to an inverter which creates an alternating current waveform of the desired frequency. That ac voltage is stepped up to the desired output voltage of the converter.

The energy storage capacity of the dc link is a critical design matter. Single-phase power pulsates at twice the line frequency, whereas in a balanced three-phase system, the power is constant. In order to impose a pulsing power load onto a steady power system, and maintain that steady power, sufficient energy must be stored in the conversion device to act as a reservoir for the portions of the waveform where the instantaneous single-phase load is not equal to the average load level.

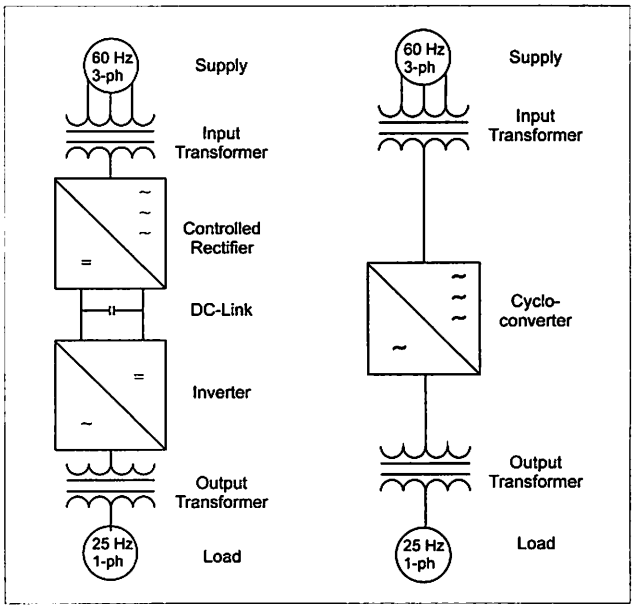


Figure A. DC Link Converter.

Figure B. Cycloconverter

If the energy storage capacity of the dc link is not sufficient to smooth out the power pulsations, then distorting frequencies similar to the cycloconverter, described below, will be imposed on the supply lines.

Assuming that the dc link has sufficient reactance to smooth out the single-phase pulsations of the load, then the dc-link converter as a whole appears to be nothing more than a controlled rectifier to the supply. Some amount of harmonic filtering may be necessary to meet present-day voltage distortion specifications on utility lines, but this is not a difficult task. As all thyristor converters are lagging loads to their ac supplies, reactive power compensation in the form of capacitor banks is often needed.

The cycloconverter is shown schematically in Figure B. There is only one stage of power conversion – directly from the incoming frequency to the outgoing frequency. Structurally, a cycloconverter is a classic rectifier bridge, but the conduction angle of the individual thyristors is modulated in a manner which "cuts and pastes" the three incoming phase voltages to form an outgoing phase voltage. In general, it is possible only to have an output frequency which is less than half of the input frequency. In Amtrak's application, the supply frequency is 60 Hz and the load frequency 25 Hz, so this requirement is met.

As with the dc-link converter, the purpose of the cycloconverter is to impose the single-phase load of the railroad on the three-phase system of the utility. As discussed earlier, if the load seen by the utility is to be balanced, then the pulsing power of the load must be smoothed, which means energy must be stored in the converter. The dc-link converter effects that energy storage with the reactance of the dc-link. The cycloconverter, by contrast, has no significant energy storage capacity. The pulsing power of the railroad load is not smoothed at all, but instead multiplexed onto the three-phases of the utility. This manifests itself as substantial distortion currents seen on the three-phase side. The spectrum of distorting frequencies, f_d is expressed by

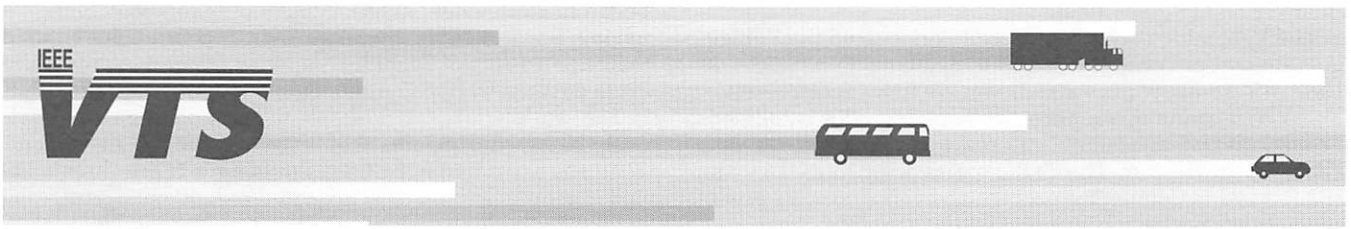
$$f_d = f_i \pm 2\,n\,f_o$$

where f_i is the supply frequency, f_o is the load frequency, and n is a positive integer. With $f_i = 60$ Hz and $f_o = 25$ Hz, as on Amtrak, then for $n = 1, 2, 3, 4, 5 \ldots$, the distorting frequencies f_d are 10, 40, 90, 110, 140 ... Hz. The 10 and 40 Hz are the most problematic, as 10 and 40 Hz currents could cause damaging vibrations in rotating machinery. The author is not aware of any instance where these subsynchronous frequencies have been filtered. The approach taken is, instead, to live with them, by providing very stiff supplies to cycloconverter stations. At Amtrak's Jericho Park station, for instance, each of the 230 KV feeds to the plant have short circuit duties of approximately 12,000 MVA.

The rms currents on the three incoming phases to a cycloconverter are balanced. But instantaneously, the three phase currents are "pieces" of the single-phase current on the output side.

Please note that the distorting frequencies peculiar to cycloconverters are specific to the case of converting from three-phase to single-phase. In other applications, such as variable speed drives for three-phase motors, the load is three-phase, and the whole issue of converting a pulsing load to a steady load vanishes. Cycloconverters feeding three-phase loads are relatively benign.

Issue	Cycloconverter	Dc-link converter
Cost	Less: simpler design, fewer parts, less space required	More: two stages of power conversion requiresm ore parts, more space
Efficiency	Better: only one stage of power conversion. But, filtering necessary to meet current power quality specifications may increase losses of the whole plant beyond that of a dc-link converter	Worse by itself, but when considered against a filtered cycloconverter, a dc-link system may be more advantageous
Reliability	More, because of fewer parts	Less, because of more parts
Distortion on utility side	Substantial. The magnitude of the total distortion currents may exceed the magnitude of the fundamental current.	Much less
Bidirectional power conversion (i.e., both from utility to railroad, and from railroad to utility)	Possible, but of little value because of poor power quality, and then only into an energized line (current source inverter mode)	Practical
Reactive power control	On load side, very good. On utility side, no control feasible.	On load side, very good. If built with a PWM rectifier, very good on utility side.



THE IEEE AND ITS

Robert L. French, R&D Associates

This article highlights the IEEE's role in shaping the Intelligent Transportation Systems movement, which sprouted during the '60s, lay partly dormant during the '70s, blossomed during the '80s, and started bearing fruit with its many deployments throughout the world during the '90s. It also outlines the mission of the IEEE's new ITS Council for coordinating ITS interests among the numerous IEEE societies whose scope includes technologies used for implementing ITS functions and services.

ITS background [1]

Intelligent transportation systems is an umbrella term that covers the application of a wide variety of computer, communication, positioning, sensing, control, and other information-related technologies to improve the efficiency, safety, and environmental aspects of surface transportation. Major categories of ITS include traffic-management systems (for example, adaptive traffic signals, automatic incident detection, electronic toll collection, and emission sensing) and traveler information systems (for example, pretrip planning, motorist information, and dynamic route guidance).

ITS also include systems for public transportation (automatic vehicle location, signal preemption, smart cards for fare collection, dynamic ride sharing, and so on) and for commercial-vehicle operations (fleet management, weigh in motion-weighing trucks as they travel, automatic vehicle classification, international-border crossing, and so on). Safety-related ITS include intelligent cruise control, collision warning, collision avoidance, night vision, and platooning. Other examples of ITS include automatic Mayday signaling, coordinated emergency response, and signal preemption for emergency vehicles.

Automated in-vehicle route-guidance systems based on mechanical principles were on the market in the US around 1910; vehicle actuated traffic signals debuted in 1928; and a concept for automated highway systems was shown at the 1939 World's Fair. However, by any practical measure, the ITS movement didn't take root until the '60s, when the first computer-controlled traffic signals and changeable message signs appeared. A US research project established concepts in the late '60s for dynamic route guidance based on real-time traffic conditions, but was canceled by Congress before testing.

Tests of similar dynamic systems occurred in both Japan and Germany in the '70s. That decade also brought the microprocessor and the beginning of GPS development and testing. Although these technologies were not associated with ITS at the time, they are now major components of many ITS systems. Thus, many of the underlying concepts and basic technologies for ITS were in place for the flurry of government-subsidized and industry-funded development programs that got underway in the mid '80s in Europe- for example, Drive and Prometheus-and Japan-for example, RACS (Road/Automobile Communication System) and Amtics (Advanced Mobile Traffic Information and Communications System).

In the late '80s, Mobility 2000, an informal organization, spurred ITS in the US. Mobility 2000 laid the groundwork for the formation in 1990 of ITS America (originally called IVHS [Intelligent Vehicle Highway Systems] America). ITS America is a public-private forum for consolidating national ITS interests and promoting international cooperation in ITS. The IVHS Act of 1991 then formalized the US ITS program and funded development through 1997. By the late 1990s, the main focus of ITS programs around the world had shifted to largescale integration and deployment.

IEEE involvement

The following selected highlights illustrate the IEEE's past and continuing involvement in the ITS movement.

Publications. The transactions and other publications of numerous IEEE societies have contained occasional papers or articles related to individual ITS technologies. However, special issues of Transactions on Vehicular Technology gave a comprehensive snapshot of ITS developments in the February 1970, May 1980, and February 1991 issues. The cover article of the May 1991 IEEE Spectrum was a special report on ITS.

Besides these occasional articles, the IEEE ITS Council has established two publications devoted to ITS:

- Newsletter of the ITS Council. Edited by Alberto Broggi of the University of Pavia, this electronic newsletter has been posted quarterly at the IEEE ITS Council's Web site (*http://www.ewh.ieee.org/tc/its/newsletters/www.ieee.org/its*) since January 1999. Individual e-mail subscriptions to the newsletter are also available at the Web site.
- IEEE Transactions on ITS. Edited by Chelsea C. (Chip) White III of the University of Michigan, this quarterly refereed journal is slated to start publication in March 2000. It will focus on the design, analysis, and control of information technology as it is applied to transportation systems. The call for papers is posted on the ITS Council Web site.

Conferences. Individual conferences of several IEEE societies have included papers and even entire sessions on ITS–for example, the Plans (Position-Location and Navigation Systems) Conference of the Aerospace & Electronic Systems

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Society. However, certain IEEE conferences have focused exclusively on ITS since 1989.

The Vehicular Technology Society originated the Vehicular Navigation and Information Systems Conference in 1989 in Toronto, which was the world's first ITS conference. The VNIS conferences were subsumed by the Intelligent Transportation Systems Conference series, starting with ITSC '97 in Boston. The ITSC series was started by the IEEE Ad Hoc Committee on ITS (the ITS Council's predecessor) and has been continued by the council.

Starting with ITSC '99, held in Tokyo from 5 to 8 October, the ITSC became annual. A major objective of the series is to focus more strongly than other conferences on cutting-edge-electronics-based technologies and their implications for ITS. The next ITSC will be from 1 to 3 October 2000 in Dearborn, Michigan.

Another IEEE conference series devoted exclusively to ITS is the Intelligent Vehicles Symposium, which the Industrial Electronics Society originated in the early '90s. IV now continues under the ITS Council's auspices. The next symposium, which focuses on basic research and present and future applications for intelligent vehicles and intelligent infrastructures, will be from 4 to 5 October 2000 in Dearborn.

Standards. In July 1991, the IEEE Standards Board approved the establishment of an ITS Standards Coordinating Committee. Known as SCC32, the committee became the 16th IEEE committee for coordinating standards in specific technology areas. Its scope reads as follows [2]:

SCC32 shall be responsible for coordinating, developing, and maintaining standards, recommended practices, and guidelines related to Intelligent Transportation Systems (ITS) within the scope of IEEE interests. SCC32 shall work with other national and international standards writing bodies to coordinate area of involvement.

Recent standards developed by SCC32 include

- 1455-1999: Standard for Message Sets for Vehicle/Roadside Communications.
- 1489-1999: Standard for Data Dictionaries for Intelligent Transportation Systems.
- SCC32 projects at the ballot stage include
- P1488: Standard for Message Set Template (MST) for Intelligent Transportation Systems.
- P1512: Standard for Common Incident Management Message Sets for Use by Emergency Management Centers.

Detailed information on SCC32 is available at its Web site: *grouper.ieee.org/groups/scc32*.

The IEEE ITS Council

On 1 January 1999, the IEEE ITS Council joined ranks with the 37 Societies and Technical Councils that constitute the 320,000-member IEEE. The ITS Council is scientific, literary, and educational in character. Its purpose is to advance and coordinate ITS activities throughout the IEEE. Its field of interest includes the theoretical, experimental, and operational aspects of electrical and electronics engineering and information technologies as applied to ITS. The council will further its work by

- publishing appropriate periodicals,
- sponsoring IEEE ITS-related conferences and conference sessions,
- sponsoring IEEE Press publications, and
- pursuing other activities in its field of interest.

Background. The ITS Council culminates an effort that began in 1993 when, at the Vehicular Technology Society's urging, several IEEE Societies with ITS interests banded together under the Technical Activities Board to create the cross-cutting Ad Hoc Committee on ITS. Although the IEEE is the world's largest professional organization, it previously had no unified vision of its role in the ITS movement. With the exception of SCC32, the IEEE's ITS interests before forming the ad hoc committee had been scattered among individual activities of the semiautonomous IEEE societies. A major concern both inside and outside the IEEE was the lack of a single point of contact for coordinating with non-IEEE ITS activities. For example, unlike other major engineering societies such as the American Society of Civil Engineers, the Institute of Transportation Engineers, and the Society of Automotive Engineers, the IEEE was not a member of ITS America, until after the ad hoc committee resolved at its organizational meeting to seek empowerment to become a member on behalf of the IEEE.

The committee focused early on ITS conference activities, starting with a special session on the IEEE's role in ITS that it organized for the First ITS World Congress, in Paris in 1994. In conjunction with VNIS and IV, the committee organized approximately 10 sessions for the Third ITS World Congress, in Orlando in 1996. The committee soon pursued plans to become a permanent IEEE entity. They successfully petitioned the Technical Activities Board for council status, a rarity in the IEEE (the Neural Networks Council is the only other IEEE Council).

Membership and organization. Unlike IEEE Societies, an IEEE Council does not have individual members. Instead, the membership comprises individual IEEE Societies that demonstrate interest in ITS technical activities and agree to share responsibility for all the council's obligations. The ITS Council's founding members include these societies:

- Aerospace & Electronic Systems
- Antennas & Propagation
- Communications
- Computer
- Consumer Electronics
- Control Systems
- Electromagnetic Compatibility
- Electron Devices
- Industrial Electronics
- Instrumentation & Measurement
- Microwave Theory & Techniques
- Power Electronics
- Professional Communication
- Reliability
- Robotics & Automation
- Signal Processing
- Systems, Man & Cybernetics
- Vehicular Technology

Additional societies may become members upon application and approval by the ITS Council.

Each member society appoints two representatives to serve on the ITS Council. In addition to funds allocated by the council's member societies, the council derives financial support from subscription sales of council publications, any surplus from conferences that it organizes or sponsors, and other sponsored activities. The council is governed by a president, vice president, secretary, and treasurer, elected annually. For additional details on the ITS Council, visit its Web site.

The IEEE has had significant roles in ITS since the movement's earliest days. With its ITS Council now in place, the IEEE is positioned to be an important ITS player in the new millennium.

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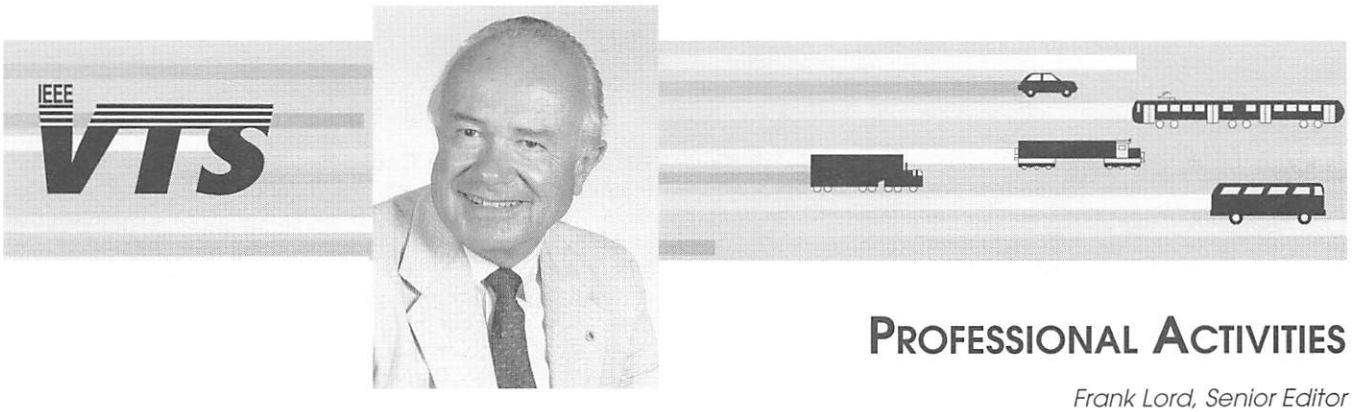

PROFESSIONAL ACTIVITIES

Frank Lord, Senior Editor

IEEE-USA President argues H-1B Bill "Wrong Approach at the Wrong Time"

On Feb. 9, Senators Orrin Hatch (chair of the Senate Judiciary Committee) and Spencer Abraham (chair of the Immigration Subcommittee) introduced the American Competitiveness in the 21st Century Act of 2000 bill, which would provide for a significant increase in H-1B non-immigrant (temporary) admissions ceilings for skilled foreign workers.

The H-1B visa program currently authorizes the annual admission of 115,000 foreign nationals in speciality occupations (most of them in high technology and health professions) to work in the United States for periods of up to six years. The new bill would increase the ceiling for H-IB visas to 195,000 for the next three financial years (raising the current ceilings by 80,000, 87,500 and 130,000 respectively). The bill also exempts non-immigrants employed by U.S. educational institutions, research facilities and recent graduates (with master's or Ph.D. degrees) of U.S. colleges and universities from the numerical ceilings, and modifies current law to eliminate the per country limits on permanent (employment-based) immigrant admissions.

IEEE-USA opposes further increases in the H-1B visa cap. It supports reforms to the permanent immigration system that would allow industry to recruit needed high-tech workers using the currently underutilized permanent immigration visa categories. Permanent immigrants can freely change jobs and compete for top salaries and promotions, which puts them on par with other U.S. engineers in a free marketplace. Guestworkers are closely bound to their employer/sponsor, which makes them susceptible to exploitation.

"This H-1B proposal makes no sense," says IEEE-USA President Merrill W. Buckley, Jr., quoted in the SFBA Grid, March 2000. "To blow the lid off the H-1B cap that was raised temporarily just two years ago before we've had a chance to see the National Academy of Sciences report that the Congress mandated, is like closing our eyes and putting the accelerator to the floor."

"The IEEE-USA believes strongly in ensuring a strong high tech workforce in the 21st century." said Buckley. "But this bill doesn't do that. Green cards, not guest worker visas, is the best way. We also need to make fundamental improvements in precollege math and science education, to have lifelong learning and retraining to keep our workers in the cutting edge and better access for underrepresented groups, women, minorities, handicapped, economically disadvantaged, especially older Americans."

"There isn't a single argument that can be made for this legislation that does not work even better for permanent legal immigration. So why aren't we fixing what's broken?"

"Rather than increasing our dependence on indefinitely temporary guest workers, we believe that legal permanent residents and citizens should be the preferred source of the skilled workers America will need in the 21st century." Buckley said, "We look forward to real hearings in the House, and Senate where, the alternatives to this fatally-flawed guest worker program can be debated."

MOBILE RADIO

Javier Gozalvez, Senior Editor

In this issue we welcome a new Senior Editor for Mobile Radio. Javier Gozalvez is a Spaniard, educated in France and working in the UK. He has extensive knowledge of 2nd generation and proposed 3rd generation systems, and welcomes your input at j.gozalvez@ieee.org. *As well as a regular column with news of recent developments in the field, from the next issue we will have a feature article each issue related to mobile radio.*

Nokia and Visa ally on wireless payment system. The two companies have agreed to look for simple, "click-through" payment methods for use with the Wireless Application Protocol (WAP) so that users would be able to pay for goods or services over a mobile phone. They will be working to open standards such as EMV'96, a credit card standard. A main concern will be security in electronic transactions, as consumers have recently shown their concerns about the safety of electronic payments. The payment data is intended to be held in a second SIM card for which Nokia intends to builds a slot in its handsets.

ETSI publishes first release of UMTS specifications. After the first year's activity of the 3rd Generation Partnership Project, nearly 300 specifications are being made available by ETSI. The specifications form the bulk of 3GPP Release 99 approved by the Partnership Project in December 1999. Apart from the services already available in 2nd generation systems, multimedia messaging and security features are included in these specifications. The specifications will be available at *http://www.etsi.org/eds*

IPv6 Forum joins the 3rd Generation Partnership Project as Market Representation Partner. The agreement, signed on 18 January 2000, represents an important movement towards the convergence of Internet and mobile communications. IPv6 contribution to the 3GPP work will allow the application of global standards in the next generation Internet domain. This new partnership will increase Internet market awareness within the 3GPP Partners and make mobile Internet standard a reality. The 3GPP is a global standardization initiative created to produce technical specifications for 3G mobile systems based on the evolved GSM core network and the UTRA radio interface. IPv6 Forum is the worldwide consortium of Internet solution vendors, service providers, research and education networks, with the mission to promote the Internet Protocol version 6.

Com-Net Critical Communications, a Pennsylvania- based provider of radio network solutions to the public safety and service market, has acquired Ericsson's Private Radio Systems business. The PRS business, headquartered in Lynchburg, Va., employs more than 700 people. The sale is aligned with Ericsson's overall strategy to concentrate on the convergence of mobility and Internet communications. To increase its concentration on those markets and competencies, Ericsson has acquired and divested various business components. To provide continuity throughout the transition for both employees and costumers, Ericsson will maintain an equity ownership in the new company, Com-Net Ericsson Critical Radio Systems.

The Finnish Government is backing a scheme to allocate every citizen a digital signature that can be embedded into a GSM SIM card. The project, named Public Key Infrastructure, is supported by the Population Register Centre Finland, a government agency, and Sonera SmartTrust. It will allow service providers to include an ID in the SIM card for use in secure wireless e-commerce applications. Also, as Mr Harri Vatanen, managing director of Sonera SmartTrust, said: "This is a fast and cheap way to roll out a national identity network as over 60% of the population already own a mobile phone."

ETSI approves HIPERLAN type 2 core standards for high-speed multimedia wireless communications. HIPERLAN/2 is an interoperable standard intended to provide high-speed connectivity for next generation wireless and mobile communications in corporate, public and home environments at 5 GHz. With this standard wireless access to the Internet and future multimedia, as well as real time video services, will be provided at speeds of 54 Mbits/sec. The group responsible for this standard is also working in collaboration with the UMTS group to draw up specifications for the access interface to UMTS. This interface could also serve as a basis for interfacing with other members of the IMT-2000 family.

Wireless companies form a consortium for secure e-commerce transactions. According to the consortium, the goal is to develop an international standard for the mobile digital signature, a basis for secure purchasing via mobile phone in the booming e-business market. The consortium includes the following companies: Sonera SmartTrust (Finland), Brokat Infosystems AG, HypoVereinsbank AG, Siemens AG, E-Plus Mobilfunk GmbH, Mannesmann Mobilfunk GmbH and Viag Interkom (all from Germany).

Vodafone Airtouch PLC and Mannesmann AG agree merger. Under the terms of the agreement, Mannesmann will own 49.5 percent of the combined company. The resulting company represents the largest mobile

phone operator worldwide. The new company will have presence in 25 countries with 42 million mobile subscribers. This agreement ends a three months battle in which the French company Vivendi played a key role by setting up a joint Telecoms-Internet venture with Vodafone. As a result of the merger, Mannesmann will have to sell the British mobile phone operator Orange. Companies such as NTT DoCoMo (Japan), KPN (Holland) and France Telecom have shown their interest in buying Orange.

UMTS Forum launches IMT-2000 licensing database on the Web. The website presents the current status and licensing conditions for the deployment of third generation mobile systems. *http://www.umts-forum.org/licensing.html*

Qualcomm announced Dr Andrew Viterbi will retire in March. Dr Viterbi will still remain a member of Qualcomm's board of directors after his retirement. After an impressing career in the development of satellite and terrestrial digital wireless communications systems, Dr Viterbi plans to dedicate more time to advise the government, academia and investment community. Dr Viterbi is widely recognized for his Viterbi algorithm and for being one of the key people in the development and promotion of the Code Division Multiple Access technology for wireless communications.

The Japanese wireless companies, Kokusai Electric Co Ltd, Hitachi Denshi Ltd and Yagi Antenna Co Ltd announce their merger. The new company will be named Kokusai Electric Inc. The merger will allow the three companies to concentrate their resources in mobile communications. The new company will focus its efforts on mobile communications, digital broadcast systems, customized communications systems and other areas such as Intelligent Transport Systems.

Intel and Symbol Technologies will jointly develop Wireless Local Area Networking products. The two companies will co-operate in the development of silicon, adapter cards and access points that will allow users to access the Internet without a wireline link. These products will be based on the IEEE 802.11 wireless networking standard and will include 2.4 and 5.2 GHz technology. This announcement coincided with the publication of the report "Enterprise Wireless LAN Market Analysis" by Cahners In-Stat Group. In this report, it is predicted that the enterprise Wireless LAN market will experience a 25% compound annual growth rate from 2000 and 2004.

An Israeli Insurance agent launches a mobile phone illness policy. The insurance will allow mobile phone users to cover themselves against brain cancer and illness of the central nervous system. The agent said that even if no direct link between these illnesses and the radiation from mobile equipment has yet been proved, there is enough research work done to admit a potential risk. The insurance will be offered to organisations that would like a collective policy for its employees.

New ITU group on IMT-2000 to develop work plans for future wireless services and systems. The Working Party 8F is a follow-on to Task Group 8/1, which previously held primarily responsibility for development of IMT-2000 and completed its activities in November 1999 with the successful adoption of release 99 of IMT-2000 radio interface standard. The new group will be responsible for the overall system aspects of IMT-2000 with a focus on wireless terrestrial components. Other issues covered by this group are: spectrum needs, higher data rate capabilities, IP-based service needs for IMT-2000 and development of systems beyond IMT-2000.

Qualcomm delivers new 3G CDMA chipsets. Qualcomm announced it has shipped chip samples and system software for the MSM5000 Mobile station Modem (MSM). According to the company, this product is the world's first 3G CDMA 1x MultiCarrier solutions for CDMA handsets that are compliant with the 3G standard specified by the ITU. The MSM5000 chipset will provide longer standby times and data rates of 153.6 kb/s. It is also backward compatible with existing IS-95A and IS-95B networks. Qualcomm also announced an agreement with Kyocera that will acquire Qualcomm's terrestrial-based CDMA wireless phone business including inventory, manufacturing equipment and customer commitments. Under the terms of the agreement Kyocera will purchase a large amount of Qualcomm's CDMA chipsets.

Israel's Foxcom Wireless improves indoor and subterranean coverage. Poor signal quality in subways, tunnels and indoor environments represent one of the main problems in mobile communications. Foxcom Wireless aims to end these problems with the use of inexpensive fiber-optic cables. Foxcom's point-to-point product, Rfiber, places a receiver outside a building or tunnel and transfers the cellular signal via fiber-optic cables to transmitters inside the building or tunnel. Foxcom Wireless has already applied this technology to subways in Berlin, Seoul and Istanbul, the new twin 50-storey Azrielli office towers and the Vancouver airport, among other costumers.

Motorola introduces one chip to handle all world wireless standards. The DSP56690 baseband processor can execute all major standards including support for CDMA, GSM, iDEN and TDMA wireless devices as well as satellite-based products. The processor integrates a DSP core running at over 100MHz and a M-CORE M210 32-bit microcontroller operating at over 50MHz. In a similar move, **Tropian Inc has unveiled an RF platform that enables to offer a multi-mode platform** for handsets and base stations encompassing GSM, TDMA and eventually CDMA and UMTS. The platform provides a programmable, all digital transmitter that doesn't need parallel hardware when switching between modes but just a change in table information. It also improves the power efficiency of transmitter systems reducing then the need for heat management in base stations.

Wireless manufacturers team up with car manufacturers to bring wireless communications to the vehicles. Motorola and Mercedes Benz have teamed up to offer drivers the first fully integrated StarTAC digital cell phone with hands free capabilities. Another agreement was signed by Motorola with General Motors to bring mobile office on wheels. As part of the agreement, the GMC Terradyne concept vehicle will incorporate a mobile office environment featuring the Motorola i1000plus integrated digital wireless handset with service from the Nextel National Network. Ericsson, Volvo and Telia also announced the formation of WirelessCar Corporation at the Geneva Motor Show. This joint company will develop and market complete solutions for mobile e-commerce services to vehicle manufacturers and fleet operators. Vehicles will be connected to a wide variety of mobile e-services such as roadside and emergency assistance, remote diagnostics, vehicle software management and Internet services. Ford Motor Co. and Sprint PCS formed a partnership to offer wireless

phones with voice and data capabilities in some 2001-model Lincoln vehicles. Ford plans to offer phone services in nearly all its vehicles in the next several years. (See also 'Cell Phones, E-Cars, Distraction/Hazard/Benefit,' in the Automotive Electronics column on page 20).

Ericsson and Qualcomm will jointly develop Bluetooth CDMA solutions for mobile handsets and devices. Under the agreement, Ericsson Microelectronics will develop a Bluetooth-compatible radio unit and Qualcomm CDMA Technologies will develop the Bluetooth digital baseband processing to be integrated into its future Mobile Station Modem chipset and software solutions. The two companies will work together to optimize the RF and digital designs for operation within a CDMA handset environment. Bluetooth is a short-range radio technology that aims to remove the limits of digital equipment interconnectivity by eliminating the need for wired connections. A group, originally formed by Ericsson, IBM, Intel, Nokia and Toshiba, was founded in May 1998 to promote Bluetooth technology. Since then, companies like 3Com, Lucent, Microsoft and Motorola have joined the Bluetooth Group.

Microsoft goes mobile. In the past months, Microsoft has increased their activities and presence in the wireless communications industry. One important milestone was the **announcement with Ericsson of a jointly owned company that will develop applications for wireless Internet access.** As part of the agreement, Ericsson committed to licensing the Microsoft Mobile Explorer microbrowser for use on its cellular phones. In return, Microsoft will use Ericsson's WAP implementation in future versions. Despite this agreement, Ericsson stated that it will continue to use the EPOC operating system, developed by Psion and supported by the Symbian venture, and that it has no plans to use PocketPC (Windows CE) in its mobile phones. The joint company will focus on developing applications that give users access to information held on Microsoft Exchange platforms. **A similar alliance with Qualcomm was announced** at the CTIA Wireless 2000 show. The two companies will jointly develop advanced wireless, multimedia capable devices focusing on CDMA smart phones integrated with Microsoft Mobile Internet Explorer. **The Microsoft MSN Mobile 2.0** was also unveiled at the CTIA show. This new version extends wireless access for MSN costumers to MSN Hotmail, MSN MoneyCentral, MSNBC.com and the Expedia online travel service. Wireless operators such as Nextel Communications Inc. and Airtouch Cellular agreed to offer MSN Mobile 2.0 to their wireless costumers.

ITU and Turkish government sign agreement to host World Radiocommunication Conference 2000, from 8 May to 2 June 2000. This conference is a forum where countries decide on the shared use of the frequency spectrum to allow the deployment or growth of all types of radiocommunications services. One of the main issues to be discussed in this conference will be the consideration of additional global spectrum identified for IMT-2000. Europe proposes to consider, apart from the bands around 2GHz already allocated, the bands: 806-906 MHz, 1710-1885 MHz and 2500-2690 MHz. This follows the demands of the UMTS forum for an additional 160 MHz band of spectrum due to their traffic demand forecasts in the next ten year. This requirement has met opposition from countries such as India and Australia that don't think that as much spectrum is needed. However, the Asia-Pacific Telecommunity Conference Preparatory Group has also proposed the band 2520-2670 MHz as one of the favoured candidates to support the future growth of the terrestrial IMT-2000 component. On the other hand, the United States have identified a portion from 700 MHz to 2.5 GHz where additional spectrum could be taken for 3G systems. Another important subject that will be discussed at WRC2000 is the use of at least some frequency bands in a global basis in order to avoid frequency shifts when roaming. Europe supports this idea whereas the US resists this proposal as they will then have to free some of the frequency bands they already use.

Worldwide 3G Licence auctions. At the time of writing, thirteen companies are competing for the **UK** auction of five 3G mobile licenses. The four GSM operators (Vodafone, BTCellnet, One2One and Orange) are among the candidates. The other nine companies are: NTL Mobile Ltd, SpectrumCo Ltd (formed by Virgin, Nextel and Sonera), Telefonica UK Ltd, WorldCom Wireless (owned by MCI Worldcom), TIW UMTS (subsidiary of Dolphin), One.Tel Global Wireless Ltd, Crescent Wireless (owned by Global Crossing), 3G ltd (subsidiary of Irish Eircom) and Epsilon (owned by Japanese finance house Nomura). At least one license will be reserved to a new entrant. In **Spain**, four UMTS have been awarded. Three of them were awarded to the existing GSM operators, Telefonica, Airtel and Amena (Retevision). The other license was awarded to Xfera (consortium led by Vivendi, Sonera and Mannesmann/Orange). The consortiums led by France Telecom and Deutsche Telekom failed to get a license. **Japan** looks set to issue only three licenses for 3G systems according to a policy statement issued by the Ministry of Posts and Telecoms. The licenses will probably be nationwide (the 2G Japanese licenses were granted on a regional basis). Among the candidates to obtain a license are NTT DoCoMo and the consortium of DDI and Ido Tsushin. Applications will be accepted from early-April 2000 until mid-May 2000. The **German** telecoms regulator announced the auction of between four and six UMTS licenses at the end of June/start of July 2000. A 60 MHz frequency spectrum band will be auctioned. The band will be divided into 12 blocks of 5 MHz and bidders will be able to bid for a minimum of two and a maximum of three blocks. Two 5MHz blocks will be reserved for new entrants into the German market. The application period runs out on 28 April 2000. Viag Telecom won a UMTS licence in **Liechtenstein**. The company aims to launch the UMTS network at the beginning of 2002. Manx Telecom, a subsidiary of BT, claimed it will launch the first commercial 3G service in Europe and probably in the world. The company plans to launch its service early next year on the **Isle of Man**. Other European countries to award UMTS licenses during this year are Norway, Netherlands, France, Sweden and Italy.

Iridium, the financially troubled satellite telephone system, is ending its service. The company was looking for a last-minute buyer that will rescue it from liquidation. Several offers (amongst them, one from Merit Studios and one from Gene Curico, a telephone entrepreneur) were received but none qualified. Iridium's hopes effectively vanished when Craig McCaw's Eagle River Investments LLC announced that it was no longer interested in investing in Iridium. The Investment Company will instead focus its attention on ICO and Teledesic, two other satellite companies, due to their closer synergies. Iridium has asked a bankruptcy court in New York for permission to allow the satellites to de-orbit. Despite this bad news for the satellite mobile phone industry, **Globalstar announced the commercial launch of its service** in nine European countries in conjunction with its partner TE.SA.M, the satellite joint venture between France Telecom and Alcatel.

China suspends the rollout of Qualcomm's CDMA technology. Qualcomm announced, at the beginning of February, a licensing agreement for its CDMA products with China United Telecoms Corp. China Unicom plans to roll-out a nationwide CDMA network that will compete with the already established GSM standard. Under the terms of the agreement, Qualcomm will grant royalty-bearing licenses to Chinese manufacturers. In return, the Chinese manufacturers will buy all their ASICs from Qualcomm. However a week after the agreement was announced, the Chinese Government suspended this rollout and didn't specify a date for a resumption. According to a Chinese official, "China Unicom has not completed its preparations and applications". However, Chinese Premier Zhu Rongji said that the problems would be solved soon and that the project was not suspended.

GSM World Congress. The Congress took place in Cannes (France) at the beginning of February. High-speed data mobile phones were the main attraction of the GSM World Congress. Several General Packet Radio Services (GPRS) chipsets were announced at the Congress. Samsung and Lucent showed their jointly developed multi-slot class 8 GPRS handset particularly suited for Internet applications. Ericsson also showed a live demonstration of a GPRS phone over an end-to-end GPRS network. Infineon Technologies demonstrated a baseband logic IC and an RF Transmitter that achieve even higher data rates using class 10 GPRS. Alcatel and LHS introduced a GPRS customer care and billing solution. Motorola announced it would offer other manufacturers a scaleable chipset/software platform for GSM. The platform will include all the components necessary to bring a GSM product to market quickly and will not target only voice products but also high speed data ones. Casio announced an agreement with Vodafone to co-develop mobile multimedia palmtops that will offer wireless Internet access through GPRS technology. More information about this event can be found at *http://www.gsmworldcongress.com/*.

CeBIT technology fair. The fair was held at the end of February in Hannover (Germany). The mobile Internet and the WAP centred the attention of the event. Many partnerships between wireless equipment manufacturers and telecom operators were unveiled in the fair. Philips Electronics reached an agreement with US-based mobile Internet services group Sraide.com. T-Mobil also unveiled its plans that are based on a pact with Microsoft and Compaq. Nokia and online retailer Amazon.com announced their pact. Nokia also presented new mobile phone handsets, some of them using WAP. Motorola unveiled a set of content partnerships for wireless Internet services that will allow mobile users to connect to Web sites via their WAP phones. The US manufacturer also presented WAP-enabled mobile terminals including their GSM tri-band GPRS WAP enabled-phone. However, this enthusiasm was not shared by Ericsson that announced they will slow WAP manufacturing until demand increases and more WAP applications appear. On the other hand, the Swedish manufacturer unveiled at the fair their complete range of WCDMA Radio Access Networks products. More information about this event can be found at *http://www4.cebit.de/index_e.html*.

CTIA Wireless 2000 trade show. The show took place in New Orleans (USA) at the beginning of March. The synergy of wireless and data/Internet delivery appeared to be a frequent message during the show. Another important topic of the show was 3G technology. Motorola announced a CDMA technology enhancement, know as 1Xplus, that will allow operators to achieve data rates of more than 5Mbt/s on their existing infrastructure. The US manufacturer also claimed to have made a Voice over IP call on top of a 3G CDMA2000 packet data call at 384kbt/s. The Universal Wireless Communications Consortium (UWCC) launched during the event their TDMA-EDGE brand identity promoting the leading wireless technology in the western hemisphere. However, despite the interest in 3G systems, CTIA research seemed to show that US consumers are not yet ready for 3G services. More information about this event can be found at *http://www.wow-com.com/convsem/wireless/2000/*

Wireless companies launch OFDM Forum. The companies behind this launch include Wi-LAN Inc., Ericsson, Nokia, Philips Semiconductor, Samsung, Sony and CalTrans. According to the companies, the Orthogonal Frequency Division Multiplexing (OFDM) Forum was created to promote global conformity of OFDM standards and spectrum allocation as well as establish a single compatible global OFDM standard for delivering low cost devices on all wireless networks. The companies said OFDM technology is considered at the forefront of the next generation of high-speed wireless data products and services.

The GSM Association requests a huge allocation of IP addresses to support the rollout of GPRS. The initial request is equivalent to two "/8" network blocks or 0.8% of the total Ipv4 32-bit address space, providing then 32 million IP addresses. The GSM Association has asked RIPE, the Internet registry for Europe, for a decision within two months. The IP addresses are necessary to allow subscribers to browse the Web and use new data and mobile e-commerce services. This huge demand has been triggered by the large rollout plans for 2.5G mobile systems. However, there are some fears that up to a billion IP addresses are required for a full rollout of GPRS Internet roaming since GPRS terminals may require multiple IP addresses. Ipv6 could solve in the future the problems of shortage of IP addresses.

Reports warn about mobile e-commerce and 3G availability. According to the report "Mobile E-commerce: Market strategies" from Ovum Ltd, potential mobile e-commerce players should concentrate on "killer applications" rather than trying to excite the market about the "cool new technology". According to Mr Brown, co-author of the report, it is debatable whether ordinary consumers are actually demanding for e-commerce services right now. In the report "Mobile's High-Speed Hurdles", the analysis firm Forrester Research claims that manufacturers have made mistakes in forecasts for next generation mobile telephony. According to the report, it could take seven years for 3G networks to become operational. The delay can be due to high costs to upgrade networks and delays in mobile phones availability.

TRANSPORTATION SYSTEMS

Harvey Glickenstein, Senior Editor

Working Group 2 of the Rail Transit Vehicle Interface Standards Committee had a well-attended meeting in Philadelphia at SEPTA's offices in February. The purpose of the meeting was to determine if there was a need to continue the Working Group since the publication of Standard 1474.1-1999 on Communications Based Train Control (CBTC). The consensus of the 28 participants was that there are a number of areas that the Working Group should explore. These areas will be discussed at the full committee meeting in March.

The area that received the most interest was environmental standards. Working Group 8 is currently developing environmental standards for trainborne equipment. The consensus was that Working Group 8, or a new Working Group, be given this assignment.

Two other areas that were discussed were rail-highway grade crossings and CBTC train operations without crews. It was felt that the existing standard should be updated by adding these areas to it. The subject of rail-highway grade crossings was considered the more important. It was suggested that operation without train crews be addressed when the existing standard comes up for renewal in two to three years.

It was also felt that means should be established for close coordination between Working Group 2 and the North American Joint Positive Train Control Program and the Rail Safety Advisory Committee of the Federal Railway Administration as their work is complementary to the work being done by Working Group 2.

Japan's Maglev test train reached another milestone. Two trains on the Yamanashi Test Track passed each other at a closing speed of 623 mph. One train was traveling at 339 mph, three mph shy of the record speed reached in April, while the other one was traveling at 284 mph. Both three-car trains had passengers aboard.

Unlike Germany, which has just cancelled its attempt to build its first maglev line between Hamburg and Berlin, Japan is planning to continue its test program for another five years before starting its first commercial line. Aerodynamic characteristics, construction and operating costs, and system reliability are among the items they want to resolve before starting construction of the new Chuo Shinkansen between Tokyo and Osaka.

Athens has opened two new rapid transit lines. Line 2 runs between Sepolia and Syntagma, while Line 3 runs between Syntagma and Ehniki Amyna. Line 1 is the existing Athens Piraeus Railway. Construction of these lines was severely hampered by the large number of archeological sites uncovered during the construction.

London's Jubilee Line Extension opened last year in time to serve the Millennium Dome for the New Year's celebration. As originally planned, the extension was to use communications based signaling. Because of problems with the signaling, which were at least in part traced to integration problems between two contractors who each were supplying a portion of the system, the decision was made to open the line with fixed block signaling. While the fixed block signaling does not provide the short headways that were proposed with the communications based signaling, the fixed block signaling headways should be adequate for the foreseeable future.

Docklands Light Railway in London has ordered twelve new cars. The new cars, which were ordered from Bombardier, will be similar to the existing cars on the line. Docklands, the first public transit system in England to be fully automated with no drivers, needs the new cars to serve the recently opened 2.5-mile extension to Greenwich and Cutty Sark.

An option for an additional twelve cars is included in the award. The railway expects that these cars will be needed in spite of the opening of the Jubilee Line, which also serves some of the same area served by Docklands.

The first vehicles for the JFK Airport Access light rail system have been completed. After extensive testing at Bombardier's Kingston Ontario test site, they are scheduled to be shipped to New York City in September. The vehicles are powered by linear induction motors, a system that is presently in use in Scarborough Ontario; Vancouver, British Columbia; and Detroit, Michigan.

Civil work for the system is currently underway. Revenue service for the circulator at the airport and the line out to the Long Island Rail Road's Jamaica station is scheduled for September 2002. The entire 8-mile line includes the on-airport circulator, the line to Jamaica, and another line to the New York City Transit's Howard Beach station.

India has decided to install automatic train protection on more than 9,000 route miles of railroad. The decision was made after the head-on collision last year of two passenger trains in Assam. A radio-based version of the European Train Control System (ETCS) is expected to be installed. Level 2, which uses track circuits, is planned for deployment. This will allow for broken rail detection. India presently has Siemens ZUB train control system in use on suburban routes, but vandalism has been high and the feeling is that a radio based system would provide fewer targets for vandalism.

The pilot installation would be on fifty miles of the 90-mile route south from Delhi toward Agra.

The high speed line between Taipei and Kaohsiung will use Shinkansen technology. A Japanese consortium beat the Eurotrain consortium of Alstom and Siemens for the right to supply the rolling stock. This was a surprise as the Taiwan High Speed Rail Consortium (THSC) originally won the contract to build the line planning to use the European technology for the rolling stock. Their rival was a Japanese consortium that had planned on using the Shinkansen technology. At the time of the award in July 1998, THSC announced that they were postponing the award for the rolling stock for a year. Eurotrain sued THSC in a Taiwan court asking that THSC be required to award the rolling stock contract to them. The court refused to enjoin THSC from awarding the rolling stock to the Japanese consortium.

Service on the 219-mile route is now planned to begin in October 2005. Trains will operate at 185 mph.

Alstom is providing high speed trains to Korea. Using TGV technology, these trains will operate at speeds up to 185 mph. The first 21-mile section of the high-speed line between Seoul and Pusan was completed last December. It will be used to test the rolling stock. The first 12 KTX trains, as the high-speed trains will be called in Korea, are being built in France. The balance of the 46-train fleet is being built in Korea.

Revenue service from Seoul to Taejon is expected to start in December 2003. The portion from Taejon to Taegu is planned to be completed by April 2004. The balance of the line to Pusan will not be upgraded at this time.

The Toronto Transit Commission (TTC) has advertised for a Speed Control System (SCS) demonstration. TTC presently uses physical train stops to enforce stop signals and to provide an intermittent speed control by use of timers at a limited number of locations. The physical train stop located at each signal is normally up. In this position it makes contact with a trip valve on the subway car that opens the brake valve, removes power from the train and forces an emergency stop. When the signal can display an aspect allowing a train to proceed past it, the train stop is rotated down out of the way of the valve projecting from the subway car. When the train stop is detected to be down, the signal displays an aspect allowing the train to proceed. When it is desired to control the speed to the train, the train stop is left in the up position when the train passes a signal in the rear. A timer then runs. If the train is operating at or below the required speed, the train stop will be driven down before the train reaches it. If the train is operating too fast, it will reach the train stop before the time runs out and the train stop will still be in the up position. This is an intermittent system with enforcement only at signals.

The intent of this advertisement is to establish a short list of qualified companies that can provide a more modern continuous speed control system that does not depend on intermittently timing the train through a timing section.

TTC will award the contract to more than one company or group of companies. TTC will then install the proposer's equipment on one married pair of a six-car subway train. A married pair is a set of two subway cars that are semi-permanently coupled. Such a set is cheaper to procure than two separate cars because some of the required apparatus, such as an air compressor, is shared between the two cars.

TTC will also install the wayside apparatus required for the demonstration that is provided by the proposer.

Each proposer will have 3 to 4 weeks for the supply, installation, testing, and demonstration of their proposed SCS equipment. At the end of that time the equipment will be removed.

All proposers who successfully demonstrate their SCS equipment, which must also show how a future migration to a Communications Based Train Control System would be accomplished, will be short-listed for a procurement to install their system on the entire TTC system. The date for advertising the system-wide procurement has not yet been announced.

A contract to provide positive train control on a portion of the Union Pacific Railroad's line between Chicago and St. Louis is about to be awarded. The proposals from the System Developer/Integrator, who will supply the system, were due at the end of March. At publication date contract award was scheduled for June 1.

The North American Joint Positive Train Control Office issued the Request for Proposal. This proposal is entitled the Illinois Department of Transportation (IDOT) Positive Train Control Project. It is one of three projects covered by the North American Joint Positive Train Control (NAJPTC) Program. The other two projects are the Eastern Project and the Industry Train Control Standards Project.

The Eastern Project is the continuation of a project started by a consortium of CSX, Norfolk Southern, and Conrail. Phase I of the project demonstrated an object-based onboard platform to support interoperable Positive Train Control (PTC). Phase II of that contract has been folded into the NAJPTC Program. It will integrate the onboard platform with existing wayside train control systems.

The IDOT PTC project is funded by a group of stakeholders. The Stakeholders Group includes the Federal Railroad Administration, IDOT, the Association of American Railroads (AAR), and an ex-officio member from the Union Pacific Railroad on whose property the test will take place. Amtrak is also involved, as they will be contributing locomotives and control cars to the project. Transportation Technology Center, Inc., the subsidiary of the AAR that has a contract with the FRA to operate the Pueblo test site, will be the contract administrator for the IDOT Project.

The project will demonstrate PTC in two separate territories: one as an overlay on the existing signal system, and the second as a standalone system. In the standalone system, non-equipped trains will operate absolute block between the existing interlockings, i.e., unequipped trains will not be allowed to follow equipped trains or other non-equipped trains into the territory between the controlled signals of adjacent interlockings.

The system will be installed in several builds. The final build, which is scheduled for 31 months after award of contract, will demonstrate 110 mph operation. Moving block capability will also be demonstrated in the standalone territory. After installation and testing of the final build there will be 12 months of operation under warranty before final acceptance.

AUTOMOTIVE ELECTRONICS

Bill Fleming, Senior Editor

Cold-Engine Tachometer Display

Besides having dual variable-valve-timing intake-and-exhaust camshafts, and electronic motor-driven throttle (drive-by-wire); BMW's new S62 V8 engine, used in its M5 car, includes an unique feature of a variable tachometer warning zone. The variable display reminds the driver that a cold engine, especially a high-performance one, should be treated with care. When the engine is cold, the tachometer's warning zone (indicated by orange LEDs) begins at 4000 rpm. But as the engine warms, LEDs are extinguished, lifting the rpm-limit in increments of 500 rpm, until the warning display begins at its normal 6500 rpm [1]. Isn't electronics wonderful.

Intelligent Transportation Systems Update

After spending $54 million during its previous three years, U.S.-DOT cut National Automated Highway System Consortium funding for fiscal year 1998 to $2 million. That cut was made because of the exorbitant estimated cost of installing road infrastructure (e.g., in-road magnetic studs). Rather than funding automated highways, DOT next allocated $30 million per year to the IVI Intelligent Vehicle Initiative, a program that emphasized collision-avoidance systems [2].

One of the first IVI programs announced by DOT was the joint General Motors (39%) and DOT (61%) $35 million program for 100 Michigan drivers to test GM vehicles equipped with crash-avoidance systems. Beginning in 2002, ten test vehicles will be real-world tested [3]. More recently, DOT announced that $12.7 million more IVI funds were awarded to these truck companies [4]:

- **Mack Truck** to demonstrate an roadside-infrastructure-assisted warning system that notifies truck drivers of road-ahead danger, along with an Automatic Collision Notification system (which also records before and after crash data).
- **Freightliner** to test a truck roll-stability advisory system.
- **Volvo** to test collision warning, and advanced truck braking systems.
- **Navistar** to test a fleet of snowplows equipped with collision warning and lateral guidance.

In yet another NHTSA-IVI study, along a 50-mile stretch of snow-plagued Minnesota highway, a stripe of magnetic tape (developed by 3M) will be laid down next to the traditional yellow center line [5]. The magnetic tape will assist vehicles to stay on the road, and avoid veering into the opposite lane, during drifting-snow whiteout driving conditions. Initially, this study will involve four snowplows, one ambulance, and one police car. Magnetometer-sensors are able to pick up the stripe at distances of about 16-to-20 inches. When a vehicle veers away from the stripe, a warning tone sounds and a steering arrow (to go right, or left, and find lane center again) appears in an instrument panel readout.

Cell Phones, E-Cars, Distraction/Hazard/Benefit

Nine years ago, AAA-funded studies showed that as cell-phone car-talk became more intense (more business related), drivers failed to respond to hazards 30% more often [6]. Four years ago, researchers showed that drivers with cell phones were 34% more likely to have an accident [7]. Recent studies show that motorists are four times more likely to crash when they're using cell phones [8]. And a NHTSA analysis of 1997 crash data showed that cell phones were a factor in at least 57 deaths, compared to 1991 when they were a factor in only seven such deaths [8]. It's believed that the actual fatality number was probably higher because most states don't track the role of cell phones in crashes.

However, it's a mixed bag because cell phones also improve police response times to accidents, alert police to crimes in progress, and help rescue stranded motorists. It's estimated that 18 million 911-emergency calls were made on cell phones last year [8].

Next, there's the telematics-equipped e-cars, referring to cars that:

- download e-mail
- surf the Net as adeptly as desktop computers
- have voice-controlled interface/control
- have cell-phone/satellite-radio/Internet connectivity
- provide instant information on stocks, weather, traffic, etc.

Automakers see e-cars as inevitable because "today's younger buyers simply won't put up with any car that can't keep them fully in touch electronically [9]." But U.S. DOT Secretary Slater frets that, "the safety of potentially distracting e-cars clearly is something to be tested." On the other hand, automakers argue that their systems will be safe because:

- its operation will be hands-free, voice-activated, as adapted from that already used in hands-free cell phones
- motorists will be encouraged to use telematics systems while parked, or be especially careful about potential distractions.

In fall 2000, certain models of Ford's '01 Lincolns and GM's '01 Cadillacs will for the first time offer factory-installed telematics options [9]. Everyone's hoping that things

will work out for the best. However, due to any reason, or telematics, the danger of distraction while driving is best summarized in these words: "A couple of seconds of lost time to react can mean the difference between a fatal collision and a near-miss."

To be sure, U.S.-DOT's NHTSA has scheduled hearings in June 2000 that will go beyond driver distraction due to cell phones, and will be expanded to include distractions due to in-vehicle telematics devices [10]. An editorial opinion stated that:

"The auto industry must be decisive and responsible because lives are at stake. It needs to develop a responsible position on in-vehicle telematics, with which all automakers comply. The alternative might be a backlash against the technology [10]."

Automotive Electronics Enabling Technologies

Marcos Oliveira, Chief Technology Officer and V.P., Visteon Automotive Systems (an enterprise of Ford Motor), was interviewed by IEEE Spectrum. Carlos identified the following as the most important recent developments in automotive electronics [11]:

- ✦Dual-voltage 42-V electronics power-supply systems, first introduced in hybrid electric vehicles.
- ✦Electronic chassis control systems that improve vehicle ride and handling.
- ✦Voice recognition control of accessory functions, first introduced in the '99 Jaguar S-Type.
- ✦Navigation systems, not only those in Japan, but also those in Europe and North America.
- ✦Advanced inflatable restraint systems that detect and classify the type of occupant (*adult, petite, child, infant, inanimate*) and deploy or don't deploy air bags accordingly.
- ✦ITS Intelligent Transportation Systems which, over time, will move from occupant protection to collision avoidance.
- ✦Integration of wireless technology in vehicles, connecting vehicles with home, office, and personal lives.

Automakers, including Carlos, see e-cars as being inevitable. In Carlos words, "5 or 10 years from now, when children who've never known an Internet-less world are buying cars, they'll surely want the same Internet abilities in their cars as they have in their homes". (Carlos also hasn't forgotten that electronic options are the most profitable items in a car – another compelling reason for new telematics-product development).

Satellite Radio Broadcasting Becoming A Reality

Eight years ago, a satellite-radio broadcast system called RadioSat, transmitting on L-band (1-2 GHz), was planned [12]. Three years ago, DARS (Digital Audio Radio Service) was slated for nationwide broadcast on S-band (2.3 GHz) in 50 channels of "pay-to-listen" programming [13]. Apparently the satellites are now in orbit, and satellite radio finally appears to really be happening [14,15]. GM expects to include 100-channel XM Satellite Radio digital receivers in their '02 model vehicles. Development of the XM Satellite Radio system was accelerated by $250 million funding from GM to help launch the service [14]. Ford Motor is expected to announce a similar satellite-radio-receiver deal, possibly with CD Radio Inc. [14].

Drivers can select all-Hispanic, all-country, or the very same channel from one coast (Los Angeles) to the other (New York). This service will cost subscribers about $10 per month, with one subscription covering both car and home receivers. Recently, Sirius Satellite Radio announced that, in line with DaimlerChrysler's slogan of "Expect the Extraordinary;" their technology will be used by the automaker [15]. The Sirius system, slated for introduction in '02 model DaimlerChrysler vehicles, will provide *"up to 100 channels of crystal-clear audio entertainment broadcast coast-to-coast, including 50 channels of commercial-free music."*

Remote Vehicle Fingerprinting

An unusual U.S. Patent, titled "Passive Vehicle Classification Using Low Frequency Electromagnetic Emanations," assigned to Raytheon Company, was recently issued [16]. With a little bit of detective work, I concluded that the objective of this patent was to passively "fingerprint" cars to allow remote identification of vehicles for recovery of stolen cars, or simply to verify the identity of cars as they enter or leave secure areas. The "fingerprint" might also be used by "Big Brother" to track the whereabouts of vehicles.

Here's how it works. Roadside electric-field and magnetic-field antennas pick up low-frequency (5 Hz-to-50 kHz) electromagnetic emissions from the vehicle's electrical systems. Using temporal, frequency-spectrum, and neural-net methods of analysis, the instrument utilizes signal processing to produce an unique signature "fingerprint" for the each vehicle. The "fingerprint" includes information on:

- ✦the number of engine cylinders
- ✦whether the car has an automatic or manual transmission
- ✦the alternator pulley ratio
- ✦the type of lighting

It's claimed that the "fingerprint" itself is sufficiently unique to allow identification of individual vehicles [16].

Continuously Variable Transmissions (CVTs)

Metal-belt durability problems have been overcome, and in 1998 approximately 270,000 CVTs were built worldwide, but just 10,000 were for the North American market. Currently, only the Honda Civic HX offers a CVT option in the U.S. Although CVTs deliver 7% better fuel economy than a comparable 4-speed transaxle, this advantage has remained unimportant to American drivers who are accustomed to cheap fuel. Recently, however, General Motors announced that Saturn Corporation's upcoming 2002 sport-utility (similar in size to today's Chevrolet Blazer) will feature a CVT built by GM's Powertrain Division [17]. The steel belt used in GM's CVT will be exclusively supplied by Van Doorne Transmissie BV of the Netherlands. Also starting in MY'02, Ford Motor is likewise gearing up to equip certain vehicles with a CVT, supplied via a joint venture with ZF Friedrichshafen AG.

So why include this item on CVTs in an automotive electronics column? The answer. Beyond having to solve metal-belt durability problems, electronic control system performance problems also had to be solved. Basically, speed sensors measure both the engine-out speed and the driveshaft speed. Then, in both the input and output pulleys, pulley-halves-separation distances (which determine the effective steel-belt-pulley radii) are electrohydraulically increased or decreased, therein varying the CVT's transmission ratio [18]. Hence, electronics is involved in CVT automotive operation; and CVTs are indeed part of the automotive electronics scene.

Hybrid-Electric-Powered Vehicle Update

Insight American Honda was first in on the mass-consumer eco-friendly vehicle market; with its Insight, a small 2-seat coupe, introduced in Europe in December, 1999. Insight is powered by a 1.0-liter, 3-cylinder, low-friction, gasoline engine mated to a 5-speed manual transmission; together with an electric motor powered by nickel-metal-

hydride batteries. Energy demand is leveled off through battery storage. Insight, built in Japan, features a combined city-highway fuel consumption of 70 mpg. It is reasonable priced at US$21,000; which Honda executives say, "is at least US$6,500 less than the cost of building the car [19]."

Prius Toyota will be next in to the eco-friendly vehicle market with its Prius, a mid-size 5-seat sedan, to be introduced in late spring, 2000. Similar to Honda's Insight, Prius is powered by a larger gasoline engine; together with an electric motor and a heavier battery pack. Prius, a larger car (as yet unpriced), achieves a city-highway fuel consumption of about 55 mpg. Under lengthy load, when climbing a mountain for example, both the Prius' batteries and the Insight's batteries may completely discharge, and drivers need to downshift to a lower gear [20,21].

EV1 General Motors' EV1 car is all electric, meaning it needs a battery recharge after traveling about 70 miles (or sooner if the weather is cold or inclement). GM launched EV1 in 1996 in four Western states, but sales of the lease-only vehicle never took off. Consumers found the EV1 too costly (around $35,000) and its driving range too limited [20].

Precept General Motors' Precept is a concept hybrid vehicle which was shown in Detroit at the 2000 North American International Auto Show. It's powered by a 1.3-liter, 3-cylinder, direct-injection Isuzu diesel engine mated to a 5-speed automatic transmission; together with two electric motors, one at each axle. Taking advantage of every fuel-saving design feature available (aluminium construction, idle shut-down with auto restart, aerodynamic body, etc.); the Precept achieves a city-highway fuel consumption of 90 mpg [22,23]. But it's not yet ready for sale.

Prodigy Ford Motors' Prodigy is another concept hybrid vehicle, also shown in Detroit at the same International Auto Show. It's powered by a 1.2-liter, 4-cylinder, Ford experimental diesel engine; with one electric motor. Also taking advantage of fuel-saving design features (aluminium construction, combined in-line flywheel/starter/alternator motor, aerodynamic body, etc.); the Prodigy achieves a city-highway fuel consumption of 80 mpg [22]. And it's not ready for sale yet either.

Ballard It's thought by many that hydrogen fuel cells will be the ultimate eco-friendly automotive energy source. Fuel cells will directly convert hydrogen into electricity that will power the vehicle's electric-drive motors, with no CO2 emissions. Also at the same Intl. Auto Show, Ballard Power Systems (Burnaby, BC, Canada) unveiled its Mark 900 fuel cell module stack which is more compact, lighter weight, and costs "about as much as an IC engine" (namely, $3,750). Ballard is hoping to mass produce these advanced fuel cells in 2004 at a rate of 250,000 modules per year [24].

There's still the questions of: "How are we going to get the hydrogen? How's it going to be stored? How's it going to be transported?" Furthermore, hydrogen is low in energy density, it's expensive to make, and there are safety problems (remember the Hindenburg and the Challenger). Hydrogen isn't extracted from the ground. Instead, producers must separate hydrogen from the chemical bonds that it forms with other elements. Moreover, the question of on-board hydrogen storage remains unresolved [25]. I'm sure the engineering community is thinking about this. So are we.

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VTC2000-Fall in New England

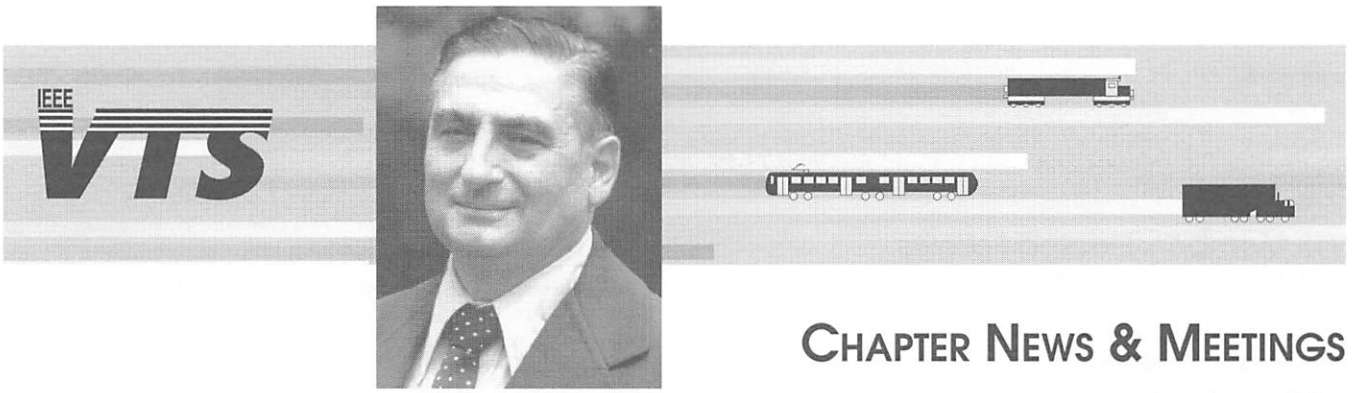
The second Fall VTC will be held at the Seaport Hotel & World Trade Center in Boston from the 24th to the 28th of September 2000. This is the North American VTC for this year, since the Spring VTC is in Tokyo. Response to the conference has been very great, with over 1000 papers submitted before the February deadline. Authors whose papers have been accepted will receive notification in May.

The theme of the conference is 'Bringing Global Mobility to the Network Age'. Third generation systems will soon be in commercial operation, and IMT-2000 technologies and performance evaluation will be a major area of interest. However, broadband access and possible 4th generation issues, such as OFDM, will be covered, as well as 2.5G and migration issues. Multimedia, short range wireless systems like Bluetooth, and IP technology are also included, as are traditional VTC subjects such as antennas and propagation, ITS and vehicular electronics. New applications like wireless E-commerce, software agents and hybrid solutions complete the subjects covered.

The conference will begin with a full day of tutorials organized into 7 parallel tracks. Quality proposals have been received for more topics then will fit into the conference and we are presently sorting and reviewing the proposals. Consistent with the theme of the conference and the focus upon enhanced voice and non-voice services, it is anticipated that we will provide extensive tutorial coverage to emerging 3rd generation and generation 2.5 topics.

The main body of the conference will consist of 7 parallel tracks hosting about 500 papers along with an 8th parallel poster session track. An informal evening discussion panel is in the planning stage with a goal to explore the possible applications and benefits of enhanced voice and non-voice 3rd generation service offerings.

Boston is a popular tourist destination and a spouse program will run during the conference. The Seaport is just over a mile from Logan Airport on the waters edge and few minutes from downtown Boston. There is no place on earth more beautiful than New England in the Fall. Plan to come a few days early and stay and few days late to enjoy Boston at it's best.



Chapter News & Meetings

Gaspar Messina, Senior Editor

New VTS Chapter

As of May 15, 1998, the Vehicular Technology / Communications Society Joint Chapter of the North Italy Section has been formed later extended as joint Italy Chapter in August 1998. The Chapter Chair is Professor Francesco Vatalaro of the University of Rome, as elections have been held in October 1998. Details can be obtained from him at

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Three double lectures on Visual Communications were delivered by staff of Rensselaer Polytechnic early last year. Part I, on Image Coding was given by Dr. W. Papllan on February 17 and March 1, 1999. Part II on Video Coding, on March 3 and 22, was delivered by Dr. John Woods, and finally Part III, on Transmission, was given by Dr. I. Modestino on March 24 and April 19, 1999. All attracted 30 participants, including 15 guests.

On November 16, 1999, Mr. Kim Lockhead from EMR Canada spoke on GPS in Canada & D-GPS in real time to 18 attendees, including 10 guests.

Philadelphia, Pennsylvania

Their series of monthly meetings included on November 10, 1999 a talk by Mr. John LaForce from SEPTA on "A Positive Train Control System for SEPTA's Light Rail Tunnel" to a total of 48 people. Earlier this year, two speakers from SYSTRA Consulting gave talks. 27 people listened to Mr. Warren Sims on "Tren Urbano Rapid Transit System" on the 19th of January, while on February 9, 2000, 22 attendeed to hear Mr. Ed Bresslin speak on the Staten Island Railway Signal Modernization Project.

Tokyo, Japan

Dr. Masaharu Hata from NTTDoCoMo spoke on Recent Standardization and Development Activities toward the IMT - 2000 on November 25, 1999. 150 attended.

Mr. Sam R. McConnaughey from Matsushita Communications, America visited on April 14, 1999 to give a talk on Mobile Communications - The Past, Present, and Future to an audience of 250, including 150 guests.

Prof. Ogose from Kagawa University presented a report on VTC99-Spring in Houston, which was also co-author by Prof. Horikoshi from Gumma University, on August 26, 1999 to a meeting of 30, including 10 guests.

On December 9, 1999, Dr. Shunsuko Finjiwara from Railway Technical Research gave a talk on the On-Going JR MAGLEV Development. 20 people attended.

VTC2000-Spring Working Team Meetings have also been held about every two weeks during the past year.

Al Gross Awarded Edwin Howard Armstrong Achievement Award

The IEEE has announced that the Edwin Howard Armstrong Achievement Award for 1999 will be presented to Al Gross for his pioneering effort and outstanding contributions over a period of years in the field of interest of the Society. The Citation reads

"Lifetime achievement for pioneering efforts and the development of personal wireless communications systems."

This award presentation will be made to Mr. Gross at the International Conference on Communications June 18-22, 2000 in New Orleans, Louisana.

VTS Members Elected Fellows

The IEEE elected 248 Fellows as of the 1st of January 2000, ten of whom are members of the Vehicular Technology Society. Congratulations are due to :

Gaston A. Arredondo, of Lucent Technologies, USA, for contributions to and technical leadership in the development and world-wide deployment of wireless systems;

Leonard Joseph Cimini, of AT&T Labs, USA, for contributions to the theory and practice of high-speed wireless communications;

Michel J. Declercq, of the Swiss Federal Institute of Technology, Switzerland, for contributions to innovative design of mixed signal integrated circuits;

Mitsutoshi Hatori, of the University of Tokyo, Japan, for contributions in communication engineering and broadcast engineering;

Hirofumi Matsuo, of Nagasaki University, Japan, for contributions to the education, research and development of efficient power conversion, and switching power conditioning circuits;

Reuven Meidan, of Motorola, Israel, for contributions to terrestrial and satellite-based cellular radio communications;

Vijay K. Nair, of Motorola, USA, for contributions to development of low-power device and integrated circuits;

Soo-Chang Pei, of the National Taiwan University, Taiwan, for contributions to the development of digital eigenfilter design, color image coding and signal compression, and to electrical engineering education in Taiwan;

Nambirajan Seshadri, of AT&T Labs, USA, for contributions to theory and practice of reliable communications over wireless channels; and

Federico Tosco, of CSELT, Italy, for contributions and leadership in technologies and international standards for optical and wireless communications.

VTC2000-Spring

VTC2000-Spring will be taking place in Tokyo, Japan, around the time you receive this issue. A full report on the conference will appear in the next issue.

VTS Questionnaire

Due to space limitations, the results will now appear in the next issue.

13th December 1999 VTS Board of Governors' Meeting Report

A meeting of the VTS Board of Governors' took place in Atlanta on the 13th of December 1999. Present at the meeting were Kent Johnson, VTS President, who was in the Chair, along with Board of Governor members Charles Backof, Dennis Bodson, Bob Fenton, Bob French, Harvey Glickenstein, Mel Lewis, George McClure, Tom Rubinstein, Eric Schimmel, and Ray Trott. Also present were VTS Secretary Essam Sourour, Jim Worsham, about to take a position on the board, Roger Madden, Conference Board Member, Ed Reedy, IEEE Division 9 Director and Zafar Taqvi of the VTS Conferences committee.

Charles Backof, Treasurer, reported that the VTS is now worth one million dollars. The IEEE is pushing for the "concentrated banking system" for all conferences, where

all banking transactions are to be done through IEEE, and the Society is investigating this. Also, the IEEE requests society budgets to include 3% savings, which the VTS does.

Kent Johnson, President, gave his report. He announced that J.R. Cruz, Tom Rubinstein, John Gilsenan, Anil T. Kripalani, and James A. Worsham are elected as officers for the IEEE VTS for the period from 1/1/2000 to 12/31/2002.

There are still problems in IEEE TAB regarding the new financial model and IEEE branding. There was a vote in TAB for no confidence in the IEEE board of directors. In addition, TAB unanimously requested the IEEE to stop spending any more money on the branding issue. However, this request was rejected by IEEE.

Kent Johnson reported that James Irvine, the newsletter editor, had made some proposals regarding the VTS newsletter covering its size, subjects to be covered and financial matters. It was agreed that the VTS would cover travel for the newsletter editor at least once a year to attend the VTS BOG meeting, preferably during a VTS annual conference. There was also a discussion on how to support Gaspar Mesina in his role as chapter coordinator. There are no written procedures to form VTS chapters, but it was agreed to base something on guidelines the New Jersey section has on chapter formation. It was noted that chapters could be formed over the Internet, with emails and WebPages, and formation requirements will be chased up with the IEEE.

IEEE TAB has decided that the conference fees for life members should be equal to student members fees. This is already VTS policy.

There is a meeting April 7-8, 2000 for the IEEE publication editors: J. R. Cruz and James Irvine will attend. The IEEE will publish an online publication, IEEE Xplore™. Readers will be able to access IEEE documents cited in document. IEEE articles will be posted as soon as they pass peer review.

Dennis Bodson, Standards Committee Chair, reported that in the Rail Transit standards developed smoothly. Tom McGean and he are involved. The IEEE Standards Board is meeting January 2000 in Singapore and no problems are expected for the Rail Transit Standards. ITS Standards will be available for on-line subscription from the first quarter of 2000.

The Board agreed for the VTS to act as a sponsor of IEEE-ISTO 5001 1999, a standard developed for the automotive industry, through the IEEE-SA Standards process if request by the ISTO.

Bob Fenton, Convergence Fellowship committee, reported that Bob Mazzola is contacting major automotive facilities to raise additional applicants. He also reported that it is advertised in the IEEE student Journal. The Board approved a motion to provide the winners of any VTS sponsored Fellowship or Scholarship free 5 years membership in VTS and VT Transactions, if they get the basic IEEE membership.

Bob French, VTS representative to the **Intelligent Transportation Systems Council**, reported that Robert Barrett will serve as the second VTS representative. He is with JPL and has wide experience. The ITS council met in October 1999, with the first Transaction issue is coming out in March 2000. It has 17 member IEEE societies.

Mel Lewis, Conference Coordinator, reported that Zafar Taqvi will join the conference committee and help him in financial matters for future conferences. Also Jim Worsham will help him in past conferences that are not closed. **VTC 99 Spring, Houston**: the seed money was returned to the VTS and other organizations. The net surplus is about $107k. About $72k goes to IEEE VTS. **VTC 99 Fall, Amsterdam** was successful, and expects a surplus of about $9k. **VTC2000 Spring, Tokyo**: Conference proceedings will be available on both CD ROM and paper formats. They cut back on the number of papers due to the limited space. The advance program is ready and mailed to prospective authors and attendees. The expected surplus is $40k. **VTC2000, Fall, Boston**: A budget has been received and revised. The call for papers is sent out and it is on their website. It includes transportation area. They accept electronic submission for papers. **VTC 01, Spring, Israel**: They have signed for the hotel (Intercontinental Tel Aviv) and submitted a budget. A small delegation will travel to Israel and inspect the preparation. They are expecting most attendees from to come from Europe. **VTC 01, Fall, North Jersey**: The conference will be held in a convention center, using the IEEE conference service. They signed a contract with Sheraton Atlantic City, which is not a Casino hotel. **VTC 02, Spring, Guadalajara**: An answer is awaited from Guadalajara. Eric Schimmel proposed considering a Latin American country as a venue if we do not get a positive answer. **VTC 02, Fall, Vancouver**: The budget is awaited. **VTC 03, Spring, Korea**: A budget has been received, and they have quotes from two hotels. **VTC 03, Fall**: Local people have proposed holding VTC in Birmingham. They have been sent memorandum of understanding. Mel Lewis also reported that he updated the conference handbook and it will be on the VTS website.

Mel Lewis also reported on the **Education Committee**. He gave a presentation in an IEEE meeting for Web Education in Washington DC, organized by IEEE Educational Activities Department (EAD), where he gave a background about the VTS Web Education Course experience. The VTS is ahead of all other IEEE societies in this regard. The VTS has approved a peer reviewed course manuscript prepared by Pat Morreale from Stevens Institute. The course includes multimedia with multiple presenters, and links to other Internet resources. The cost of the course is expected to be about $300. The IEEE selected the VTS material to be a model template for IEEE Web based courses. When courses are developed, IEEE will provide brand recognition, advertisement and sales for the Web courses from its societies, and IEEE will share the profit. It was agreed to add a second $10k from the VTS to be spent at the discretion of Mel Lewis to finish the course. Udan Yao will join the VTS education committee to help with this project. It was noted that the IEEE Education Activity is asking for an ITS Web-based course as well.

Ed Reedy, IEEE Division 9 Director, responded to a invitation by Kent Johnson to talk about the IEEE Board of Directors. He noted that the IEEE budget was not balanced for 2000 because of additional items in the information technology area. The budget was approved after modifications, but new financial model was not approved. Regarding the branding issue, he noted that a long discussion took place in the Board of Directors. Most society presidents wanted the kite and the IEEE letters to stay the same. So far no changes have been decided.

Jim Worsham reported as a member in the conference committee, in charge of past conferences that are not closed. The only conferences that are open are VTC 99, Fall, and VTC 99, Spring, which is awaiting an audited financial report.

Tom Rubinstein, webmaster reported that the VTS website had 2000 hits since last meeting, and that he had attended the webmasters meeting in October. A digest of the VTS News is now available on the web site. He has also made a regular revision of new VTS member's material.

Eric Schimmel, representive to the CCIP and ITU, reported that the main CCIP activity is in the communica-

tion and information policy committee. They are heavily involved in Internet matters, and are studying possible scenarios for the future of the Internet. On ITU matters, he reported that the main issue is in the 3G wireless systems. The basic decisions have been taken by the task groups and will be submitted by the radio assembly for financial adoption. Some work will need to continue, and a new working party was adopted to continue the remaining work.

Ray Trott, Awards Committee Chairman, reported that the VTS submitted 17 nominees for the Millennium medal. He is looking for nominations for the Stuart Meyer award and recruiting volunteers to judge the best propagation and system papers awards. They will be awarded at VTC2000-Spring.

Harvey Glickenstein, Vice President for Land Transportation discussed the Sperry Board of Award. The board consists of two members from each of the member societies, including IEEE. There are some vacancies on the board.

The Board then discussed the society's perceived identity crisis, in that name of the society (Vehicular Technology) misrepresents the main interest of the VTS members. Roger Madden gave a historical background. In the 1950s, there was a group under the IRE umbrella called the Professional Group on Vehicular Communications. This was the origin of the VTS. In the sixties automotive electronics was a hot issue and the group changed its name to Professional Group on Vehicular Technology. In about 1973 the group was changed to a society, the VTS. The constitution of the VTS states that part of the society interest is in the terrestrial mobile communications. In about 1987 the land transportation group was incorporated to the VTS, leaving their previous home in the Industrial Electronics Society.

The process to change an IEEE society name is complex, and after some discussion it was decided to add a subtitle to the name instead. After a brain storming sessions with Board members suggesting and debating possible subtitles, the subtitle **"Connecting the Mobile World"** was the first choice.

Eric Schimmel took the chair for the final item of business, the election of officers. Kent Johnson was elected President for the coming year and J.R. Cruz was elected Executive Vice President.

Full minutes of this meeting are on the VTS web site.

21st February 2000 VTS Board of Governors' Meeting Report

George F. McClure

The meeting was chaired by President Kent Johnson. Others attending were Charles Backof, treasurer; Dennis Bodson, chairman of the Standards Committee; J. R. Cruz, VTS executive vice president and Transactions editor; Bob Fenton, Convergence Fellowship committee; Bob French, VTS representative to the Intelligent Transportation Systems Council of IEEE (consisting of 18 IEEE societies); John Gilsenan, recently elected board member; Harvey Glickenstein, VTS vice president for Land Transportation; Mel Lewis, VTS conferences coordinator; Bob Mazzola, VTS Long Range Planning committee and SAE liaison; George McClure, VTS Conferences Committee and publicity chairman; Sam McConoughey, elected board member; Tom Rubinstein, VTS webmaster and new member liaison; Eric Schimmel, VTS past president, Nomination Committee chairman, and representative to CCIP and ITU; Essam Sourour, VTS secretary; Ray Trott, Awards Committee chairman; and Jim Worsham, recently elected board member and member of the VTS Conferences Committee.

Treasurer Charles Backof reported that the Society is in sound financial condition and in a position to do more for its members. There was discussion about increasing the frequency of the Transactions to six issues per year. It is now running 2500 pages per year, but should be self-sustaining since it has a separate subscription fee. Board members were asked to help identify other projects for members. Expanding the VTS News is one option, now that it is once again healthy under its new editor, Dr. James Irvine. Moving $100,000 from the IEEE short-term investment fund to the higher-yielding long-term investment fund was discussed and approved before the end of the meeting.

President Kent Johnson reported on the meeting of the Technical Activities Board held the previous week in New Orleans. There was much discussion about waning industrial support for IEEE activities because the connection to the "bottom line" was not evident. But many tutorials are well-attended, because the return to the employer is more evident. Tutorials held in conjunction with technical con-

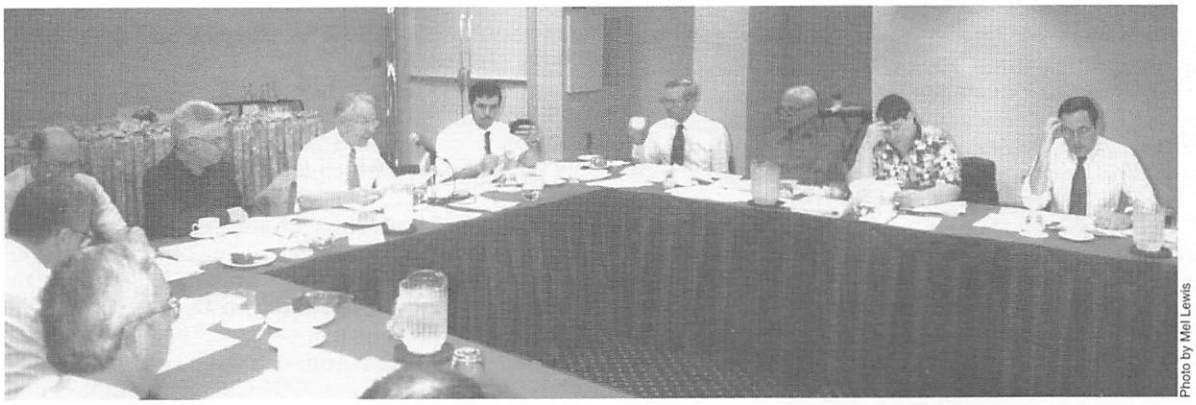

Photo by Mel Lewis

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ferences are often the reason a conference attendee gets approval to attend the conference. TAB encouraged conference exhibits as another way to get industry involvement.

Wireless communications is increasingly pervasive, in fixed as well as mobile applications. Understandably, various IEEE societies are interested in addressing the area from their point of view. Microwave Theory & Techniques Society has launched a new publication, "IEEE Microwave and Wireless Components Letters," over the opposition of the Antennas & Propagation Society. A TAB committee has been formed to discuss publication of an IEEE-sponsored periodical on wireless. J. R. Cruz will support Kent Johnson as VTS representatives to this committee, which includes the Communications Society as well as others.

There was discussion about how VTS could protect its claim to wireless technology. Gaining public awareness through advertising, and mentions in the trade press of such activities as standards, conferences, a calendar of events, notices of VTS-sponsored tutorials and other educational materials, and actions from meetings of the Board of Governors were suggested. Eric Schimmel and Jim Worsham agreed to contact trade publications for advertising rates. Eric Schimmel will compile a list of addresses for trade publications for use with VTS press releases. The wireless networking course being developed jointly by VTS and the Education Activities department will be advertised in the VTS News and in "Potentials", the student magazine. There is a tie-in to membership development here as well.

An e-mail reflector linking all VTS chapters was discussed as a means to improve chapter communications and services, better linking VTS to its chapters. An action item was taken to establish such a reflector. Kent Johnson will appoint a chairman to form a Membership Development Committee. George McClure will assist Gaspar Messina with chapter activities, including development of the Platinum Member concept, using retired members as mentors and as resources for special projects.

Dennis Bodson reported on a Singapore standards meeting. A new on-line subscription service for rail and ITS standards will start mid-year. Recent standards actions are shown on the VTS web site.

J. R. Cruz has retooled the process for papers review to make more steps electronic.

The Board of Governors extended its compliments to Dr. James Irvine for the excellent work he is doing on the VT News. He reports that the May issue should be 24 pages, +/-4 pages.

Bob Fenton has sent out 330 packages announcing the Convergence Fellowship.

Bob French announced that the ITS conference will be held in October in Dearborn, Michigan, back-to-back with Convergence. The ITS magazine has features that can be reprinted in the VTS News. The IVHS video developed earlier with VTS sponsorship has sold 178 copies. The Board approved $10,000 in funding for an update to the video.

Mel Lewis reported on the joint development of the Wireless Networking video course. Parts of the course are to be posted on the web at www.stevens-tech.edu. The complete course should be available by June.

Bob Mazzola mentioned that after the Convergence in October, VTS can reprint the new Convergence papers in the VT News without charge.

George McClure mentioned the possibility for use of the Chapters reflector to promote more programs with chapters, such as repeats of presentations of technical papers from conferences or talks by distinguished lecturers. He expressed interest in joining the Chapters Committee to help with this.

Sam McConoughey expressed concern over the apparent demise of the Propagation Committee, and urged that VTS work on other courses and book topics to be sponsored by VTS. Dennis Bodson agreed to check with IEEE Press on the possibility of reprinting the previous reprint book, "Land-Mobile Communications Engineering," or an update to it.

Tom Rubinstein reported that he had updated the VTS web site with Javascript. It now includes the VT Conference Handbook in PDF, chapter officer duties, etc., and a conference calendar update. The latter is important, since IEEE will not longer be publishing a paper version of the Technical Activities Guide. Tom reports that the site is running some 30 hits per day.

Ray Trott announced that the best papers awards would be announced in Tokyo. Millennium awards would be given during VT conferences in either Tokyo or Boston.

Bob Fenton moved that the chairman of the VT Fellows Committee appoint three other members to the Fellows Committee, although the VTS bylaws are silent on the point. The motion passed.

The next meeting of the Board of Governors will take place during the conference in Tokyo, on May 17, 2000.

Conferences of Interest

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

DATE	CONFERENCE	LOCATION	WEB PAGE
7-12 May 2000	17th World Telecommunications Congress and ISS2000	Birmingham, United Kingdom	http://www.wtc2000.org
9 May 2000	EMCFest 2000	Dearborn, MI	http://emc.eaton.com/emcfest2000.htm
15-18 May 2000	VTC2000-Spring	Tokyo, Japan	http://www.convention.co.jp/vtc2000s
17-19 May 2000	AFCEA/IEEE EuroComm 2000	CANCELLED	http://www.eurocomm.org/2000/
14-16 June 2000	3G Wireless 2000	San Francisco, CA	http://delson.org/3g/3gwireless00/
14-16 June 2000	2000 Virginia Tech Symp. on Wireless Personal Comms	Blacksburg, VA	http://www.mprg.ee.vt.edu
18-22 June 2000	Int'l Conference on Communications ICC '00	New Orleans, LA	http://www.icc00.org
10-12 July 2000	Wireless 2000	Calgary, AB	http://www.cal.trlabs.ca/wireless
10-13 July 2000	HF Radio 2000	London, United Kingdom	http://www.iee.org.uk/conf/HFRadio/
16-21 July 2000	AP-S International Symposium / Radio Science Meeting	Salt Lake City UT	http://www.caeme.elen.utah.edu/aps2000
22-25 August 2000	ISAP	Fukuoka, Japan	http://www.crl.go.jp/pub/ISAP2000/
10-13 September 2000	RAWCON '00	Denver, CO	http://rawcon.org
12-14 September 2000	European Wireless 2000	Dresden, Germany	http://www.comnets.rwth-aachen.de/Wireless2000/
18-21 September 2000	PIMRC 2000	London, United Kingdom	http://www.pimrc2000.com
24-28 September 2000	VTC2000-Fall	Boston, MA	http://www.vtc2000.org
1-3 October 2000	3rd IEEE Conf. on Intelligent Trans. Sys. ITSC-2000	Dearborn, MI	http://www.ewh.ieee.org/tc/its/itsc2000/cfp-itsc-2000.html
1-4 October 2000	Mobile Communications Summit 2000	Galway, Ireland	http://www.mobilesummit.ie/
4-5 October 2000	2000 European Conference on Wireless Technologies	Paris, France	http://www.eumw.com
4-5 October 2000	IV 2000 IEEE Intelligent Vehicles Symposium	Dearborn, MI	http://WWW.CE.UniPR.IT/iv2000/
16-18 October 2000	Convergence 2000	Dearborn, MI	http://www.convergence2000.org
6-8 November 2000	APWC '00	Waltham, MA	http://www.eece.unm.edu/apwc2000
12-15 November 2000	WPMC-2000	Bangkok, Thailand	http://www.tc.ait.ac.th/wpmc.htm
27 November – 1 December 2000	Globecom 2000	San Francisco, CA	http://delson.org/si/gc00/
17-20 December 2000	ICPWC '00	Hyderbad, India	http://www.citr.ece.uvic.ca/icpwc2000
20-22 February 2001	EPMCC 2001	Vienna, Austria	http://www.epmcc.com
6-9 May 2001	VTC '01/Spring,	Tel-Aviv, Israel	http://www.congress.co.il/ieee_new/
7-11 October 2001	VTC '01/Fall	Atlantic City, NJ	http://www.fallvtc2001.com/index.htm
Spring 2002	VTC '02/Spring	Region 9	
September 2002	VTC '02/Fall	Victoria, BC	mailto: bhargava@engr.UVic.CA
Spring 2003	VTC '03/Spring	Seoul, Korea	mailto:m.lewis@ieee.org

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.