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# VTS NEWS

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## FEATURES

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**[future.wireless@mobilevce.com](mailto:future.wireless@mobilevce.com)**



Equipped with an experimental fuel cell system to allow night time flight, the solar-electric Helios Prototype flying wing soars over Pacific. Tim Tozer discusses such High Altitude Platforms on page 4. (Photo NASA)

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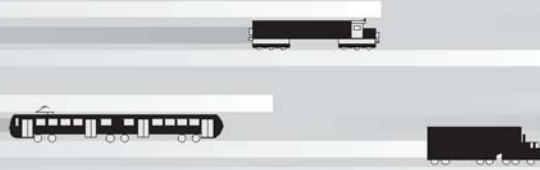
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## Foreword

James Irvine, Editor

The leafy English shires are not the location one would normally think of when considering the start of a rebellion. In fact, the uncomplaining 'grin and bare it' attitude is something of a national trait. All the more surprising, therefore, that the small but increasingly vociferous protest has recently turned violent. The victim – a mobile phone mast in Sutton Coldfield which was felled during the night by vandals.

The Sutton Coldfield incident is by no means the first such incident. Two masts were recently felled in Northern Ireland, and damage to equipment during mast erection has caused some operators to take a 'hit and run' approach to construction. However, it was the first to fit the headlines in the general media.

Mobile penetration in the UK is high, at about 70%. Roughly 8 in 10 households have at least one mobile phone, and a recent report concluded that practically every young adult has one. This increased demand has led to the deployment of more cells, and more carriers in existing cells. In addition, the deployment of 3G, GSM-R along rail routes, and a nationwide TETRA network has caused a backlash amongst the natives, with groups co-ordinated by sites such as [www.ProtectSurrexFromTETRA.org.uk](http://www.ProtectSurrexFromTETRA.org.uk)

Operators are fighting back by disguising their masts. 3G operator '3' has employed The Undetectables

([www.undetected.co.uk](http://www.undetected.co.uk)) to hide masts using film set techniques. However, campaigners are generally more concerned with possible health effects than aesthetics, and have seized upon a Dutch study<sup>1</sup> which exposed two groups of people, one consisting of people who reported sensitivity to radio-frequency waves, and a control group, to a 1 V/m field replicating GSM fields at 900 MHz and 1800 MHz, and also a 2100 MHz UMTS field. They found a statistically significant relation between the UMTS (3G) fields and feelings of well being for both groups. Interestingly, no such effect was seen for the GSM signals at 900 and 1800 MHz. Obviously, more work needs to be done to replicate these results and study any effects in more detail. In the UK, the Advisory Group on Non-ionising Radiation (AGNIR) is presently carrying out a review of all research published since the Stewart Report in 2000, which itself recommended a precautionary approach while more research was carried out. The AGNIR is due to report early next year, but in the meantime campaigners are arguing that the precautionary principle should constrain the deployment of masts.

Politicians are starting to take note, with restrictions being placed on siting masts near schools. However, that doesn't seem to be soon enough for some people. With such direct action being taken, operators will need to man their barricades.

<sup>1</sup>A P M Zwamborn, S H J A Vossen, B J A M van Leersum, M A Ouwens and W N Makel. *Effects of Global Communication system radio-frequency fields on Well Being and Cognitive Functions of human subjects with and without subjective complaints.* Netherlands Organisation for Applied Scientific Research (TNO). FEL-03-C148 (2003), available at [http://www.ez.nl/beleid/home\\_ond/gsm/docs/TNO-FEL\\_REPORT\\_03148\\_Definitief.pdf](http://www.ez.nl/beleid/home_ond/gsm/docs/TNO-FEL_REPORT_03148_Definitief.pdf)

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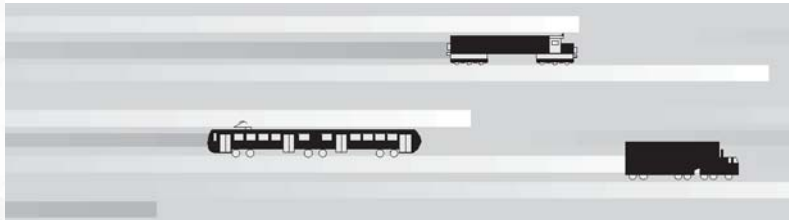
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For inquiries and orders, see telephone numbers above.





# High Altitude Platforms for Communications Services

Tim Tozer, University of York

High Altitude Platforms – HAPs – represent an emerging technology for delivery of communication services, including 3G and broadband. They offer a number of potential benefits, chief among which are the potential for rapid deployment, and very high spectral efficiencies and data capacity. There are several development projects worldwide, although progress to date has been limited. However, activity and interest is increasing, and current programmes involving airships, unmanned and manned airplanes look promising. Challenges remain particularly in the areas of energy storage, antenna technology, and regulatory constraints.

## Introduction

High Altitude Platforms – HAPs – are airships or airplanes operating in the stratosphere and capable of delivering services such as communications and remote sensing. By flying against the wind, or maintaining a tight turning circle, they can appear in a roughly fixed position. With the addition of suitable transponding payloads they may thus fulfil the role of either a very tall radio mast or a very low geostationary satellite [1]. The potential of this technology is fairly self evident, and HAPs have been a topic of interest and activity over about the past 5 years; however, viable commercial systems are still somewhat elusive. The limited rate of progress to date would appear due more to investor caution and market uncertainty than to fundamental technical impediments. But things are progressing rapidly, and a major upsurge of interest may be anticipated once some of the current programs succeed in firmly demonstrating the concept and, hopefully, economic viability.

HAPs operate at altitudes between 17 and 22 km (55,000 – 72,000 ft). This is comfortably above normal aircraft activity, but more importantly it is above the jet stream. Figure 1 gives a typical profile of wind speed against height, showing the relatively benign winds in this altitude region. Here craft can succeed in maintaining station keeping, flying against the wind without excessive power demands. At this altitude the platform and payload technology need conform only to aeronautical standards, and not to the more demanding space qualification requirements applicable to satellites. An important aspect of HAPs is that they should be capable of providing ‘long endurance’ services – either with craft which can stay aloft for extended periods, months or even years, or through regular platform substitution.

## Types of platform

Airships are one of the principal forms of HAP. These are unmanned semi-rigid or non-rigid structures, most likely helium filled, and deriving power from solar cells on their upper surface, which is used for propulsion (electric motors

and propellers) as well as for payload operations. Recent years have seen advances in envelope materials, using laminated layers of advanced polymers for low helium leakage and high UV resistance. Aerodynamic considerations dictate that these airships need to be very large to maintain station keeping effectively, perhaps up to 200 m in length, and this introduces a number of new engineering challenges. These can not be resolved simply by extrapolation from smaller airships, and full-scale engineering prototypes are required to be developed, each estimated to cost several \$10’s of millions. So major investment is needed for convincing demonstrations, and to date we have more artists’ impressions than actual airships (Figure 2).

Airships can provide ample prime power, with plenty to spare for the payload; however, energy storage, to maintain propulsion and hence station-keeping during the night, is another demanding issue. Fuel cells are being evaluated for this purpose, but represent a major challenge, especially in the harsh environmental operating conditions (e.g. temperature) at that altitude.

Unmanned solar-powered aircraft are the other main form of HAP. These can be also quite large, with wingspans to over 70 m, but they do suffer from very tight mass and power constraints and the problem of energy storage at night is even more acute than for airships. Once this can be overcome, craft may be designed for long operational endurance, with missions lasting months or even years without returning to earth.

Of course, manned conventionally fuelled aircraft can also be used, and these have no problems of energy storage.

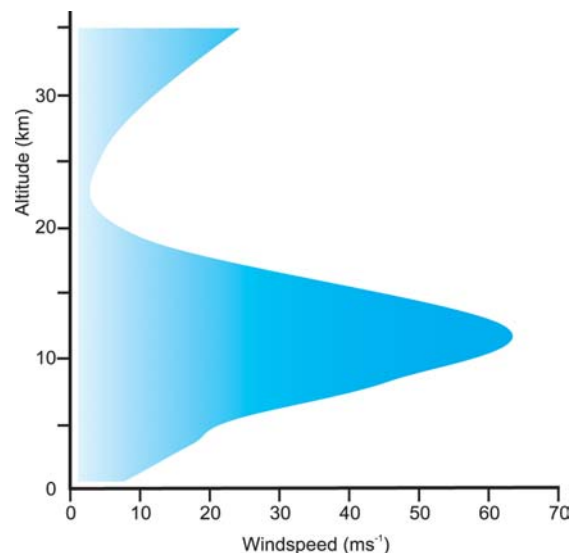


Figure 1 Typical windspeed profile with height



**Figure 2** Linstrand airship HAP

They represent an essentially established technology, even though the planes may need to be specially designed for this high altitude. However, shift operation is required, with other craft on standby and several crew altogether: superficially, the economics of this may appear less attractive.

Finally, there is the large category of traditional UAVs – Unmanned Aerial Vehicles. Ranging from small ‘model plane’ types through to much larger craft such as the Predator UAV, these are not usually designed for long endurance missions, and are unlikely to suit commercial communications requirements. UAV development is driven largely by military surveillance interests, rather than communications applications. However, a considerable number of companies and projects are involved in UAVs, commanding increasing investment and government funding. The UAV fraternity is becoming well organised, and already has various associations and interest groups [e.g. 2, 3]; recently a consensus seems to have emerged that HAPs now fall within their remit, and this should prove of benefit to HAP development overall.

### System architectures and features

From a HAP operational altitude, a communications coverage area of up to about 400 km diameter may be served, depending on the acceptable minimum elevation angle from the ground terminals. Figure 3 illustrates some service area examples for 3 HAPs with 5° elevation look angle. A more practical coverage zone may be around 60 km diameter for ground terminals with elevation look angle  $\geq 15^\circ$ .

Single cell coverage over such an area may be readily provided, for example for 3G in regions with sparse user density, or for low data rate emergency communications. However, it is relatively straightforward to deploy a number of antenna beams on the HAP to deliver a cellular pattern of services with frequency re-use. Such a cellular scenario also offers potential for greater flexibility than in a terrestrial system, and performance here is ultimately limited by interference from adjacent beams [4], rather than terrestrial propagation excursions. Figure 4 illustrates broadband services from a HAP, which might operate in the 47/48 GHz band (as allocated by the ITU), and employ typically 121 cells.

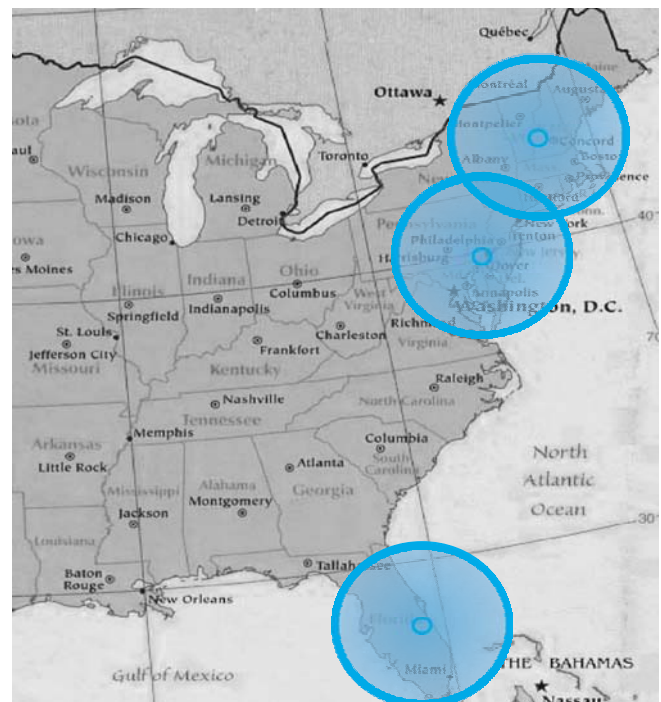
The link power budgets will depend on many factors, but are basically much more favourable than from a satellite. Small cell sizes can be achieved on the HAP; this permits dense frequency re-use and very high overall spectral utilisation. For example, analysis in the HeliNet project has shown the feasibility of a system with cells of 6 km diameter and aggregate data rates per cell well in excess of 100 Mbit/s. User data rates of up to of 120 Mbit/s may be accommodated using steerable ground terminals of only 20 cm or so diameter, while for lower data rates smaller fixed user antennas can suffice. Practical limiting factors include propagation losses, especially in the *mm*-wave bands where rain is highly significant, and interference from adjacent cells due to antenna sidelobe performance on the HAP.

Backhaul links may be provided to suitably located ground stations, possibly several which may also have their own backhaul cellular re-use pattern, to other HAPs, thus creating a network in the sky via *mm*-wave or optical links, or via satellite, which is useful for remote regions.

IMT-2000 (3G) type services can be readily provided from a HAP with a 3G base-station on board, and *mm*-wave backhaul links to the core network. Thus a HAP might serve to fill in gaps in network coverage, to cover large areas prior to establishment of full terrestrial coverage, or to supplement capacity for emergency requirements or for event servicing such as major sporting events. Facilities could also be provided to serve temporary migration such as August in the south of France or the HAJ in Mecca.

There seem to be no fundamental difficulties with direct 3G services from a HAP – unlike GSM there is no timing limit to constrain operational range. However, the range will at all times be in excess of 17 km, extending much further for large cells, and this may mean that signals are not always strong enough to provide good service within buildings.

An important feature of HAPs is their rapid deployability. Once the basic engineering design is established, it should be possible to procure new HAPs and payloads relatively quickly – certainly much more quickly than procuring new



**Figure 3** Illustrative service areas (3 HAPs, 5° elevation)

satellites or installing large terrestrial infrastructure. HAPs already designed or in service can have their payloads reconfigured or updated relatively easily. And prepared HAPs could be put on station in a matter of hours to service disasters and provide emergency communications and/or surveillance.

### Current and future activities

The past few years have seen a number of developments in airships, although emphasis has been traditionally on low altitude craft such as Zeppelin airships aimed at carrying passengers for tourism [5]. However the technology is increasingly being applied to HAPs.

Perhaps the most comprehensive program on HAPs and their applications is the Japanese government-funded SKYNET program [6] which is aiming towards an integrated network of up to 10 large stratospheric airships covering Japan and delivering a range of communication services including broadcasting, interactive broadband, and emergency communications. Figure 5 illustrates the concept. This has been progressing since 1998, and involves development of prototype airships in the 45 – 65 m class, with flight tests scheduled for 2003 - 2004. In addition to providing environmental observation facilities, telecom and broadcasting payloads and architectures are being developed in Japan by the Communications Research Laboratory (CRL) and the Telecommunications Advancement Organisation (TAO). Key features include on-board digital beam-forming (DBF) antennas in the 31/28 GHz band, multibeam horn (MBH) antennas in the 48/47 GHz band, and IMT-2000 services in the 2 GHz band, as well as digital TV UHF broadcast. Some of these payload elements have already been trialed successfully under Japan-US collaboration in 2002 using SkyTower's Helios craft (see below) operating at 20 km altitude.

Korea has a similar government funded program [7]. Working initially with a low altitude platform, a full size airship is planned for 2008. Communications technology is being developed in Korea by ETRI for services at 48/47 GHz as well as for 3G services.

The European Space Agency (ESA) is funding development of a HAP airship by Lindstrand Balloons of the UK in collaboration with Daimler-Chrysler Aerospace [8]. Using the term HALE (High Altitude Long Endurance) craft, this is aiming for five years continuous operation on station.

Also in the UK, Advanced Technologies Group (ATG) [9] has been working with airships for several years and has a number of airship partnership projects with other companies worldwide.

A potentially significant step forward in promoting the development for HAPs is the recently announced US government funded High Altitude Airships Advanced Concept Technology Demonstration (HAA-ACTD) [10]. This aims to demonstrate the engineering feasibility and operational concept of a large, unmanned, solar powered, stratospheric airship capable of flying for a year or more at 70,000 ft. It should serve as a multi-purpose platform for communications, reconnaissance, surveillance, and other military applications; however it is not clear that there are plans to explore the applications themselves at this stage. Key HAA-ACTD players currently include Worldwide Aeros, Lockheed-Martin and Boeing.

Unmanned airplanes are also making advances, and by far the leading programme here is Aerovironment's solar-powered Helios craft [11], see Figure 6. This 247 ft (70 m) wingspan plane is the result of considerable NASA support, and has demonstrated reliable operation in a number of trials from a test site in Kauai in the Hawaiian islands, including to nearly 30 km (96,000 ft). Basic daytime flight duration has been proven up to 17 hours, and this is being extended through use of hydrogen-oxygen fuel cells, with the ultimate goal of providing true long endurance missions of maybe months. At the moment open-cycle systems are used, consuming hydrogen fuel, but these may be replaced by regenerative fuel cells which recharge by solar power, and it seems that the energy system holds the key here to future progress and long endurance viability. Aerovironment's subsidiary, SkyTower [12], has used Helios, and a similar craft Pathfinder, in trials in conjunction with the Japanese. These employed off-the-shelf equipment on board the plane to successfully demonstrate the operational feasibility of various telecoms applications including High Definition TV and 3G mobile services.

A positive attitude towards the application of HAPs is being taken by the European Commission, which has supported the recently completed HeliNet project [13, 14, 15], involving some 10 European partners and funded by the IST (Information Society and Technology) 5<sup>th</sup> Framework initiative. A prototype solar powered airframe has been partially developed in conjunction with key elements of the power and propulsion systems, and detailed study undertaken of three applications: broadband communications; remote sensing; and navigation / localisation. The work explored key technology features and the viability of such services. It is anticipated that EC funding will continue with further HAP-related projects under the 6<sup>th</sup> Framework initiative, in particular the development of broadband communications including practical trials, and communication systems to support emergency / disaster scenarios.

Manned aircraft should not suffer so greatly from the HAP conceptual 'barrier to entry' problem, since they represent generally established technology. Angel Tech-

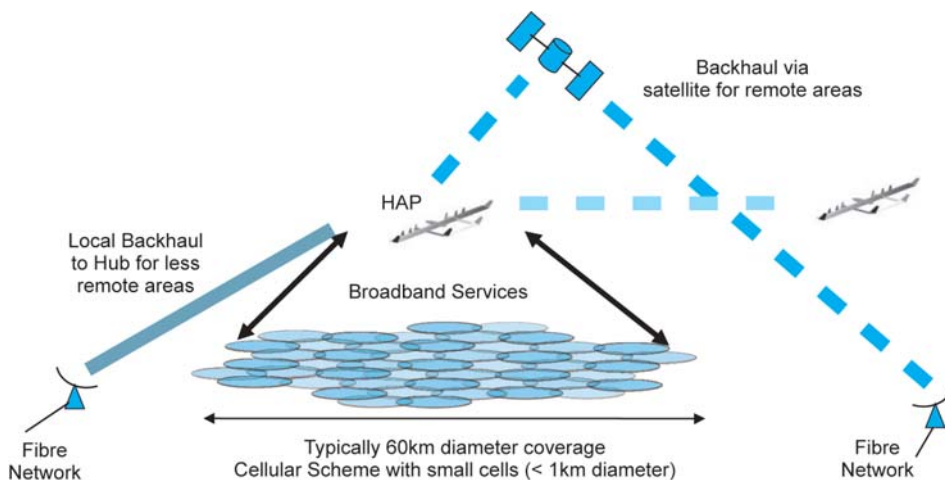


Figure 4 Illustrative broadband architecture



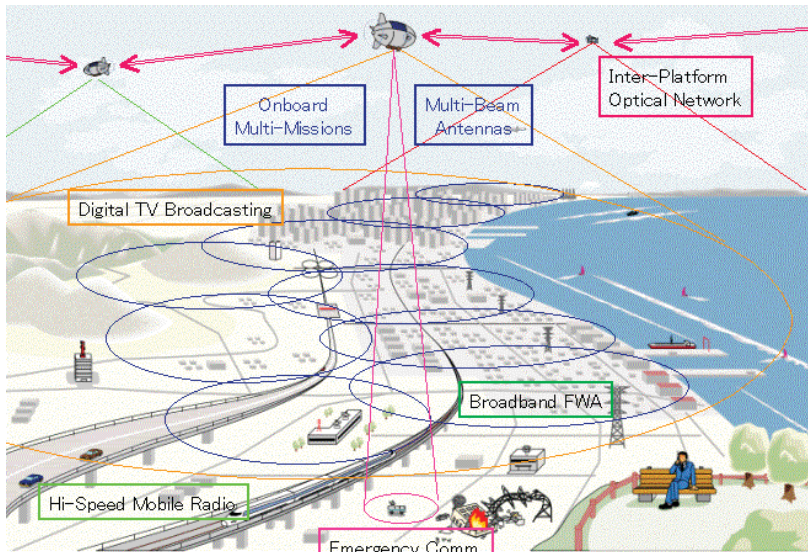


Figure 5 Japanese SkyNet concept



Figure 6 Aerovironment Helios HAP



Figure 7 M-55 stratospheric airplane

nologies' HALO Proteus aircraft [16] was specially developed a few years ago to deliver wireless services from HAP altitude, but little seems to have been heard of this venture recently. Meanwhile, there are plans to develop the use of an established Russian aircraft, the M-55, for delivery of wireless services and remote sensing [17]. This plane is designed to operate at 20 km (65,000 ft), and is well suited to fly such payloads – see Figure 7. With an on-station dwell time of around 5 hours, some 4 or 5 planes would be required to maintain continuous service. Proposals are being developed by Geoscan International in the UK for communication demonstrator trials (in collaboration with Motorola and the Universities of York and Bath), with potential support from the UK Dept. of Trade & Industry (DTI) and the EC Eureka programme. Among scenarios planned for demonstration programmes with the M-55 are:

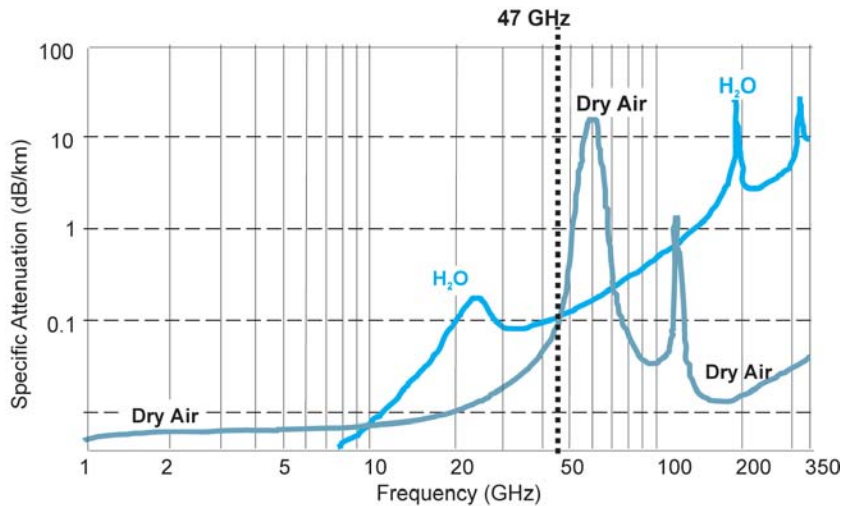
- ◆ **3G direct-to-user.** This might serve to cover gaps in service provision, or provide a rapid roll-out for new market entrants.
- ◆ **Backhaul provision for transportable 3G base stations.** These might be deployed for event servicing, with users affiliating to a local temporary base station on the ground, which would backhaul in a *mm*-waveband via the HAP.
- ◆ **Electronic newsgathering (ENG).** Highly portable lightweight video cameras could link directly with the HAP, probably in a *mm*-waveband, using antennas mountable directly on the camera and taking advantage of the favourable link power budget where a line of sight exists between a camera and a HAP at a range of maybe only some 20 km or so. This latter application is attracting the interest of media organisations, since it offers considerable benefits for news-gathering and event coverage.

## Key issues

There are a number of key issues which will determine the ultimate economic viability of HAPs for communications service delivery, and which represent ongoing research effort:

**Station keeping** A HAP needs to maintain its nominal position within some agreed tolerance limits, e.g. a cylinder of a few km dimensions, and this will be a function of its ability to cope with statistical variations in the wind. This will depend on its power resources, and inevitably there may be occasions when station keeping cannot be maintained. (ATG's StratSat proposes using an auxiliary diesel engine for extreme conditions, although fuel depletion will of course limit the mission endurance.) Detailed information on wind statistics at HAP altitudes is somewhat limited, and this may represent unproven territory for solar-powered craft. The resulting performance will determine the system availability and ultimate Grade-of-Service of any application.

**Energy storage** HAPs require sufficient propulsion to maintain station keeping during



**Figure 8** Radio spectrum: typical clear-air losses

the night as well as the day. For a solar powered craft this means batteries of some kind, presenting considerable challenge in terms of weight, energy efficiency and reliability. Hydrogen-Oxygen fuel cells appear the favoured solution, but their long-term viability and reliability remain to be proven, and they have a long way to go.

**Regulatory matters** HAPs present a headache to regulatory authorities who cannot easily fit them into existing categories. Are they planes? Are they satellites? Are they really tall masts? The answer seems to be not quite any of these. Although operating above commercial airspace, aeronautical regulations need to be observed in terms of tracking and collision avoidance, particularly on ascent and descent. It looks likely that the UAV fraternity may succeed in pushing the barriers here to establish a clear regulatory framework for operation of unmanned craft.

In terms of spectrum allocation, HAPs still present uncertainty. Broadband services especially require large bandwidth, and this is at a premium. Aeronautical allocations are inadequate to support any significant bandwidth, and any spectrum may well have to be shared with satellite users. HAPs also have evident potential to cause interference over a wide area. The ITU has specifically allocated limited spectrum for HAPs in the IMT-2000 band at around 2 GHz (shared with terrestrial), and much broader spectrum in the *mm*-wavebands (V-band) from 47.2 – 47.5 GHz and 47.9 – 48.2 GHz; this would be shared with potential satellite users. Such high frequencies represents about the upper limit of normal practical spectrum, just below the oxygen absorption region (see Figure 8). Not only is the technology expensive, but the band also suffers severely from rain losses. For this reason, at WRC2000 additional less demanding allocations were made available for some countries in Region 3 (Asia) of 27.5 – 28.35 and 31.0 – 31.3 GHz, on a non-interference basis. More recently at WRC2003 in June, it was agreed to extend those frequencies similarly to Region 2 (the Americas). This represents something of a breakthrough for the HAPs lobby, although it remains for other countries in Region 1 to sign up individually to what is a more practical band, and no doubt this will be the subject of much forthcoming pressure and debate in Europe.

**Propagation** Given the very high frequencies envisaged for use by HAPs, link performance is very much a function of weather and rain statistics. Figure 9 illustrates a typical required link margin vs. availability. For many uses it may be unrealistic to provide large margins, so means must be found

to accommodate outages: this implies some form of diversity technique. Space diversity may be achievable for backhaul links to widely separated ground stations, but will not solve the problem of rain fades on the user path. Time diversity solutions would appear to be the most promising, involving caching of traffic for the duration of outages; this may facilitate acceptable video-on-demand and some Internet services, but real-time voice communications may present problems. Detailed knowledge of rain fade durations is thus critical, and the types of service which may be offered most effectively will depend upon the local propagation environment. This may be bad news for tropical regions which ironically otherwise provide a favorable environment for platform operation in terms of stability of winds and high-elevation sunshine throughout the year.

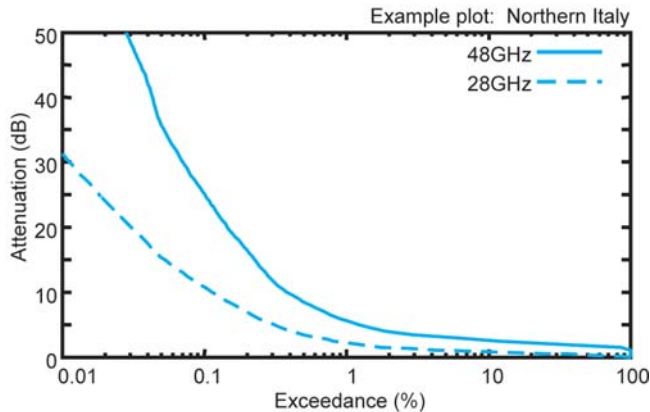
**Antennas** Antennas on the HAP are key to system performance. They need to be steerable to accommodate platform motion and displacement. And for broadband *mm*-waveband services they need to be able to project a large number of spot beams to provide dense frequency re-use cellular patterns, and to be flexibly configurable to respond to changing resource requirements. Planar phased arrays might appear an elegant solution, but tend to suffer from significant insertion loss and poor sidelobes – neither of which is suitable here, especially since capacity is likely to be limited by interference from adjacent cells, which is a function of antenna sidelobe performance. The high cost of developing good planar arrays for a non mass market is also an impediment. The most pragmatic solution looks to be an array of simple horn antennas on the HAP, despite weight implications and some lack of flexibility.

**Resource management and spectral efficiency** A HAP architecture is ideally suited to provide high capacity through flexible and adaptive resource allocation, managed from a common point, i.e. the HAP itself. This means putting bandwidth where it is needed, and includes techniques such as adaptive modulation and coding, to maximise capacity according to link conditions of fading and interference, adaptive beam forming, and traffic management. Such management can be applied readily and effectively to the entire HAP coverage area, without excessive communication overheads as might be the case for any terrestrial network. There is evidently considerable scope for advanced techniques here to maximise overall system throughput effectively, in the context of the wider communications network, and provide extremely high overall spectral efficiency.

## Further aspects of HAP services

**Network development** HAPs offer unique opportunities to develop networks in an incremental fashion. A single HAP can provide useful service, unlike LEO satellites which require a very large number for full availability. From the initial deployment of a HAP with perhaps one broad coverage cell, capacity may be built up in a straightforward manner through the division of the coverage area into cells with frequency re-use, which may be accomplished flexibly through the HAP antenna configuration. As capacity demands increase, additional HAPs may be deployed over the same broad coverage region, with discrimination through the use of directional antennas at the user terminals. Such a scenario will be highly subject





**Figure 9** Link margin and availability illustration

to interference, as a function of antenna beamwidths and sidelobe levels, but studies have shown how overall capacity may be extended in rough proportion to the number of HAPs deployed over a given region [18].

**Military applications** These are attracting increasing attention, and HAPs may be deployed rapidly over or close to a region of interest to provide communications and other services. Line of sight links may be established with tactical terminals on the ground, providing high data rate services direct to users; alternatively the HAP can support trunk backhaul links. In addition to terrestrial tactical services, standard commercial-type services (e.g. 3G) may be supported using COTS (Commercial-off-the-shelf) terminals, or the HAP might act as a ‘surrogate satellite’ to support miltatcom equipment. In the latter scenario especially, the relatively close range and consequent lack of need for high power transmissions means that users can enjoy much enhanced LPI (Low Probability of Intercept) than would be the case for operation via satellite.

**Surveillance and earth observation** In both military and commercial scenarios, HAPs also provide unparalleled opportunities for deployment of surveillance equipment, whether optical, infra-red or radar. The target range of maybe between 20 and 100 km is significantly closer than LEO satellite systems, permitting high resolution at modest cost. With the large power and mass budgets on many platforms, particularly airships, equipment may range from the very simple to the highly sophisticated. And of course equipment can be brought down for maintenance or updating readily easily. Images can be readily distributed with availability of wideband communication links, allowing services to extend into real-time monitoring of events, including road traffic management.

**Navigation and localisation** HAPs can support navigation and localisation services in a number of ways. While one might conceive of elaborate bespoke navigation systems based on a number of platforms, it is unrealistic to see HAPs as rivalling major established systems. More likely they would act simply as relays for differential GPS or Galileo signals by disseminating correction data over a wide area. It is of course also straightforward to employ direction-of-arrival techniques on a HAP, and these could serve to provide a stand-alone navigation service or to enhance a communications service. The latter may be especially valuable in an emergency scenario, providing both users and network controllers with accurate location information.

**Integrated services** It has been shown that a range of facilities and services can be provided from HAPs. Localisation, surveillance and communications systems can be

readily integrated, resulting in excellent ‘C3I’ (Communications, Command, Control, Intelligence) performance, whether for military / emergency use or for vehicular traffic management etc. This may mean that a HAP is likely to have more than one funding agency supporting its deployment. A further particularly interesting opportunity is that of TV and radio broadcasting, which is where the money often seems to be. Such multi-functionality can significantly enhance the overall economic arguments in favor of HAP development, even where doubts might exist about the viability of a particular stand-alone service.

## Final thoughts

In some respects, the evolution of HAPs and associated services resembles the early development of satellite communications in the 1960’s – it is certainly exciting times. There is considerable potential ‘applications pull’ coupled with steady technology developments and opportunity for creative system design. The next few years will hopefully see some significant demonstration projects coming to fruition, and increased investment leading to full commercial exploitation.

## Acknowledgements

Interest in HAPs is truly worldwide. Thanks are due to many colleagues for input and information, in particular those at York and in the HeliNet consortium.

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# System Comparison of Hybrid and Fuel Cell Systems to Internal Combustion Engines

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Increasing shortages of energy resources as well as emission legislation development is increasing the pressure to develop more efficient, environmentally friendly propulsion systems for vehicles. Alternatives such as fuel cell systems or hybrid propulsion are in discussion or have already been introduced.

This paper gives a survey on the present technical status of internal combustion engines, hybrid concepts and current fuel cell vehicles. Different solutions will be presented, so that an evaluation of advantages and drawbacks can be given. The further potentials of each concept, as well as combinations of different systems are discussed, and an outlook into the future is given.

## Introduction

The "Otto" engine celebrated its 125th birthday in 2001. In the face of increasing requirements for propulsion systems, discussions about replacing the well established internal combustion engine (ICE) by "unconventional propulsion systems" are on the way. Today, the best chances are attributed to fuel cell (FC) and hybrid electric (HEV) systems.

Internal combustion engines, hybrids and fuel cells are complex systems when used for vehicle propulsion. In order

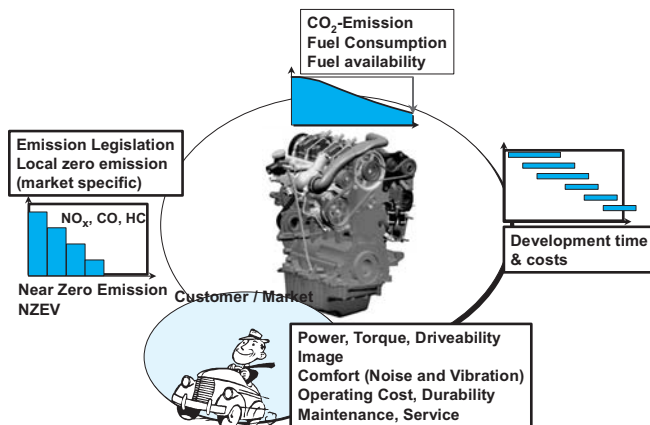


Figure 1 Future requirements for powertrains

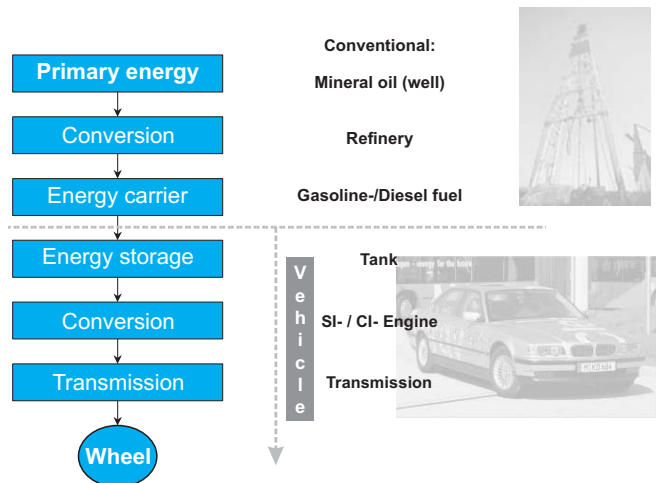


Figure 2 Energy process chain (vehicle)

to compare the systems it is necessary to identify for each system:

- ◆ Motivation for introduction: i.e. the expected benefits
- ◆ Technical challenges
- ◆ Development potential for the future

Motivation for changing the propulsion source can only arise from the requirements for such systems. These requirements, as shown in Figure 1, are driven by legislation and customer needs and often lead to competing targets. Up to now, the internal combustion engine has served as the best compromise among the different targets.

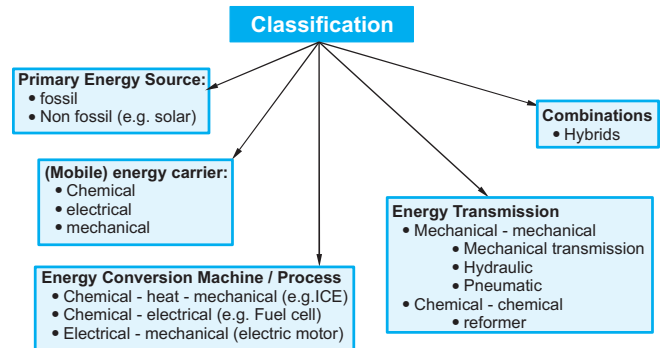
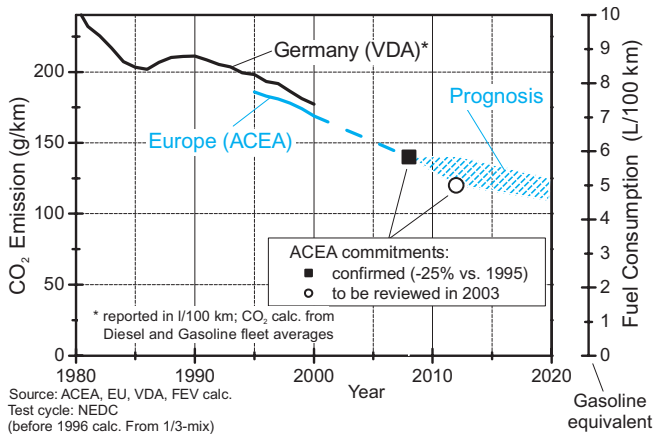


Figure 3 Classification of unconventional vehicle propulsion systems





**Figure 4** Fuel economy and CO<sub>2</sub> emissions of new passenger cars (fleet average)

Major arguments justifying the development of alternative propulsion systems are:

- ◆ Local zero emission legislation (e. g. California)
- ◆ CO<sub>2</sub>-reduction targets
- ◆ Fuel availability: usage of alternative fuels

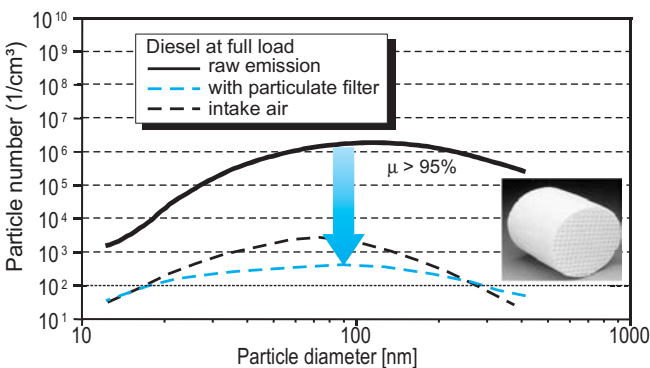
When changing to different fuels the whole chain (“well to wheel”) has to be included in the “system” in order to obtain a valid comparison, Figure 2.

Following the energy chain different criteria can be identified to categorize unconventional propulsion systems, Figure 3. In the following benefits, challenges and potentials of the ICE, HEV and FCV shall be discussed.

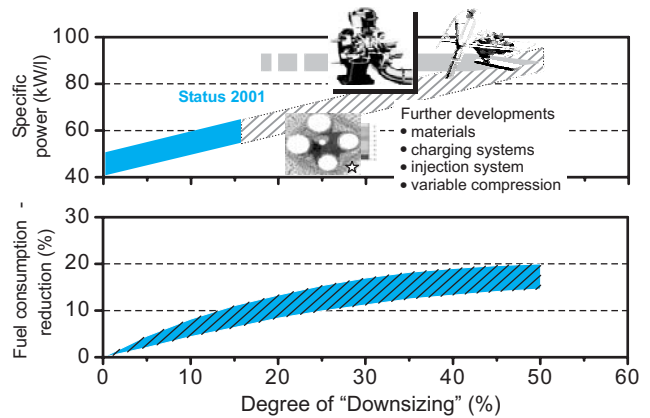
### The Internal Combustion Engine

The internal combustion engine has come a long way since its industrialization in the beginning of the last century. Today, the SI-engine is able to fulfill the NZEV emission standards of California, where, depending on the air quality, the exhaust gas can be cleaner than the intake air.

In addition, much has been achieved in Europe to improve fuel economy and thereby reduce CO<sub>2</sub>-emissions, Figure 4. Extrapolating the current trend of fleet average, future CO<sub>2</sub>-targets of 140 g/km and 120 g/km in 2008 and 2012 respectively seem reachable. However, much of this has been achieved by increasing the market share of modern DI-Diesel engines in passenger cars. Further increases are expected to lead to Diesel car shares of more than 40 % by the year 2005.



**Figure 5** Exhaust gas aftertreatment using particulate trap (Diesel engine)



**Figure 6** Potential of downsizing: DI Diesel engine (passenger cars)

The major challenge for the Diesel engine is to reach the emission level of modern SI engines, without sacrificing its excellent fuel economy. This seems possible with measures like:

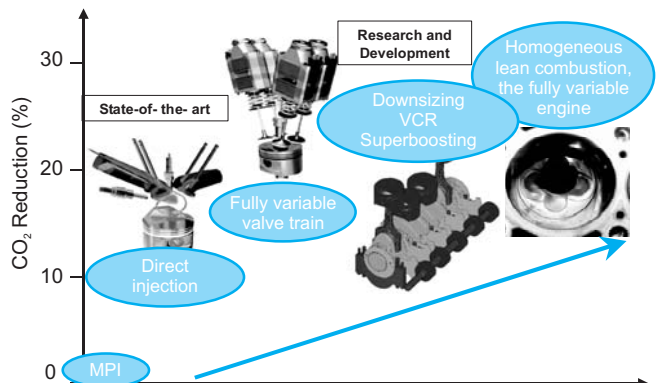
- ◆ Improved injection systems, high EGR (cooled / uncooled).
- ◆ Partly homogeneous combustion.
- ◆ Advanced after treatment systems (such as particulate trap and NO<sub>x</sub>-catalyst).

The first cars with particulate traps have been introduced in Europe and they have the potential to reduce the exhaust particulate level below that of ambient air in cities, Figure 5.

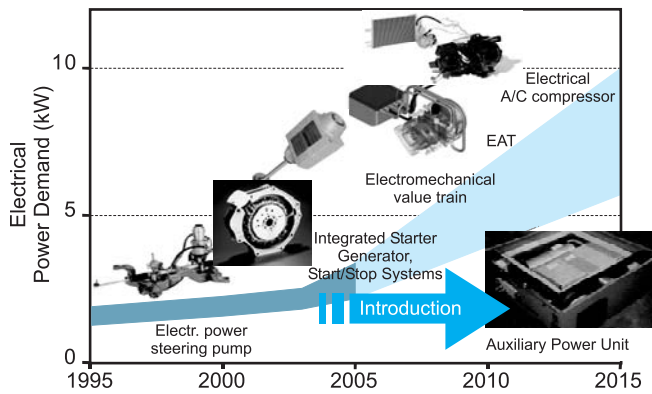
In addition, Diesel engines have the potential for further improvement of fuel economy. This will mainly be achieved by downsizing, which is possible by increasing the specific power output. Figure 6 shows, that by this a further improvement of up to 20 % in fuel economy can be achieved. For this, development of materials, injection systems, charging systems and possibly the introduction of variable compression will be necessary.

While SI-engines have reached an excellent level of pollutant emissions, their fuel economy has to be improved considerably. Compared to Diesel engines the SI-engine has about 35 % higher CO<sub>2</sub>emissions. With the introduction of

- ◆ Direct injection
- ◆ Fully variable valve train systems
- ◆ Downsizing, with variable compression
- ◆ Homogeneous lean combustion, controlled auto ignition



**Figure 7** CO<sub>2</sub> reduction - Trends in gasoline engines technologies



**Figure 8** Development of the electrical power demand - the mechatronic powertrain

a reduction of CO<sub>2</sub>-emission by up to 25 to 30 % will be possible, reaching fuel economy levels of today's Diesel engines, Figure 7.

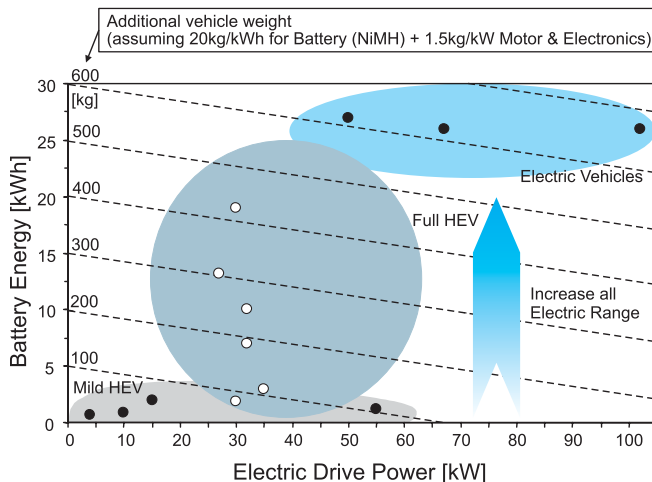
Eventually this will lead to the fully variable engine where more and more mechanical-only systems of the past are replaced by mechatronic, variable components. This, together with other electric consumers on the vehicle side, will result in a rapid increase of the electric power demand in the vehicle, for Diesel as well as gasoline engines, as shown in Figure 8. This will make the development of more efficient devices for electric power generation necessary – the fuel cell as an auxiliary power unit (APU) is one possible solution for this.

### Hybrid Systems

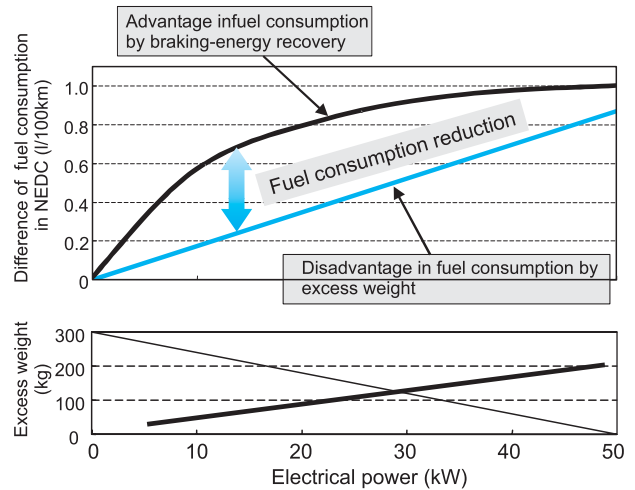
Today hybrid electric vehicles (HEV's) are commonly understood as vehicles combining combustion engines and electric motors for vehicle propulsion. The motivations for hybrid propulsion systems are:

- ◆ Local zero emission (all electric driving)
- ◆ Reduced fuel consumption/CO<sub>2</sub>-Emission by:
  - ◆ Brake energy recovery
  - ◆ Start/stop operation
  - ◆ Operation point shifting
  - ◆ Engine downsizing by: Launch assist/power assist

How much today's and future hybrids can contribute to these targets will be discussed in the following section.



**Figure 9** Hybrid electric vehicles - battery energy vs. electric drive power



**Figure 10** Fuel consumption improvement by braking energy recovery in the NEDC

### Local Zero Emissions

Local Zero Emissions are evaluated by the all electric range (AER) the vehicle can achieve, which is appreciated by the Californian zero emission legislation. Although a certain minimum of electric drive power is necessary, the all electric range is primarily a function of battery capacity. Battery capacity and electric motor power are shown for various production and concept electric vehicles in Figure 9. Depending on electric power and battery capacity one can distinguish between

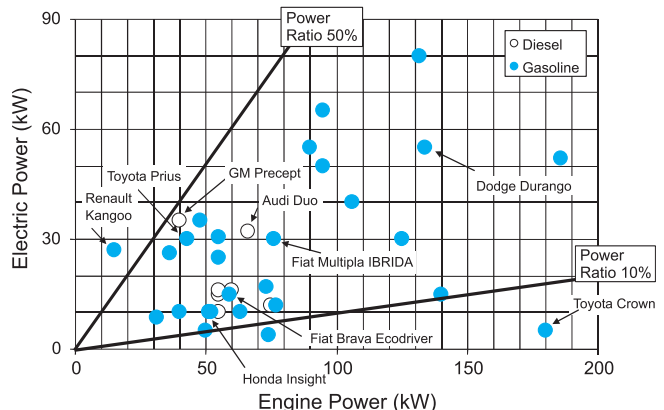
- ◆ Mild hybrids,
- ◆ Full hybrids,
- ◆ Electric vehicles.

Assuming competitive values for specific weight of battery (20 kg/kWh) and electric motor/power electronics (1.5 kg/kW) lines for constant additional vehicle weight are included in the diagram. Battery capacity, which is the dominant factor for the all electric driving range, is the major contributor to vehicle weight increase.

Additional vehicle weight, in return, has an adverse effect on fuel economy. A drawback of about 0.4l / 100kg can be expected. Cost increase runs in the same direction. Therefore, a large all electric driving range will not be suitable for mass production unless battery technology is improved considerably.

### Brake Energy Recovery

Brake energy recovery is one major potential of fuel economy improvement to be achieved by hybrid operation. Here,



**Figure 11** Hybrid vehicles: electric vs. engine power



moderate electric motor power with low battery storage capacity is sufficient to achieve considerable benefits. Even though mild hybrids with a ratio of battery capacity to electric power of 1/20 kWh/kW are sufficient, the weight increase with increasing electric power is considerable. Therefore the total achievable benefit can only be increased up to a certain extent, as shown in Fig. 10. Depending on the system layout, the maximum electric power is in the order of 10 to 30 kW for typical compact cars.

### Operation Point Shift, Start Stop

Shifting the operating point by discontinuous engine operation near the optimum efficiency and storing the excess energy in the battery will theoretically lead to large improvements in efficiency. However, the drawbacks are as follows:

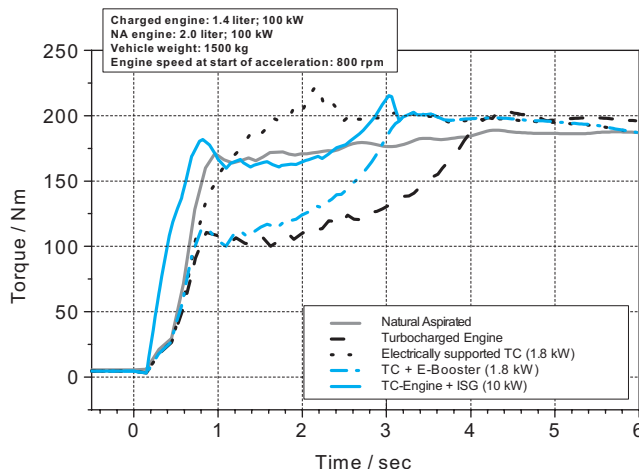
- ◆ Any operation point shift to a point with equal power can be achieved through a transmission as well: CVT, automated manual gearbox (ASG) and high gear ratio concepts do realize this in a more conventional way. Eventually the hybrid becomes an electric transmission
- ◆ Operation of the engine close to best efficiency will require an energy storage with a large storage capacity or frequent start/stop of the engine
- ◆ Most SI-engine concepts to improve engine fuel economy do already address the part load efficiency, thereby reducing the benefit of operation point shifting.

### Power Assist, Launch Assist

Part of the motivation for parallel and power split hybrids was often to reduce the engine size and power by installing electric power. Figure 11 shows the electric power versus engine power for various hybrid vehicles. Even though a clear correlation can not be detected, it becomes obvious, that many concepts use the electric motor to reduce installed engine power. However, when seriously considering customer requirements this is not generally acceptable, in particular for conditions such as

- ◆ high speed driving (especially Europe) and
- ◆ gradeability,

where full power is needed for a long period of time. In the case of reduced maximum engine power the maximum speed would be reduced after continuous operation due to limitations in battery storage capacity. Only in special re-



**Figure 12** Comparison of torque response during vehicle acceleration

stricted applications like city-only driving will a reduction of engine power be acceptable.

However, power assist/launch assist-concepts can be used to improve fuel economy by compensating performance losses of engine downsizing concepts. Such downsized, highly turbocharged engines are able to achieve the same engine power as the original full size engine, but normally suffer from insufficient low-end torque. This disadvantage, primarily apparent under transient operating conditions, can be compensated for the best by electric drives (e.g. ISG, E-Booster) as shown in Figure 12.

In summary, local zero emission and CO<sub>2</sub>-reduction potential make hybridization very attractive. However, the weight and price of electric components (battery, electric motor) limit the extent of hybridization to small electric powers. Development effort is necessary regarding:

- ◆ Weight
- ◆ Cost
- ◆ Battery durability.

### Fuel Cell

Just like the hybrid vehicle the fuel cell's target is to achieve:

- ◆ Local zero emission (depending on fuel)
- ◆ Better fuel economy/CO<sub>2</sub> emission (particularly at part load/stop & go)

The acceptance of the fuel cell zero emission propulsion depends on the fuel used. Looking at the recent history of fuel cell vehicles one can see that almost all vehicles are driven by hydrogen as a fuel, Figure 13. This will ensure zero emission acceptance but illustrates the biggest current hurdle of the fuel cell: there is no fuel for a simple low temperature fuel cell available. With available fuels, including methanol, complicated reformers are necessary and they cause well-known start-up and transient problems.

The fuel economy benefits of fuel cell vehicles are dominant under part load conditions. This relates to the kinetic and diffusion type process in the fuel cell where losses increase with increasing current. Besides the fuel cell itself the periphery, in particular the air supply and humidification systems, have a significant impact on efficiency. The influence of different charging systems on efficiency of a hydrogen system is shown in Figure 14.

Optimized charging systems are ideally combined with a humidification system, where the temperature rise in the compressor is used to evaporate the water, Figures 15 and 16. Internal cooling leads to compressor efficiency improvement of several percentage points.

Even though the fuel cell has made improvements with respect to weight and cost, it is still a long way from being competitive with today's internal combustion engine. Status and future targets are shown in Figures 17 and 18.

With hydrogen availability and reformer systems for transient operation being far in the future, the introduction of mobile fuel cells is most likely to occur as auxiliary power units (APU), Figure 19.

These APU's can be used to supply electrical energy for:

- ◆ Engine accessory drives,
- ◆ Air condition etc., also during engine shut off,
- ◆ Power & launch assist,
- ◆ Electric power supply for HEV's.

### Conclusion

Considering the status and potential of the different propulsion technologies, the following fuel economy bene-

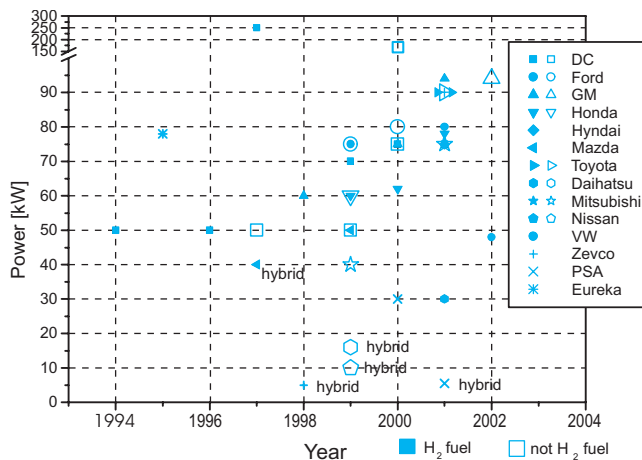


Figure 13 Published fuel cell vehicles since 1990 [8]

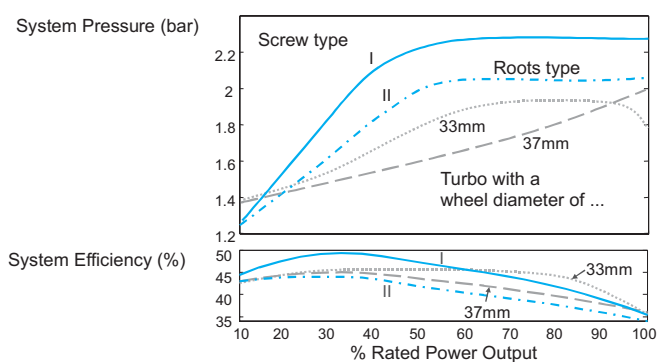


Figure 14 Comparison of pressure strategy and system efficiency with various charging concepts (H<sub>2</sub> system) [9]



Figure 15 Water injection into the compressor [9]

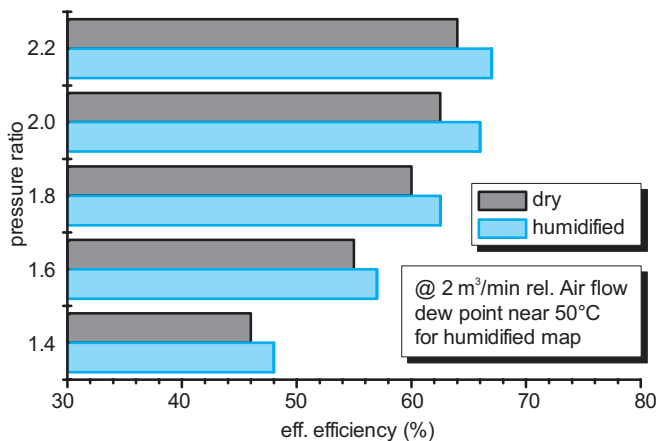


Figure 16 Efficiency comparison – dry and internally humidified compressor

fits with respect to today's MPI Gasoline engines can be expected:

- ◆ ICE (Gasoline): a potential for fuel economy improvement of 25 – 30 %, including transmission concepts appears feasible in the next 10 to 15 years.
- ◆ Hybrid: with start/stop and brake energy recovery an improvement of 20 to 25 % should be possible. Further market introduction of hybridization will expand from lower to higher electric power installation. Market penetration can be expected up to a level where additional overall costs are balanced by the benefits of the technology in comparison and competition to more conventional approaches.
- ◆ Fuel Cell: No statement can be made including all the fuel processing. At this point a major reduction in overall energy consumption and CO<sub>2</sub>-emission needs high development efforts, but can be expected based on fossil fuel comparison. Vehicle equipment in terms of components will have at least the same level compared to standard vehicles.

The question arises whether the combination of systems makes sense and what the combined benefits are. As stated above previously, benefits can not be added generally, since they address similar losses (e. g. part load FE), but in many aspect synergies do exist between technologies. By adding

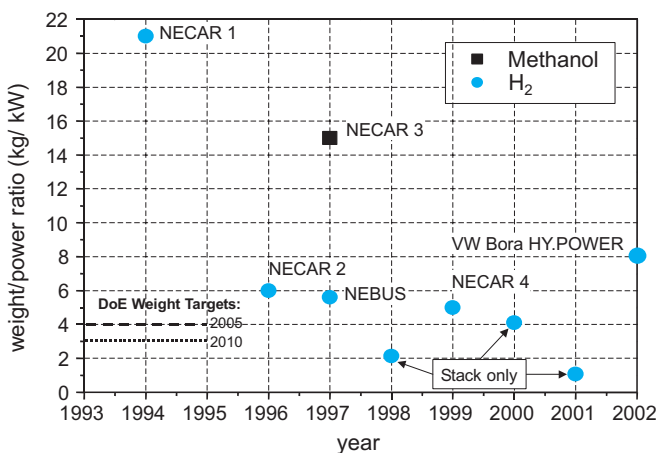
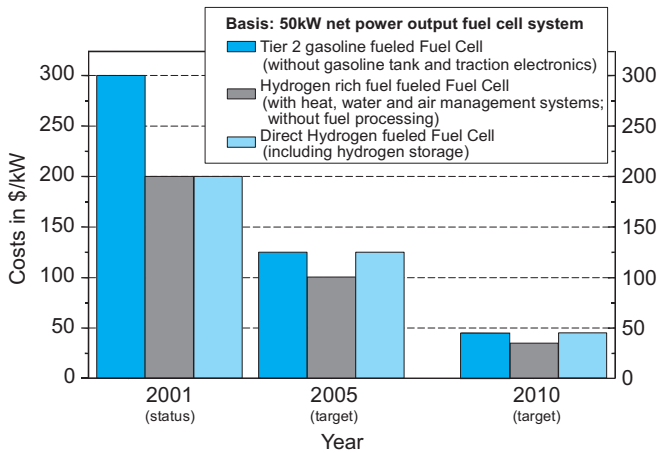
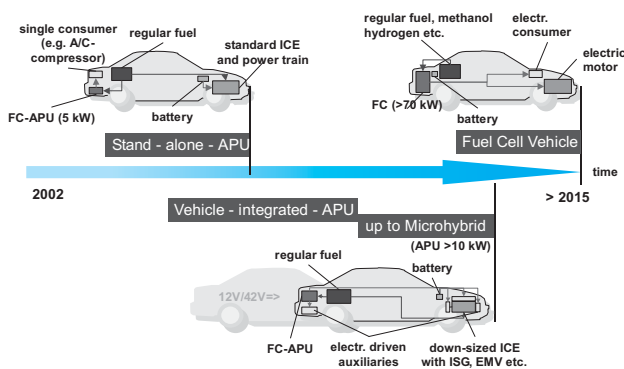


Figure 17 Specific weight of fuel cell systems [10]





**Figure 18** Costs of fuel cell system components [12]



**Figure 19** Fuel cell systems series introduction – from APU to fuel cell vehicle

hybridization plus fuel cell systems to future IC engines one could envision a propulsion system as follows:

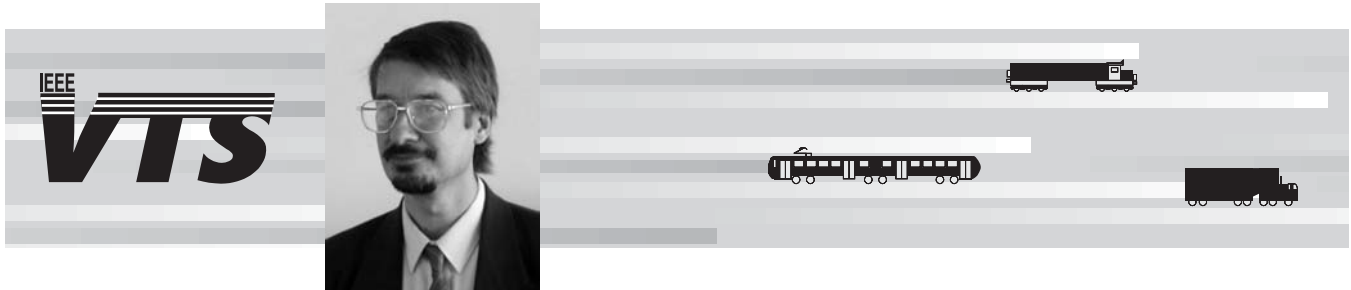
- ◆ a variable, mechatronic, downsized SI-engine with advanced combustion systems,

- ◆ a mild hybridization for brake energy recovery, dynamic assistance, and moderate all-electric range (AER),
- ◆ a fuel cell for efficient electric energy generation to supply auxiliaries and low speed driving.

A total fuel saving of up to 40 % could be expected from such a combined system, based on today's MPI gasoline engine. Their market acceptance is very much dependant on a cost-effective production. Until then just smaller areas, where local zero emission plays a dominant role, will be served.

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Walter Tuttlebee, Executive Director, Mobile VCE

The shape of future mobile and personal communications may not be the simple generational shift that characterised past transitions. In October 2003 the ITU-R Working Party 8F, responsible for 'IMT2000 and Systems Beyond' hosted a Workshop on Services & Market Aspects, jointly organised with Mobile VCE, to consider such issues [1]. In this article Walter Tuttlebee describes the role of Mobile VCE and its research programmes. An important aspect of this is the way that the differing regional perspectives on the future held by its member companies shape Mobile VCE's own industry-led research programme, which aims to enable new services and revenue streams for the industry.

### What is Mobile VCE?

Mobile VCE – the Virtual Centre of Excellence in Mobile & Personal Communications – is a not-for-profit company, established as a joint initiative of the mobile communications industry and leading research universities in 1996. Initially a national initiative, Mobile VCE today has a global industry membership base and its research is having international impact.

The sustained involvement of member companies from Asia, America and Europe means that Mobile VCE is unique in undertaking an integrated industry-driven research programme, which accommodates diverse perspectives of '3G/4G'. This permits the identification of new synergies between these approaches which would otherwise be overlooked.

The innovative nature of the organisation provides companies with a unique environment for the development of shared visions and with a highly cost-leveraged approach to industry-led academic research, supporting the future development of the wireless telecoms industry. This brief introduction to the company – its origins, its objectives, its membership and its modus operandi – is complemented by an overview of the evolution of its research priorities at a

time of significant change, as the industry begins to implement 3G services and systems.

Mobile VCE offers to its industry members a range of benefits including *inter alia* high financial gearing of research funding, a favourable IPR arrangement, ready access to highly talented academic research teams and opportunities to exploit research spin-off for shorter-term objectives.

### Origins & Objectives

Historically the mobile telecoms industry, like others, viewed research as something to be undertaken by company research departments or subcontracted to universities. In Europe collaborative research with universities utilised mechanisms such as the Framework programmes (RACE, ACTS, IST, etc) [2]. The apparent dichotomy between the long-term academic research culture and the short-term development-focused mentality of industry is well recognised. It was from this background that representatives of the mobile phone industry began to explore alternative models as part of the UK Government's Foresight exercise in late 1995. At that time companies were placing direct research contracts with Universities, but such work was often uncoordinated and disconnected from mainstream industry thinking. From this came the concept that something more effective and substantial could be done together – but what?

By late 1996 ideas had clarified and a nucleus of industry players had coalesced around the idea which subsequently became the Virtual Centre of Excellence in Mobile & Personal Communications – Mobile VCE. The emerging concept was for a 'virtual company', funded by industry, pioneering an industry-steered programme of research, undertaken by integrated, but geographically-dispersed, research teams drawn from the country's top universities specialising in mobile telecoms research. Mobile VCE was thus proposed as part of the Foresight Challenge competition. Clear industry support and the evident benefits of the proposed approach were key factors in the subsequent Government decision to award Foresight funding, which led to the formal establishment of the company in November 1996.

Mobile VCE's strategic objective is to facilitate industry growth, through pioneering long term research directed by shared industry vision, and, within this framework, to create commercially valuable IPR relevant to mobile / wireless communications for its industrial members and, most importantly, with their active involvement. The motivation, creativity and collaborative approach of the research teams, matched by the commitment of the major industry players, has created a momentum and environment that encourages open participation from the mobile telecommunications companies – perhaps one of the key factors in its success in anchoring the research into industry evolution.

BAE Systems	BBC	Crown Castle
Degree2 Innovations	Fujitsu	Hutchison 3G
Inmarsat	Independent Television Commission	Lucent
NEC	Nokia	Nortel
Orange	Panasonic	Philips
Radiocommunications Agency	Samsung	Siemens
SK Telecom	Sony	Thales
Toshiba		Vodafone

Table 1: Industrial Members of Mobile VCE, FY2003

- ◆ Industrially Relevant, Long Term, Research – defined and steered by the industrial member companies
- ◆ Highly Cost Effective – due to the significant Financial Gearing of Members’ Subscriptions (See Figure 1)
- ◆ Intellectual Property – royalty-free access to the IPR portfolio is available to full industrial members
- ◆ Short Term Technology Spin Offs – structures in place for commercial exploitation
- ◆ Elective Research Opportunities – funded by a single company, or by a small group of companies on a shared-cost, shared-benefit, basis, to address specific R&D needs outside of the Core programme
- ◆ Development of Company Staff – through working alongside highly competent academic researchers
- ◆ Recruitment – access to identify and recruit leading academic research talent
- ◆ Networking – to identify and shape, with industry colleagues, the trends which will influence the short and long term

Table 2: Benefits of Industrial Membership

University of Bristol	University of Edinburgh	Kings College London
Royal Holloway College	University of Strathclyde	University of Southampton
	University of Surrey	

Table 3 Academic Members of Mobile VCE

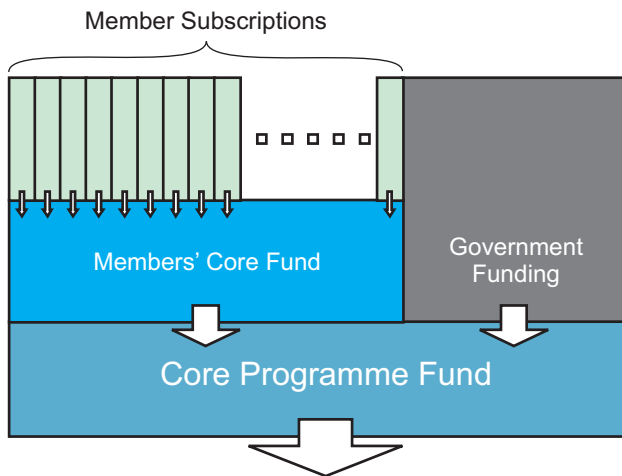


Figure 1 High Financial Gearing: The Core Research Programme is funded by the aggregation of members’ subscriptions, further augmented by Government support

## Membership

Industrial Members join Mobile VCE on payment of an annual membership fee and acceptance of the Memorandum and Articles of Association of the company, and upon signing a Deed of Adherence to the company’s IPR Agreement. In 2003 Mobile VCE had 23 industrial members, including many top international players in the mobile telecommunications industry – see Table 1 – each paying an annual subscription of £36k / £72k, for Class 1 / Class 2 membership respectively. Members’ annual subscriptions sustain ‘Core’ research programmes, with membership viewed as a long-term commitment, rather than simply as a one-year decision; the costs, taken over a typical Core Programme period of 3-4 years, are however remarkably low compared to the benefits.

Mobile VCE delivers value to its Industrial Members in many ways, the main ones being summarised in Table 2. As noted earlier, the philosophy of Mobile VCE ties its research into industrial reality – the contribution of the in-

dustry staff, whilst relatively low in terms of manpower, is crucial in shaping the direction and value of the research. Different companies choose to participate with different levels of manpower, with those who play a more active role deriving proportionally greater benefits.

To date Mobile VCE has generated approaching 40 patent applications, of which 4 have reached the grant stage (3 European and 1 USA); 18 others have progressed to the national/regional stage. Industrial members have royalty-free exploitation rights to this IPR. A comprehensive library of technical reports is delivered each year on CD-ROM, covering all aspects of the Core Programme. This is complemented by a series of Members’ Technical Seminars, providing opportunities for a much broader base of staff from Member companies to be familiarised with the results, tools and resources available to them through Mobile VCE. Raw data and processed results from propagation research campaigns (SISO, SIMO and MIMO) are also available to members, as are software tools relating to multimedia traffic planning, channel models and other topics.

These membership benefits are seen as of varying importance by different members, reflecting their size, position and role in the industry. For some companies membership provides a highly cost-effective means to monitor new research directions, threats and opportunities across a wide field, without the need to fund large in-house research activities. For others, quite the converse is true – the programme of Mobile VCE is used to inform a larger internal programme, to help shape its strategic direction. Another group sees royalty-free access to the growing pool of IPR as important, whilst for others, the interaction with the academic researchers is seen as a way of keeping their staff sharp and aware of new research trends or as a means of recruiting key research staff.

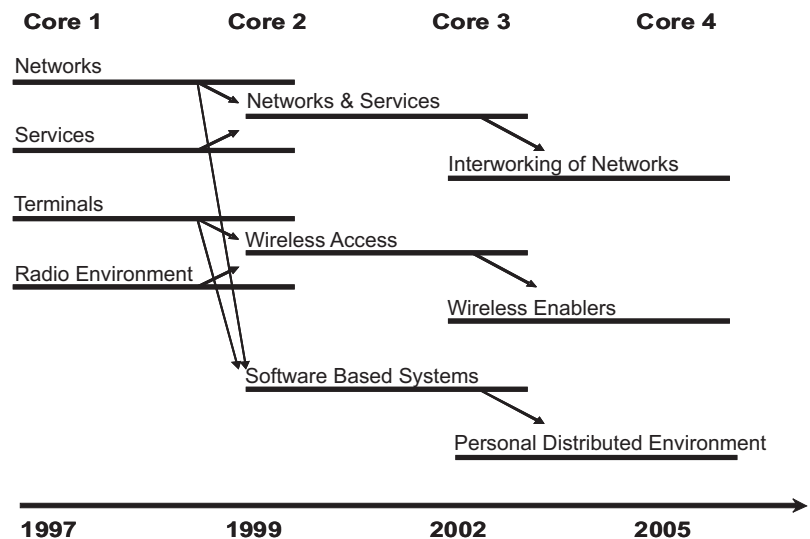


Figure 2 Evolution of Mobile VCE’s Core Research Agenda



Academic Members, who staff the research teams, must meet a tough set of objective criteria, a key one being a *proven and clearly demonstrable track record* – not just potential – of *excellence in relevant research*. Ongoing performance, assessed through formal review by the Industrial Members, determines the level and areas of participation in future research programmes, thereby ensuring Mobile VCE maintains the highest quality, as befits a true Centre of Excellence. Whilst such procedures mean that membership of Mobile VCE is not a ‘cosy club’ for academics – far from it – the universities clearly benefit from their participation, not least through the explicit recognition of quality that accompanies membership and which thus helps them to attract international, high quality, staff. Perhaps one of the most strategically important benefits for the universities, however, is the input regarding research directions that they receive from a wide breadth of Industry representatives through Mobile VCE’s Steering Groups.

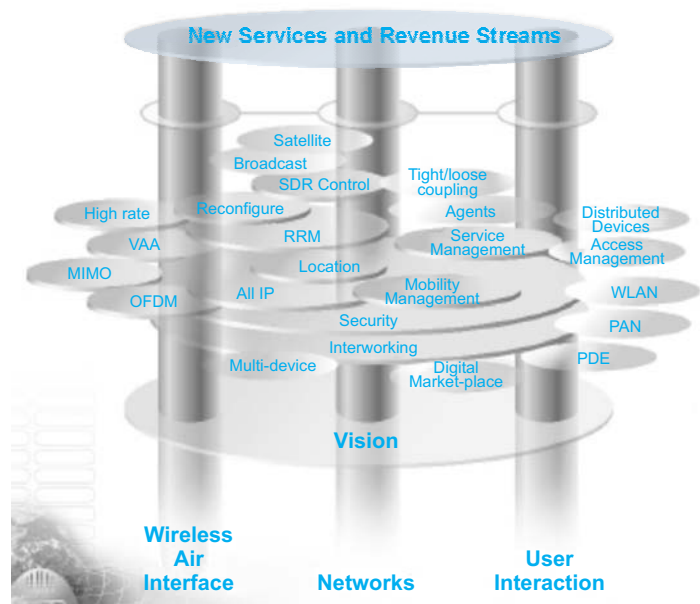
### Modus Operandi

Industrial Members have full access to the Mobile VCE Core Research Programme, technical reports and research teams, as well as the opportunity to participate in Industrial Steering Groups, established for each of the Core Programme work areas. Steering Groups typically comprise some 8-15 Industrial Members who meet quarterly to monitor, review and direct the research activities, identifying patent proposals and approving publications. Each Steering Group is chaired by a senior Industrial Member.

The appointment of senior industry technologists, from the operational as well as the research parts of their companies, to chair and participate in these groups allows for a very strong input to the academics. It secures a higher degree of industrial relevance than is achieved in most other models of collaborative research. And yet, the structure and ownership of Mobile VCE ensures that such industrial relevance is achieved without compromising either the long-term nature of the research or its academic integrity.

Whilst such involvement demands a high degree of commitment, experience has shown that those Industrial Members who participate actively in this way reap substantial benefits. Steering Group membership provides an avenue to direct the research, to secure early access to its results, to network with other members of the mobile industry on a regular basis and, from time to time, the opportunity to recruit top quality research staff.

The research within each work area is undertaken by collaborative teams, comprising personnel usually from two or more universities. Co-ordination of these pan-university teams is managed by an Academic Co-ordinator, a senior staff member – Lecturer or Professor – from one of the member Universities who acts in support of the Industrial Steering Group Chairman. Innovative ‘carrot and stick’ mechanisms have proven to be very effective in encouraging the universities to deploy high quality creative staff within the Mobile VCE teams, to collaborate closely across traditional boundaries and to identify valuable IPR. Joint pan-university research has achieved more than simply the sum of the parts, as unanticipated opportunities to leverage research activities have been identified. Complex software simulation tools have also been created in a composite manner across multiple research institutions. When Mobile VCE was first established such collaborative achievements were just hopes, but have become reality.



**Figure 3** Key Elements and Pillars of Mobile VCE’s Core 3 Research Programme

### Core Research

Two types of research activities are undertaken by Mobile VCE, integrated research programmes available to all Members – ‘Core Research’ – and research for just one or a few Industrial Members – ‘Elective Research’. Both types of programme (described more fully below) are defined jointly by industrial members (usually specifying objectives) and by lead academics (usually proposing technical approaches). They are monitored and steered by Steering Groups and are undertaken usually by combined teams from more than one university, selected to match expertise to requirement. Formal research contracts are placed by Mobile VCE with its Academic Members. The research is monitored by the Industrial Steering Groups and overseen by the Mobile VCE office, which provides a central hub for management, communication and information dissemination.

Core Research Programmes represent substantial integrated programmes of research, funded by pooling members’ subscriptions, augmented by competitively-won Government grants (see Figure 1). The evolution of the scope of the Core Research Programmes is shown in Figure 2, which illustrates the way in which the research agenda has developed, to reflect the evolution of mobile services and consequent industry requirements.

The Core 1 Programme (1997-2000) was a 50 manyear programme, with four distinct work areas – Networks, Services, Terminals and Radio Environment [3]. Whilst the focus of this was primarily 3G systems, some of its outputs were used, for example, for 2.5G deployment, and other firmly beyond 3G. The vision for the Core 2 Programme (1999-2003) was described in [4], and was more substantial in scope, with an effort of over 100 man-years, structured into three work areas – Networks & Services, Wireless Access, Software Based Systems. The enlargement of the staffing for Core 2 enabled Mobile VCE to widen its academic base, embracing an increased emphasis on mobile computing, middleware, agent technology and security, complementing, and building upon, foundational strengths in wireless access, software radio, networks and services.

As we look forward at future evolution of the cellular industry, beyond the relatively short term evolutions being developed by 3GPP, three distinct geographical emphases have emerged over the past two years – these have been presented at various international conferences; indeed these perspectives have also been hotly debated within the ITU-R Working Party 8F over this same period [1]. From Asia a requirement has been identified for high bit rate wireless access (100Mb/s wide area, 1Gb/s short range), reflecting the rapid rollout of wired broadband and a sense that in the relatively near future users will require such access to be provided wirelessly. In Japan, NTT DoCoMo have implemented a testbed using their VSF-OFCDM wireless access technology [5], which continues to be trialled at the present time. In North America the dramatic growth of wireless LAN, combined with the wireless industry downturn, has resulted in a focus on shorter term issues such as WLAN-based technology concepts [6] and IEEE 802.20 wireless WAN [7]. Meanwhile, in Europe the focus, largely led by the early 6th Framework agenda, has tended to be upon reconfigurable networks [8] and interworking between mobile and other networks, such as digital broadcasting networks [9].

Reflecting the geographical composition of its industrial membership, Mobile VCE's Core 3 Programme (2002-2005), contains key elements of all the above themes, see Figure 3, which illustrates interrelationships between the main three work areas:

- ◆ 'Wireless Enablers' encompasses work on novel air interface technologies and implementations, for both high-speed PAN and wide area coverage. Part of this approach includes a novel MIMO-based propagation measurement campaign and exploration of flexible multi-standard hardware implementation.
- ◆ 'Interworking of Networks' includes research on secure internetworking of mobile networks with digital broadcast, WLAN and personal networks. This is based upon an 'arms-length', rather than convergent, philosophy, reflecting the industrial reality of the distrust that exists between the broadcast and telecommunications industry – both believe in convergence, but each industry would prefer it to be under their own control [10].
- ◆ The 'Personal Distributed Environment' distinctive is its focus upon the challenges of the user's individual information environment, to provision new services in a world of multiple short-range interlinked wireless devices and ubiquitous service access. Such personalised services will become increasingly essential to ARPU growth in the saturated voice markets of the developed world, but to succeed will require easy, flexible and efficient management of user services and devices.

## Elective Programmes

In addition to its Core research, Mobile VCE also undertakes 'Electives' – research programmes of interest to a subset of the industrial membership and in which members may choose ('elect') or decline to participate. Such programmes are funded by either a single company or jointly by a group of companies with common interest. For such programmes, access to results and any consequent IPR is restricted to those who elect to fund the work. Such programmes may build on prior Core Research, providing



Figure 4 Mobile VCE session at recent ITU-R WG8F meeting in Edinburgh

members with an easy route for cost-effective pre-development of emerging technology, bridging the gap between research and product development and ensuring that the companies have direct access to the relevant researchers, easing the transition from research to product. Recent research in this category has included an adaptive antenna handset demonstrator, which has been shown to eliminate fades. New elective programmes just commencing include research on ultrawideband and a software defined radio experimental programme.

## The International Dimension

Mobile VCE began life as a national initiative but today has global impact, reflecting the international composition of its industrial membership and the focus of its research agenda, with member companies making full use of today's IT tools to circulate its outputs to their research groups across national boundaries.

Formal collaboration exists with Yokosuka Research Park, YRP, in Japan, who hosted a Mobile VCE event in 2002 [11]; a second regional event in Asia is under consideration, as are researcher secondments to Japan.

A similar MoU exists with the SDR Forum, which has included Mobile VCE research in its responses to the FCC's Notices of Inquiry into SDR. The Forum supported a recent 'by-invitation' Round Table event on the impact of SDR [12], attended by spectrum regulators from Europe, Asia and North America.

Strategic research overviews from Mobile VCE's academic members are regularly contributed into the Wireless World Research Forum, whilst infeed to ITU-R WP8F is also increasing. Whilst overview publications are fed into such fora, as well as into international research conferences and refereed journals, access to the detailed technical research reports, software tools etc, remains limited to industrial member companies.

## Moving Forward...

Mobile VCE – the Virtual Centre of Excellence in Mobile & Personal Communications – is now 8 years old. Initially trading on promise and the goodwill of the industry, the company has delivered tangible benefits to its Members and has evolved from merely a national initiative to become an important player on the world stage. Effective structures and mechanisms have resulted in a high and sustained degree of research achievement, whilst the value and effectiveness of its Industrial Steering Groups has encouraged

companies to resource these with high quality staff. Together these result in a very effective industry input to the work and enable member companies to derive direct benefits themselves. International recognition of the Core Programme research outputs has been accompanied by a fresh thrust into important new areas reflecting key priorities of today's industry.

For further information on industrial membership please see the Mobile VCE website [www.mobilevce.com](http://www.mobilevce.com) or e-mail [future.wireless@mobilevce.com](mailto:future.wireless@mobilevce.com)

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*Walter Tuttlebee joined Mobile VCE as Executive Director in December 1999, with a background in R&D management and business development in personal communications. With his previous company Dr Tuttlebee was a key player in the initiation of major research programmes, including the European FRAMES programme that significantly shaped 3G standards. His activities in short range wireless communications and software radio – editing several books and creating a global web community ([www.dectweb.com](http://www.dectweb.com)) – involve him in chairing and speaking at industry conferences on DECT, Bluetooth, SDR and related technologies.*

*Dr Tuttlebee has BSc and PhD degrees from Southampton University and an MBA from Cranfield. He is a Senior Member of the IEEE.*

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## Joint Rail Conference

6-8 April 2004, Baltimore, Maryland

The annual ASME/IEEE Joint Rail Conference, sponsored by the ASME Rail Transportation Division and the Land Transportation Division of the IEEE Vehicular Technology Society, offers a unique and comprehensive technical forum. Join your peers to share information, learn about technological progress, and share operating experience at the 2004 Joint Rail Conference, in Baltimore, Maryland. This year's theme is *Applying technology for system improvements*.

Seventeen electronic and electrical papers will be presented at the conference. Abstracts of these papers will be published in the next issue, but in the meantime for details and registration information, see <http://www.asmeconferences.org/JRC04/>







## Automotive Electronics

Bill Fleming, Senior Editor

### 2004 Model Year Technologies

DaimlerChrysler's 2004 Jeep Grand Cherokee offers a Navigation Radio option that combines radio, CD-player, and DVD-navigation using a front-face 4.2-inch color display screen on the radio. Most of DaimlerChrysler's vehicles also offer SIRIUS commercial-free 100-channel satellite radio, along with Uconnect Bluetooth wireless hands-free communications which allow customers to use their personal cellular phones placed anywhere in the vehicle [1].

General Motors debuts an industry-first OEM remote start system on the '04 Chevy Malibu. The remote transmits up to 200 feet, starts up the climate control as well as the engine, and (unlike aftermarket add-ons) is fully integrated with the vehicle's safety and security systems [1]. Radar adaptive cruise control debuts on the '04 Cadillac XLR, and includes a heads-up display showing following distance and driver-set distance interval. The U.S. debut of speed-sensitive electric power steering was on the '03 Saturn ION, and has now been added to the '04 Saturn VUE, Pontiac Grand Am and Chevrolet Malibu [1].

Honda has introduced a variable-displacement 3.0-L V-6 engine on their Inspire model sold in Japan. It's said to offer the fuel economy of a 4-cylinder engine (27 mpg) when cruising, or deliver as much as 250 hp when accelerating [2]. This Honda engine control, which cuts back to half its cylinders while cruising, is similar to GM's displacement-on-demand 8-cylinder control system [3]. However, the Honda system features active/electronic engine mounts that reduce vibration and noise using 180-degree out-of-phase feedback.

### More Driver Distraction Studies

A study conducted by the University of South Florida on patterns of driver response to in-vehicle cell phone distraction showed that [4]:

- ◆ older drivers had longer brake response times than younger drivers
- ◆ cell-phone distraction had a greater influence on females' brake response time compared to males.

A second study conducted by Miami University using subjects in a vehicle simulator showed that [4]:

- ◆ whether a conversation was conducted in person or via cell phone, in either case the conversation caused brake reactions times to slow
- ◆ it was concluded that hands-free phones could not totally alleviate the problem of performance impairment when using a cell phone

### Teens' Attitudes/Resistance to Traffic Safety

Teenagers in the U.S. have the lowest safety belt use rate, which is as much as 20 percentage points below that of the

general population. (For reference, the general population belt use rate last year in the U.S. reached an all-time high of 79 percent). Volkswagen of America conducted an informal poll of hundreds of high school students, and it was found that the most common reasons for teens not wearing seat belts were [5]:

- ◆ 32% said: "peer pressure," it was uncool, or embarrassing
- ◆ 30% said: "uncomfortable," it was too constricting, and wrinkled clothes
- ◆ 20% said: "unnecessary," because they were only traveling short distances
- ◆ 18% said: "nothing would happen," because they felt invincible

Tragically, like a death wish come true, of the more than 5000 teenagers who were killed in crashes in 2001, only 33% were wearing seat belts. (Belts are known to be the single most effective safety devices, and their use statistically would have saved nearly half of these teens' lives).

Another survey, conducted at San Diego State University identified the following dangerous attitudes regarding traffic safety among a group of 2,310 California teens [5]:

- ◆ poor examples of safe driving from friends and parents
- ◆ video games that emphasize speeding and evading police
- ◆ popularity of movies that glorify reckless driving
- ◆ teens felt they were speeding only if they were driving around or above 90 mph
- ◆ 62% of the teens admitted to having been in a car during activities such as drunk driving, drag racing, reckless driving, etc.

### In-Vehicle Wireless Parking Meters

The French company, EPARK, has developed a wireless aid for street parking. Their new system, called MobilPark<sup>®</sup>, allows motorists to pay parking fees directly from their car. Parking meter fees are paid electronically via mobile/cellular telephone, or via Internet/wireless (WiFi, Bluetooth, etc.) [6]. Extension of parking time can similarly be done remotely, using bank account or credit card e-transactions. On the other hand, parking enforcement is also done remotely and more efficiently, by replacing the usual paper ticket violation with automated electronic billing of the driver's account.

### Audio Spotlight Update

Two years ago, this news column described the audio spotlight, under development by collaboration of DaimlerChrysler and M.I.T.'s Media Lab [7]. Only vehicle occupants sitting directly in projected ultrasonic beams of sound will hear the audio in that beam. This allows occupants to listen to their stations/sound-play of choice, with-

out earphones, without disturbing each other. Two companies have pursued further development of this technology. One company is a spin-off from M.I.T. — this company is Hologonic Research Labs, Watertown, MA, and their product is called The Audio Spotlight [8]. The other company, American Technology Corp., San Diego, CA, developed a product called HyperSonic Sound Technology [9], [10]. While working independently of each other, these two companies developed similar audio-beam products.

To obtain highly directional sound beams using reasonable-size loudspeakers, audio is transmitted via an ultrasound carrier wave, which is amplitude-modulated. No sound is heard outside the beam, but occupants seated within the beams hear the sound. The sound is heard because amplitude-modulated ultrasonic carrier wave is demodulated (by the nonlinear interaction of the AM-modulated ultrasound beam in the medium of ordinary air). The demodulation of sound only occurs in the volume of air upon which the beam is focused, so persons outside the beam don't hear the sound.

In essence, the audio spotlight serves simply as a replacement for earphones. Since today's earphones are evolving into wireless types, it's uncertain whether the audio spotlight's earphone-free convenience advantages will offset the less expensive, higher-fidelity, and noise-eliminating features of earphones [11].

## Heads-Up Input Device

HoloTouch Inc. (Darien, CT) has developed a virtual control panel that seems to float in air. Holography and wave-sensor technologies are combined. A holographic image of, for example, a numeric input keyboard is projected in front of, and aside, the driver's forward view above the instrument panel [12]. When the driver puts a finger into the image space corresponding to a projected entry key, a wave sensor (either infrared or acoustic) detects finger presence in that space, thereby determining which "virtual button" was "pushed." The HoloTouch input device can be used to enter a phone number, or to input a set speed for speed control, etc. [Editor's Note. *Given current progress with voice recognition, future applications of the HoloTouch virtual control panel may be limited*].

## Safety-Critical Data Bus Choice

A year ago, this news column described the inability of automakers to agree on a common data bus configuration for use in safety-critical by-wire control systems [13]. In August of this year, Volkswagen AG bolted from the TTA (Time-Triggered Architecture) group and joined the majority of automakers who already belong to the FlexRay Consortium [14]. The only major automakers not yet committed to any standards-based safety-critical architecture are Toyota, Honda, and Nissan.

## California Treaty Opens Way to Hybrid/Fuel Cell Vehicles

This summer, automakers and the State of California settled their legal differences, setting the stage for the emergence of hybrid and/or fuel cell vehicles while likely writing off the broad acceptance of battery-powered purely electric vehicles [15], [16]. To achieve California's low emissions goals, the new regulation calls for a 10-percent sales target by allowing a combination of hybrid (gasoline-electric), cleaner gasoline-powered engines, fuel cell vehicles, and battery-powered electric vehicles. Phase-in begins in 2005, and completion of the 10-percent goal is targeted for 2008.

Pure electric vehicles still get full zero-emission credits. Indeed, DaimlerChrysler is currently selling golf-cart-like neighborhood runabout pure electrics that receive full credits. There are also some ultraclean gasoline-only vehicles that currently qualify for partial zero-emission credit (e.g., Ford Focus, Nissan Sentra, Toyota Camry, Honda Accord/Civic and BMW 325).

Over the past ten years, approximately 800 pure electric vehicles were leased (automakers didn't sell them due to battery warranty concerns and to maintain control of the cars). Drivers who didn't drive very far liked electric vehicles; whereas other drivers disliked their limited range, long recharge time, and higher cost [16]. A particularly serious problem was battery cost. While devices such as laptop computers and cell phones could afford batteries costing \$1000/kW-hr, electric vehicle batteries needed to be 90-percent less expensive, something battery suppliers never achieved. Another limitation with electric-vehicle batteries was their unacceptably low energy density (which ranged between 70 and 100 W-hr/kg).

On the other hand, hybrid/gasoline-electric Toyotas and Hondas are presently selling well. Moreover, each Big 3 automaker plans to introduce hybrids by the end of this year. It's estimated that up to 600,000 hybrids will be in California within 8 years (that's 1 in every 50 vehicles on the road there in 2011). In addition, General Motors has announced a hub electric motor technology where electric drive motors are packaged in the center of each vehicle's wheel [17]. Hub motors will enable GM to more easily convert front- or rear-wheel-drive vehicles into all-wheel-drive hybrid vehicles without radically re-engineering the vehicle platform. A hub-motor hybrid powertrain is currently being evaluated on a Chevrolet S10 pickup. Liquid-cooled hub motors add a combined 68 hp and boost torque by 36 percent. Since the motors directly drive the wheels — transmissions, driveshafts, and axles are not required; thereby minimizing friction losses, and simplifying conversion-to-hybrid effort. GM's R&D vice president, Burns, says that, "hub motors have the potential to enable ordinary vehicles to have sports car performance as well as improved fuel economy [17]."

A wild card in the mix is the fuel cell-powered, "skateboard-like-platform," vehicle that General Motors plans to start selling by 2010. But as described in the following *VTS News* item, fuel cell vehicles may be facing more technical challenges than one might think.

## Hydrogen Fuel-Cell Vehicle Technology Challenges

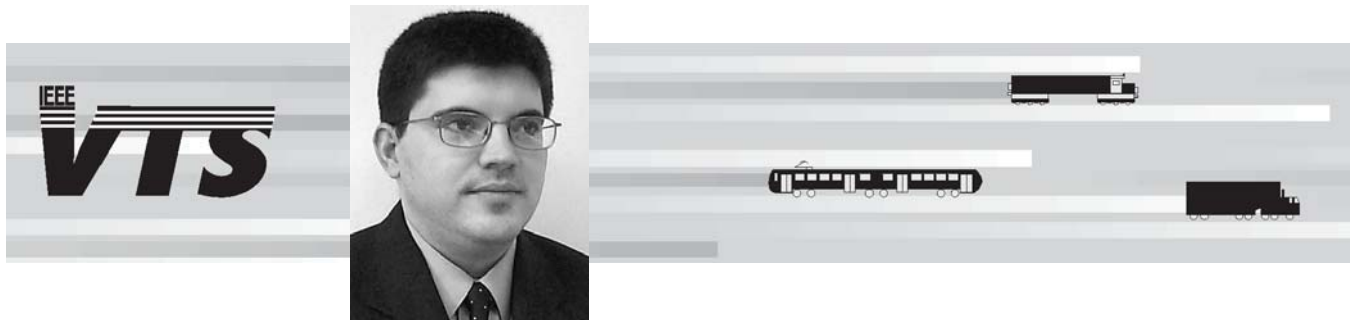
"As far as I know, no one who is technically literate is an enthusiastic supporter of fuel-cell powered vehicles," said Donald Sadoway, professor of materials engineering, Massachusetts Institute of Technology, and nationally recognized battery expert [18]. "At technical and scientific meetings, we're hearing nothing to lead us to the conclusion that there's been a big scientific breakthrough in fuel cells," said Elton Cairns, professor of chemical engineering, U-Calif.-Berkeley, and developer of electric-vehicle batteries for General Motors during the 1970s [18]. The key obstacle facing fuel cell researchers continues to be the need for large amounts of costly precious metals — usually platinum.

Safety hazards must also be addressed [19]. Fuel cells use pressurized hydrogen, which is more flammable and explosive than gasoline. Hydrogen burns with a clear flame, is odorless, prone to leak, and can embrittle some metals. Typical added safety provisions — used, for example, on a

Honda FCX limited-lease fuel cell vehicle — include: hydrogen sensors to detect leaks (and shut off valves and activate ventilation), dual refilling cap doors (to remind the operator to first ground the vehicle before refilling to avoid static-charge ignition of the hydrogen), and tanks pressurized to 5000 psi (reinforced to withstand pressures that are about 160 times higher than those in vehicle tires). To summarize, Cairns believes that, “the auto industry is building up public expectations for something that may not materialize — it simply isn’t going to happen unless we see some major breakthroughs [18].”

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## Mobile Radio

Javier Gozalvez, Senior Editor

### WRC-03 and Spectrum Licenses

The World Radiocommunication Conference 2003 (WRC-03), the international forum where Member States gather to revise an international treaty known as the Radio Regulations, concluded with a number of landmark decisions. WRC-03 successfully established new frequency allocations to the mobile service in the bands 5150-5350 MHz and 5470-5725 MHz for the implementation of wireless access systems including RLANs. The lower part of the 5 GHz spectrum will be predominantly used for indoor applications with the first 100MHz (5150-5250 MHz) restricted to indoor use. The use of these frequency bands is conditional to provisions that provide for interference mitigation mechanisms and power emission limits to avoid interference into other radiocommunication services operating in the same spectrum range. Regarding systems beyond IMT-2000, the ITU will study technical and operational issues relating to the future development of IMT-2000 and systems beyond IMT-2000, and develop Recommendations as

required. These studies will also take into consideration the particular needs of developing countries, including use of the satellite component of IMT-2000 for suitable coverage of these countries. ITU delegates at WRC-03 approved a resolution that will pave the way for the deployment of new technologies for wideband and broadband public protection and disaster relief applications. At present, public protection and disaster relief applications are mostly narrow-band supporting voice and low data-rate applications. It is anticipated that many future applications will be wideband-based (with data rates in the range of 384-500 kbit/s) and/or broadband-based (with data rates in the range of 1-100 Mbit/s). The assembly urged countries to use regionally harmonized bands for public protection and disaster relief to the maximum extent possible. The issue of high altitude platform stations (HAPS) was the topic of much negotiation during the conference. While the decision to deploy HAPS can be taken on a national basis, such deployment may affect neighbouring administrations, particularly



in small countries. This decision includes a new resolution on the potential use of the bands 27.5-28.35 GHz and 31-31.3 GHz by HAPS in the fixed service. Results of some ITU studies indicate that in these bands, sharing between the fixed service systems using HAPS and other conventional fixed service systems in the same area will require that appropriate interference mitigation techniques are developed and implemented. ITU will continue studies on technical and regulatory fronts. It will also study sharing between systems using HAPS and the radio astronomy service. More information on other resolutions adopted can be found in <http://www.itu.int/newsroom/wrc03/PressReport.html>

Hi3G Access has been awarded a license to offer 3G services in Norway. The company is expected to provide at least 30% population coverage within 6 years. Luxcommunications has been awarded Luxembourg's fourth 3G license in exchange of a payment corresponding to 0.2% of their revenues for 15 years. Tele2 has received a 3G license in Estonia. The Swedish operator has also acquired a GSM900 license in the Republic of Udmurtia, Russia. Tele2 has already GSM1800 networks in Russia. Switzerland's telecommunications regulator has opened a tender for additional frequencies, three licenses of 3.8MHz each, that excludes the three existing GSM operators.

Guinea-Bissau has launched an international call for tenders for a license to build and operate a GSM network. Namibia has also launched a tender for a second GSM license in the country. Cayman Islands has issued nine telecoms licenses, including mobile ones, with the aim to break the local monopoly of Cable & Wireless. Winners of these licenses include AT&T Wireless, Cellular One and Digicel.

### 3G News

Ericsson, Motorola, Nokia and Siemens mobile have announced the completion of a jointly developed Push to talk over Cellular (PoC) specification based on the IP Multimedia Subsystem (IMS) as defined by 3GPP. The PoC specification leverages existing 3GPP, OMA, and IETF specifications making the service easy to integrate in operators' existing access and packet core network infrastructures. The PoC specification is a bundle of six specifications including: Requirements, Architecture, Signalling Flows, Group/List Management, and two User-plane specifications (Transport and GPRS).

Nokia has started shipments of its Nokia 6650 mobile phone, the first mobile phone in the market capable of seamless handovers between GSM and WCDMA systems in a dual-mode network. Consumers will be able to enjoy global roaming on all GSM900/1800 networks globally as well as on WCDMA networks in Japan and Europe. Also, Qualcomm has announced successful WCDMA (UMTS) field trials in operators' networks in Asia, Europe and North America. Using the company's TM6200 test mobile, Qualcomm has successfully tested WCDMA (UMTS) circuit switched data, packet switched data, GPRS data, and WCDMA (UMTS) and GSM voice - both in the multiple WCDMA (UMTS) and GSM/GPRS frequency bands and on the multiple networks supported by a majority of the worldwide infrastructure providers.

NEC has announced that it has realized an advanced new telecom platform. The first product based on the new platform for mobile operators are new SGSN and GGSN, a packet core node which can handle large-volume IP packet transmission applications such as video streaming and GPS services in 3G systems. According to the manufacturer, the new platform is the world's first working model of an Advanced-TCA(TM) (ATCA) based commercial product. ATCA

is the world standard for the basic architecture of the next-generation highly advanced telecom platform set by PICMG (PCI Industrial Computer Manufacturers Group) Forum. On the ATCA architecture, the new platform also employs carrier-grade Linux and NEC's middleware. NEC will soon deliver the new SGSN and GGSN product to its first user, NTT DoCoMo, for an evaluation test. The new products will eventually operate in the 3G FOMA service network.

NTT DoCoMo has announced the development of micro base stations for the 3G FOMA network that are up to 1/30th the size of conventional base stations. The service area of the FOMA service has expanded steadily, and will reach 96% of the population nationwide by the end of September. The micro base stations will allow DoCoMo to expand FOMA service more economically and with greater flexibility for adaptation to operational environments. The micro base stations have both outdoor and indoor applications. In outdoor areas with low population densities, the stations' low cost enables DoCoMo to install enough units to ensure necessary coverage on an economical basis. For indoor applications in buildings and underground malls, where installation spaces are limited, an external antenna allows the stations to be placed out of the way without sacrificing signal strength. For the indoor applications, DoCoMo plans to have a total of 1,600 conventional and micro base stations in operation nationwide by the end of March 2004, and will increase this number to 3,000 by the end of March 2005. The Japanese operator has also announced that a new service starting October 1, 2003 will enable 3G FOMA videophones to make international videophone calls and 64 Kbps transmissions to the UK in cooperation with Hutchison 3G UK. With the new service, they will also be able to make face-to-face contact via videophone and dial directly into private LANs via data transmissions. Hutchison has announced that its 3 operation in the UK has now 155000 subscribers with 70% of the population already covered, including all major cities. In Italy, the operator has 300000 subscribers.

Huawei Technologies has announced the first R4-based IP video call on WCDMA ever made in China. The company has made the call in its own WCDMA pilot networks, using commercial WCDMA handsets and its R4 network equipment. 3GPP R4 is the first step of WCDMA towards an all-IP multimedia era. Leveraging soft-switch architecture, Huawei's WCDMA core network can substantially increase the efficiency of the whole network and reduce OPEX by a large margin. The manufacturer has also announced that the company has made a successful demonstration of 3G MMS (Multimedia Messaging Services) on its trial network of WCDMA. The trial showcased an interconnectivity call completed between WCDMA commercial handset and GSM handset supporting MMS.

Nokia has announced what it claims is the world's first cdma2000 1xEV-DV high-speed packet data phone call. The call, achieving a peak data rate of 3.09 Mbps, was made between a test set based on a commercially available Nokia 2285 handset upgraded with a Nokia 1xEV-DV chipset and a Racal Instruments, Wireless Solutions Group, 1xEV-DV basestation emulator. According to the Finnish manufacturer, this chipset is the world's first to support complete 1xEV-DV Release C functionality. cdma2000 1xEV-DV, also known as IS-2000 Release C, delivers a maximum forward link data rate that is 20 times greater than the peak rate deployed in today's IS-2000 Release 0 CDMA networks. Furthermore, IS-2000 Release C provides typical user through-

put of 1 Mbps in a 1.25 MHz frequency channel and system-wide throughput that ranges from 420 Kbps to 1.7 Mbps depending upon traffic and channel conditions.

Saigon Post and Telecommunications Co has commercially launched its cdma2000 1X network, covering 12 provinces and cities in Vietnam. The CDMA Development Group (CDG) has announced that the 3G CDMA2000 subscriber base reached 54 million in June, an increase of nearly four million from the previous month. According to the EMC World Cellular Database, CDMA2000 is by far the most widely used technology to access wireless data across the globe. Asia Pacific is the fastest growing CDMA2000 region in the world, fuelled by subscriber expansion in the key markets of Japan, China and India. Latin America, including the Caribbean, is another rapidly expanding market for CDMA2000 with 22 commercial CDMA2000 networks in the region, and four more expected to be operational by the end of 2003.

The Organizational Partners of the Third Generation Partnership Project (3GPP) have approved an application by the TD-SCDMA Forum to become a Market Representation Partner within the project. Established in December 2000, the TD-SCDMA Forum brings to 3GPP its commitment to promote the Time Division – Synchronous Code Division Multiple Access technology (TD-SCDMA) as part of the global family of 3rd Generation technologies. TD-SCDMA has been developed by the Chinese Wireless Telecommunications Standards group, CWTS, and has been included in the specifications of 3GPP since 2001. Siemens and Huawei Technologies have signed a Memorandum of Understanding to form a joint venture to develop, manufacture and market TD-SCDMA technology. Manufacturing and Marketing efforts of the joint venture will initially be focused on China while emphasizing on the market introduction of TD-SCDMA Radio Access Network (RAN) infrastructure products in a starting phase. TD-SCDMA infrastructure products are undergoing field tests currently in China, first commercial products of the joint venture will be available in China at the beginning of 2004. Nortel Networks and Datang Mobile have also opened a joint laboratory in Beijing in a move to explore the commercialization of the TD-SCDMA technology in China. Nortel Networks is providing the core network and Datang Mobile the access network. The laboratory plans to conduct tests in the areas of interoperability, network performance and system functions based on TD-SCDMA.

IPMobile has received a trial license to deploy a “Mobile Broadband” trial system using TD-CDMA technology in Japan. The company has built three cell-sites inside Tokyo with subscribers using PCMCIA cards and modems. Testing of the system in high-speed environments (highways) has already been conducted.

Cingular Wireless has become the first operator in the US and worldwide to commercially deploy EDGE. The operator has launched the service in Indianapolis offering average data speeds between 70kbps and 135kbps with peak data rates of 170kbps. Hong Kong’s CSL has also launched Asia’s first commercial EDGE network. The initial deployment targets key locations with a progressive expansion as demand grows.

## Location Technology

Motorola has announced the availability of the M12+ Timing Oncore. According to the manufacturer, the new GPS timing module surpasses industry Six Sigma averages in accuracy by utilizing the latest timing algorithms developed

by Motorola. An independent report from the United States Naval Observatory documents the results of extensive tests performed on the M12+ Timing Oncore and is available at [www.motorola.com/gps](http://www.motorola.com/gps). Motorola’s M12+ Timing Oncore can be easily integrated into a variety of applications to improve performance. For example, within GSM, the M12+ Timing Oncore enables higher accuracy position measurements from the LMU (Location Measurement Unit) overlay. Within any cellular system, real time synchronization establishes faster handovers for speech and data services.

Motorola has also launched FS Oncore, a breakthrough miniature Global Positioning System (GPS) product. The FS Oncore module, smaller than a dime at 200 Sq. mm, is used for adding accurate location sensing to virtually any portable electronics product. The GPS receiver, designed specifically for cost-sensitive, high performance applications is capable of supporting autonomous and assisted-GPS functionality, with applications ranging from cellular handsets and accessories to asset tracking and PDAs. Features include cameras that will time- and location-stamp photos, PDAs with maps which will offer real time navigation and E-911 compliant cellular phones.

Nextel Communications and Motorola have announced the availability of several location-based services, ranging from voice-enabled driving directions to asset tracking solutions, that can now turn Motorola’s GPS-enabled iDEN mobile phones into sophisticated workforce management and navigational devices for Nextel customers.

## Technology and Research News

Researchers at the University of Missouri-Rolla and Motorola’s Advanced Technology Center in Schaumburg, are developing three-dimensional switches and tiny fuel cells to improve the reception quality and extend the operating time for wireless communications and other wireless sensing devices. The use of Meso-MEMS (MEMS stands for micro-electro-mechanical systems) as switches will not only improve reception quality, but will save energy. The switch would enable a cell phone, for example, to be used in any geographic location by simply changing its frequency operation band. Over the course of four years the Defense Advanced Research Project Agency (DARPA) and the Department of Defense (DOD) have contributed \$2.6 million towards the research. In the next phase of the program the researchers will also be developing tiny fuel cells to power these wireless devices. The fuel cells would provide power for these products longer than traditional batteries in such wireless devices as cell phone. STMicroelectronics has also reported progress by one of its research teams in developing tiny fuel cells. In particular, the manufacturer is developing new technologies in which the fuel cell could be implemented as a 3D structure containing thousands of buried microchannels that maximise the contact area between the gases, the catalysts and the electrodes. Other areas in which the company is working includes a special nanoporous layer and novel membranes that exhibit high proton conductivity and lower cost than membrane materials that are commercially available today.

UC Irvine researchers have been awarded a grant from DARPA to develop high-frequency electronic devices based on nanotubes. The aim of the researchers is to develop nano-RF signal processing components for wireless communications using the carbon nanotubes.

Researchers at BTEExact have developed new technology that, according to the company, allows conveying actual emotions in a physical and tactile way through mobile

messaging. The technology allows interactive toys to be linked to mobile phones so that SMS communication can be displayed through the toys' actions. The interactive toys are tuned into their owner's mobile phone so that, whenever an emotional graphic symbol is sent, the toy displays the emotion that has been communicated.

NTT DoCoMo has announced it will establish a research center in Beijing, to research and promote the advancement of mobile communications technologies for 4G and beyond.

picoChip Designs has announced the availability of its "3G basestation on a CD", a software reference design for 3G basestations. The product includes tested algorithms and source code for WCDMA FDD. The company believes the product can reduce development times for a basestation by up to 50%. The system, which complies with Release 4.2.0 of the standard, is capable of supporting the full set of 3G voice, data and video services. The company has also announced what it claims is the industry's first High Speed Downlink Packet Access (HSDPA) solution, an extension to its "3G basestation on a CD" reference design. In addition to WCDMA FDD and HSDPA, reference designs for TD-SCDMA, 802.16 and other standards are under development.

Nokia has introduced what it claims is the first GSM module for machine-to-machine applications. The Nokia 12 GSM module offers Java-based application development with support for EDGE and location service. The Nokia 12 is a compact and intelligent GSM module for machine-to-machine, mobile-to-machine and machine-to-mobile (M2M) applications and other wireless solutions that can be integrated into devices during assembly. Operating in the GSM 900/GSM1800 and later also in the GSM 850/1900 bands (Americas region), the Nokia 12 GSM module is planned to be available in Europe, Africa and Asia in the fourth quarter, 2003.

Metrowerks and Motorola have joined forces to target wireless device markets based on the Linux operating system. In particular, Motorola's i.MX1 microprocessor will support the Metrowerks OpenPDA platform, a development solution based on the Linux operating system for the creation of next generation wireless devices. The development studio includes a pre-integrated Board Support Package (BSP), complete with an enhanced Linux operating system kernel with related drivers, as well as middleware and applications that have been optimized for systems performance and reliability. The OpenPDA Development Studio also features an intuitive GUI-based development environment.

Verizon Communications has unveiled its 'One' phone, a prototype cordless-at-home and cellular phone. The phone, that is developed and manufactured by Axestel, includes tri-mode, E-911 compatibility and other features.

Nextel Communications, Motorola and Symbol Technologies, have announced the availability of the first bar code scanner attachment for mobile phones. The Symbol PSM20i allows mobile workers to use their phones to collect information wirelessly and in real time. This solution combines the accuracy and reliability in laser-based bar code scanning with the extensive voice, data and application capabilities of Nextel's Java technology-enabled phones from Motorola.

AT&T Wireless and Microsoft, together with Motorola, have announced they will offer the first GSM/GPRS-compatible Windows Mobile-based Smartphone for the North American market — the Motorola MPx200. The new Motorola MPx200 is expected to be available from AT&T Wireless in the fourth quarter of this year.

Radiolinja and PTV have jointly developed what they claim is the first mobility services based on traffic information from a mobile communications network. Radiolinja offers a system which draws traffic information from the movement of mobile phones, while PTV has developed the front-end that enables access to almost real-time traffic information.

Cellular Design Services have launched IBiSA, which they claim is a unique software tool for ensuring that in-building systems meet coverage requirements. The tool, which is applicable to 2G, 3G, TETRA and WLAN, is based on the company's technology Measurement-based Prediction, MbP.

## Mobile Phones and Health Issues

The Portuguese Institute of Telecommunications and Vodafone Telcel have developed a project, known as ITEM, for the continuous measurement of electromagnetic radiation. The aim of the project is to provide the public with accurate and relevant information about electromagnetic radiation. The Institute of Telecommunications is developing, among others, the following activities: carrying out measurements in around four hundred locations, establish a remote measuring network, publish the results on a web site, and prepare studies on the use and methods of monitoring the emission of electromagnetic radiation. More information can be found in: <http://www.lx.it.pt/item/>

A new study has reported that the new generation of digital mobile phones can interfere with many types of heart pacemaker. The authors of the research (researchers from the Italian Institute of Health and the Center for Devices and Radiological Health of the Food and Drug Administration) claim that newer pacemakers fitted with a ceramic filter are immune and recommend all manufacturers to use these filters.

Qualcomm, together with CardioNet, a provider of mobile outpatient cardiac telemetry technology and services, have announced that CardioNet's cardiac monitoring service has been enabled with Qualcomm's CDMA technology and wireless networking services. The US manufacturer is providing the QConnect wireless network management service to provide connectivity between the CardioNet mobile monitoring devices and the CardioNet Monitoring Center. Qualcomm's QConnect service provides the back-end infrastructure and network management service that allows the device to wirelessly transmit patient ECG data to the CardioNet Monitoring Center, and ultimately deliver succinct, timely information to physicians for diagnosis and therapy management.

## US Mobile Market

The Federal Communications Commission (FCC) has adopted its Eighth Annual Report on the state of competition in the Commercial Mobile Radio Services (CMRS) industry. The Eighth Report concludes that the CMRS industry is competitive and, during 2002, experienced increased service availability, lower prices for consumers, and a greater diversity of service offerings. During 2002, the mobile telephone sector generated more than \$76 billion in revenues, and the number of mobile telephone subscribers rose from 128.5 million to 141.8 million, resulting in a nationwide penetration rate of roughly 49 percent. Broadband PCS and digital SMR licensees continued to deploy their networks. To date, 270 million people, or 95 percent of the total U.S. population, live in counties with three or more different mobile telephone operators, and more than 236 mil-



lion people, or 83 percent of the U.S. population, live in counties with five or more operators competing to offer service. During 2002, subscribers' average monthly cell phone usage continued to rise and the price per minute of mobile telephone service continued to fall. Minutes-of-use per month averaged 427 between June and December 2002, an increase of 12 percent from 380 during the same period in 2001. Mobile data services have begun to play a more significant role in the CMRS industry. While such services generated only one percent of total industry revenue during 2002, an estimated 11.9 million, or 8 percent, of the 141.8 million mobile telephone subscribers at the end of 2002 subscribed to some type of mobile Internet service. An additional 2.3 million consumers subscribed to mobile Internet services on data-only mobile devices at the end of 2002. It is estimated that 20 percent of all mobile telephone subscribers used text messaging services during the fourth quarter of 2002.

The FCC has asked for public comment on changes to several technical rules in Parts 2 and 15. The rule changes, proposed in a Notice of Proposed Rulemaking, would permit operators, including wireless internet service providers (WISPs), and device manufacturers to more readily modify or substitute technically equivalent parts, facilitating increased deployment of broadband services. WISPs use unlicensed devices to provide a broadband alternative for rural and underserved areas and, while they are a relatively nascent industry, their deployment rates have been increasing rapidly. In the Notice, the Commission proposes several rule changes that will remove unnecessary regulatory impediments to deployment of advanced technologies for wireless networking.

The FCC has also adopted a Notice of Proposed Rulemaking (NPRM) proposing ways to amend its spectrum regulations and policies in order to promote the continued rapid and efficient deployment of quality spectrum-based services in rural America. In the adopted NPRM, the Commission considers a number of issues that could be addressed to help improve wireless services in rural America, including: modifying construction requirements by allowing all providers of wireless services licensed on a geographic areas basis to demonstrate "substantial service"; to remove or modify regulations that may impede rural service, the Commission also discusses measures to increase power level flexibility for licensed services in rural areas; seeks comment on a tentative conclusion to retain the cellular cross-interest rule in RSAs with three or fewer CMRS competitors; etc.

The FCC has adopted a Report and Order requiring wireless manufacturers and service providers to make digital wireless phones accessible to the more than 6 million individuals with hearing disabilities that use hearing aids. Specifically, the Commission modified the exemption for wireless phones to require that digital wireless phones be capable of being effectively used with hearing aids. In order to make digital wireless phones accessible to individuals who use hearing aids, the Commission found that digital wireless phone manufacturers and service providers should be required to take steps to reduce the amount of interference emitted from digital wireless phones and to provide the internal capability for telecoil coupling. The Commission also released a Report and Order modifying the statutory exemption for wireless phones from hearing aid compatibility requirements and establishing compatibility rules for wireless service providers and handset manufacturers. In particular, the Order adopts the ANSI C63.19 standard as the measurement procedure to be used for determining

compatibility ratings and sets certain ratings as minimum performance benchmarks.

The FCC and the U.S. Department of Commerce's National Telecommunications and Information Administration (NTIA) have announced a plan for implementation in the United States of the Final Acts of the 2003 World Radiocommunication Conference. The changes adopted by the WRC 2003 will directly impact global spectrum use for government and commercial use of the spectrum. The U.S. achieved its goals at WRC-03 and the FCC, in concert with NTIA, has developed a plan to implement the results of the Conference. Information on the plan and time schedules can be found at: <http://www.fcc.gov/wrc-03/>

The FCC has taken further steps to modernize its satellite licensing procedures. These measures will expedite the satellite licensing process and facilitate public access to the FCC, particularly regarding satellite license filings. The new initiative introduces two interactive forms that will facilitate the application process for satellite and earth station licenses.

Cingular Wireless has announced plans for purchasing NextWave Telecom's licenses to provide wireless service in 34 markets for \$1.4billion. The licenses, 10MHz of broadband PCS (1900MHz) spectrum, covers a potential market of 83million customers. The US operator also reached an agreement with Unwired Inc to purchase spectrum licenses and operations in Texas, Arkansas and Louisiana. Sunshine PCS has also said it has entered into an agreement with Cingular to sell three licenses in Florida worth \$13.75million. Verizon Wireless has also announced it will acquire a PCS license from Devon Mobile Communications to serve the Pittsburgh PA BTA area. Verizon has also agreed to buy a PCS license and certain network assets serving the Lebanon, NH BTA. Leap Wireless has announced it has been authorized to sell 15MHz of spectrum in each of the Idaho Falls and Twin Falls, Idaho markets.

Verizon Wireless has announced the nationwide availability of its Push to Talk service that allows customers to connect directly with other users.

## Industry Forecasts and Surveys

A report released by ARC Group predicts that by the end of 2003 more than 55million consumers worldwide will own camera-phone handsets, doubling the units sold in 2002. The study also expects that by 2005, 130million handsets with camera capability will be shipped globally, whereas the figure will reach 210million by 2008. Although the company expects the Asia Pacific region to lead the market, it also expects Europe to improve its market share. In a different report, Datacomm Research predicts that the main reason why mobile phone subscribers will upgrade to 3G is to download, stream and swap short videos. IDC also forecasts a 178% compound annual growth rate through 2007 in the number of wireless Multimedia Messaging Services (MMS) subscribers, reaching 67million MMS subscribers with camera-phone handsets and 29million MMS subscribers without camera-phone handsets.

Research from Nokia shows that mobile email usage is set to grow 35% in the next 18 months amongst businesses already using mobile phones as enterprises seek to boost competitive advantage from increasingly mobile workforces. The research polled thousands of small, medium and large European companies which provide mobile telephones to employees and have mobile workers. The Nokia research results showed 39 percent of these companies intended to provide mobile workers with mobile email access within 18

months. Beyond mobile email, 19 per cent of businesses surveyed said they would provide access to company information systems such as company databases and intranets from mobile terminals - a growth rate of 202%. Distribution, utilities, real estate, manufacturing, financial and professional service industries will experience the most growth in usage, with utilities/agribusiness and the hotel, restaurant and catering industries predicted to have the highest mobile email penetration amongst mobile providing companies within 18 months. According to research conducted by Analysis Research, 40% of people with a business mobile phone (21million Europeans) will use mobile email in 2008, compared to less than 1% today. The firm also predicts that the annual mobile service revenue generated by email will increase from \$30million in 2003 to \$3.5billion in 2008. In its report, it is expected Western European businesses to be spending \$10billion across all mobile data services by 2008, with 78% of that spend corresponding to small and medium-sized businesses.

According to research conducted by IDC, the worldwide mobile phone market is expected to expand in 2004, surpassing 500million units sold for the first time in history. The firm expects a 42% year-over-year growth in the 2.5G market with more than 241million units being shipped. As for 3G mobile phone shipments, the firm expects this figure to reach 48million units in 2004, which represents a 140% growth over 2003. In a different report, Gartner stated mobile phone shipments in the second quarter of 2003 were up 12% over last year. The firm also said shipments were up 2% sequentially, which seems to be a sign that the stagnation in the sector has ended. According to the firm, particularly strong markets were Japan, Latin America, Central and Eastern Europe, the Middle East and Africa. In terms of total wireless infrastructure contract values, ABI claims these are down 40% year-over-year from the first half of 2002. According to the firm, for the first half of 2003, 3G contracts represented about 13% of all deals signed, representing over \$1billion in contracts for WCDMA. ABI said the current leader Ericsson holds the top slot with 44% of all WCDMA contract awards this year alone.

According to a study from In-Stat/MDR, there will be more than 931million new subscribers over the next five years, with an expected total worldwide wireless population by 2007 exceeding 2billion subscribers. The research conducted showed that while China continues to lead the world in overall subscriber growth, the new percentage growth leaders are found in Southern Asia and Southeast Asia. The firm also found that Western Europe's growth virtually stops during their 2002-2007 forecast period and the region's penetration rate will reach 83.6% in 2007. IDC Japan is predicting the 3G service market in Japan to reach 69million subscribers in 2007 accounting for 77.6% of the 88.9million subscriptions in the entire cellular phone/PHS market. The firm also expects the 3G market to be worth \$54billion in terms of revenue.

According to new figures published by EMC World Cellular Database, the total number of new mobile subscribers in the first quarter 2003 approached 51 million, with GSM accounting for almost 42 million, or 82% of new additions in this period. GSM operators are also the largest in the world with China Mobile at over 144 million, and China Unicom at almost 75 million subscribers with GSM accounting for 65 million, by the end of the first quarter 2003. China still accounts for the largest proportion of mobile growth globally, followed by Asia Pacific, Western Europe and Eastern Europe. GSM has the highest annual growth of any wireless

technology in Latin America and the Caribbean with a 121% increase in customers from June 2002 to June 2003 according to EMC World Cellular Database. Five years ago, GSM was operating in only four countries in the region and has rapidly extended to 36 countries today, making it the fastest growing technology. Wireless carriers in the region currently operate 66 GSM wireless networks.

The Yankee Group is predicting the global wireless user base will increase by 49% over the next 4 years and reach 1.72billion subscribers by 2007. The company is also forecasting that the subscriber revenue will grow from \$387billion in 2002 to \$584billion in 2007, which according to the firm will make wireless services similar in value to worldwide crude oil production.

According to a study from Telephia, business users view push-to-talk voice calling (PTT) as one of today's mobile applications most likely to improve productivity. However, the launch or preparation to launch the PTT service has been slow.

## Wireless LAN and Bluetooth

NEC America and Motorola have announced their intent to collaborate on the development of a converged WLAN, Voice over Internet Protocol (VoIP) and cellular communication solution to create potential cost savings opportunities, improved user efficiencies and new capabilities for enterprise customers. The solution will be enabled by integrating Motorola's core seamless mobility components with NEC's WLAN infrastructure and NEAX family of enterprise communication platforms. Motorola's components include a dual system WiFi/cellular phone and mobility manager that controls the hand-off between local (WLAN) and cellular networks and dispatch functions. The companies will work together towards definitive agreements that will allow them to leverage industry standards such as WiFi and Session Initiation Protocol (SIP) to deliver a flexible, cost-effective communication solution that will provide wireless voice and data communications over IP inside an enterprise or visited WLAN and over public wireless services outside the enterprise.

Texas Instruments has announced a complete hardware and software solution that may solve any interference issues inherent in using Bluetooth and 802.11 simultaneously. The manufacturer said its solution allows a Bluetooth voice call simultaneously with a WLAN data transmission.

WLAN Smart Card Consortium has released a smart card specification to allow hot spot operators to extend SIM technology for WLAN authentication. This specification presents a smart card interface that provides interoperability between smart card and device manufacturers and includes industry standard EAP-based security technologies to allow mobile operators to reuse existing deployments. Moreover, the four members of the Wireless Broadband Alliance have started a pilot trial for wireless broadband roaming in Asia.

Research conducted by Infonetics Research predicts WLAN hardware revenue will double from \$1.6billion last year to \$3.2billion in 2006. According to the firm, WLAN sales topped \$608million in the second quarter of this year and it is predicted sales will reach \$661million in the second quarter of 2004. Another study from Datamonitor predicts the wireless hot spot market to grow, reaching 23million users by 2006. The firm expects that by the end of this year there will be 31,580 hot spots around the world, and about 1.53million within the next three years. As a result, Datamonitor expects the public

WLAN hot spots market to be worth \$7billion by 2006. A survey of IDC found that 34% of respondents use an 802.11 LAN at home, compared with 27% at work. According to the survey conducted, the most daily use of Wi-Fi connections is happening at universities, with travel locations and coffee shops rounding out the three hot spot locations. In terms of services, consumers are mainly attracted by entertainment and messaging, while business users mainly focus on email, PIM, Internet and Intranet access. A study conducted by BroadGroup suggests that European pricing for public access WLANs is still the highest worldwide whereas the USA appears to have a more cohesive price range and is highly competitive. The analysis also expects that the European growth in hotspot deployment will increase by 45% to the end of this year.

Qualcomm and Broadcom Corporation have announced a non-binding agreement for a strategic collaboration to jointly develop, promote and market Bluetooth solutions for CDMA mobile phones. As part of the collaboration, Qualcomm's leading-edge Mobile Station Modem (MSM) baseband solutions, which include fully integrated Bluetooth baseband technology, will be combined with Broadcom's short-range wireless RF products to provide a complete, fully tested Bluetooth solution for 3G CDMA devices.

Ericsson Technology Licensing has announced that they have signed a licensing agreement with Philips' semiconductor division. The agreement states that Philips will license Ericsson's new Bluetooth baseband core, which implements the complete range of mandatory Bluetooth 1.2 features. With the Ericsson Core Bluetooth Baseband Platform Q-E1, Philips will be one of the first companies to offer their customers Bluetooth chips based on the Bluetooth 1.2 specification with, for example, better voice and audio quality and improved coexistence with other wireless technologies.

A study from In-Stat/MDR has reported that final 2002 shipments of Bluetooth chipsets were 35.8million units, which corresponds to a 245% increase over 2001. The company said that the growth was mainly due to GSM handsets, especially those embedded models. According to the study, Asian and European operators, in particular, are looking to Personal Mobile Gateways that use Bluetooth to increase average revenue per unit.

## Wireless Data

Ericsson is rewarding developers of mobile services by launching the Ericsson Mobile Application Awards 2003. Developers from around the world are invited to submit their best applications. The top three applications in one of four categories will compete in the finals on November 25 in Zurich Switzerland. The Ericsson Mobile Application Awards 2003 is an international competition run by Ericsson to find the best, market-ready mobile applications. Services that add value, create convenience and make daily life and work easier and more effective are those that will be widely adopted. There will be four categories with three finalists in each: Best Mobile Entertainment, Gaming, Enterprise and Information Application. Developers of mobile applications may submit their service online at <http://www.ericsson.com/mobileinternetforum>

Telefónica Móviles España, S.A. has announced the introduction of i-mode, the service developed by DoCoMo, to the Spanish market from the beginning of June 2003. Spain marks the seventh market for i-mode service, which is already available in Japan, Germany, the Netherlands, Taiwan, Belgium and France.

NTT DoCoMo and Wind Telecomunicazioni have announced that they have started a strategic i-mode partner-

ship in the Italian market. As a result of this partnership with Wind, DoCoMo will have the opportunity to deliver the i-mode service it developed to Europe's most competitive mobile market. The agreement also introduces Wind into the i-mode alliance, the group led by DoCoMo that comprises all the operators that have launched i-mode, and that offers its members the opportunity to market handsets specially adapted for their own services. The agreement, which will remain in place for five years from June 2003, is renewable by mutual accord and is an exclusive contract with Wind in Italy for Wind's 2G and 3G.

## Forums and Industry Alliances

Ericsson, Huawei, NEC, Nortel Networks and Siemens have announced the creation of a new industry cooperation, CPRI - Common Public Radio Interface, aiming to define a publicly available specification for the key internal interface of radio base stations. The CPRI industry cooperation enables base station manufacturers to focus their research and development efforts on their core competencies and to buy selected radio base station subsystems. Key benefits are faster development when introducing new technologies and allowing base station manufacturers to offer a wider portfolio of products to the operators with shorter time to market. The founders of CPRI are committed to open up a competitive mobile network element component industry and will make the CPRI-interface openly available for the benefit of the wireless industry. The CPRI-initiative complements current activities in existing standardization organizations (for example, 3GPP/3GPP2). The CPRI-specification is planned to be available during 2003, with the objective to introduce compatible products on the market by the end of 2004.

Motorola, Nokia, Siemens, Sony Ericsson and Sun Microsystems, have announced plans to unify their application testing and certification programs into a single initiative that will help accelerate the availability of applications and services for Java technology-enabled wireless devices. The initiative will set common certification criteria for content testing that the participants aim to make a symbol of consistent quality in the wireless industry. In support of the initiative, Sun will provide a Java logo under license for applications that have passed certification testings.

The Mobile Industry Processor Interface (MIPI) Alliance, a new industry initiative that will define and promote open standards for interfaces to mobile application processors, has been announced by founding members ARM, Nokia, STMicroelectronics and Texas Instruments. The MIPI Alliance is a response to the broad interest in the OMAPI standard launched by ST and TI in December 2002. OMAPI was formed by TI and ST to standardize interfaces for mobile application processors. The new MIPI Alliance has been established with the goal of defining and promoting open, standard specifications for application processor interfaces. By establishing consistency in application processor interfaces, the alliance expects to ease implementation and design of hardware and software, promoting reuse and compatibility in mobile devices to accelerate time-to-market. As part of the MIPI Alliance, 10 working groups will be established to develop specifications in key areas such as camera and display interface, software abstraction, communications interface and system control.

The Open Base Station Architecture Initiative (OBSAI), a forum creating open specifications for base station archi-



ecture, has announced the availability of the first OBSAI interface specifications. The recently finalized specifications apply to interfaces between a base station's control, transport, and base band functions. Currently, a number of OBSAI members are working on implementing products based on these interface specifications. As a result, mobile operators will benefit from increased functionality and the ability to get advanced services to market more quickly.

Nokia and SEGA Corporation have announced a definitive agreement in which Nokia will acquire assets of Sega.com Inc., a subsidiary of SEGA. This agreement will further enhance online games and service offerings for the Nokia N-Gage game deck, as Sega.com's leading multi-player technology will now become an integral part of the Nokia N-Gage experience.

## Wireless, PMR and Public Safety

Motorola has unveiled, what it claims is, the industry's first solution that provides both Project 25 voice and advanced wireless data communications using a single platform – Mission Critical IP. Mission Critical communications systems require high system reliability, open standards and dedicated spectrum to guarantee communication paths are available when public safety users need them. The Mission Critical IP platform is designed to achieve this objective. In addition to supporting advanced Project 25 voice capabilities, the Mission Critical IP platform enables multiple data applications to operate at varying data rates across both wide and local areas. It helps optimal network performance and allows users to move seamlessly across the coverage area without interruption to their applications. Motorola's Mission Critical IP platform accommodates ASTRO Integrated Voice and Data, as well as High Performance Data solutions. New capabilities will continue to be built on the Mission Critical IP platform including offerings in the 700 MHz wideband spectrum, as well as the 4.9 GHz frequencies. Moreover, the manufacturer unveiled the communications industry's first full suite of Project 25 compliant integrated mobile, portable, voice and data communications solutions at the Association of Public Safety Communications Officials International (APCO) Conference.

Motorola has also announced the introduction of a new range of security products for TETRA digital radio systems that will further protect emergency services' communications. The new suite of software products, named Dimetra SecureNet, provides an important new level of protection against criminal eavesdropping on communications, impersonating officers on the air and deliberate clogging of radio systems at crucial times. According to the manufacturer, the company has been the first to have Class 3 encryption on trial with the Police Service of Northern Ireland. Although ETSI Class 3 encryption has been available for test and demonstration purposes for some time, Motorola is the first company to roll out ETSI Class 3 encryption in its Dimetra

SecureNet system. The Dimetra SecureNet system uses embedded encryption measures to protect not just the transmission content, but also user identities and signalling data. On the other hand, Nokia has announced its TETRA system and three TETRA radios have been granted the world's first TETRA Class 3 encryption interoperability certification. Class 3 combines efficient authentication of radio terminals with content encryption secured by automatically generated dynamic ciphering keys.

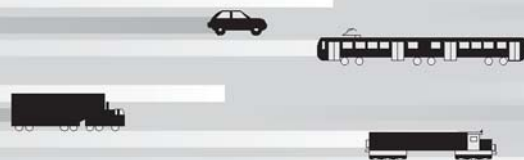
Siemens Business Services has implemented Europe's largest mobile emergency call system for the Italian police force. The system has gone live in 113 Italian cities. A total of 102 provincial command centers have been equipped with state-of-the-art call center technology and linked up via GSM to some 8000 Carabinieri vehicles, which are in turn equipped with the GPS satellite navigation system.

## Other News

The Norwegian National Rail Administration has placed an order with Siemens' mobile to construct a national GSM-Railway (GSM-R) mobile radio network. A total of 700 trains, 3,800 km of track, and 650 tunnels will be fitted out with the new system. Construction will begin in August 2003 and is scheduled to be completed by April 2006.

The industrial prime consortium Galileo Industries have announced the signature of a M.O.U with a new partner, Thales Group. Thales is acquiring an equity share of 12% in the joint venture for an undisclosed sum. Galileo Sistemas y Servicios (GSS), the Spanish industrial consortium representing the major Spanish actors in satellite navigation, (Aena, Alcatel Espacio, Eads-Casa, GMV, Hispasat, Indra and Sener) has also completed its equity stake in Galileo Industries SA after the signature of the shareholders agreement. GSS major contributions to the Galileo programme will be at system, subsystem and equipment levels. In the Galileo satellites themselves as well as in the Ground Control Segment and Mission Control Segment, GSS will bring its recognised expertise and equally co-operate with the main European Aerospace actors.

Alcatel Space has signed a \$150 million contract with RascomStar-QAF, the pan-African satellite service operator, to build and deliver in orbit the first RASCOM telecommunication satellite dedicated to the African continent. Alcatel Space will supply both the in-orbit delivered satellite and its associated ground infrastructure including the mission, business, and ground control segments. RASCOM, a pan-African intergovernmental, commercial satellite organisation, has a membership of 44 African countries as of now. This satellite will offer RascomStar-QAF the capability to provide fixed voice, data telecommunications and Internet access as well as broadcasting satellite services to the whole African continent, although its footprint extends beyond Africa to include part of Europe and of the Middle East.



## VTC2004-Spring: Towards a Global Wireless World

17-19 May 2004 Milan

### New Date and Location

The rising value of the Euro has made our intended venue at Genoa very expensive, so the 59th Vehicular Technology Conference has been moved to the neighboring city and the following week. VTC2004-Spring will now take place in the Milan Marriott from 17 to 19 May 2004.

### Milan

Milan has many attractions – the impressive Duomo, a Gothic cathedral which took 500 years to complete, the 19th century ‘shopping mall’ Galleria Vittorio Emanuele, or even the National Museum of Science and Technology, with its permanent Leonardo da Vinci exhibits. The city also hosts Leonardo’s Last Supper, in the church of Santa Maria della Grazie, along with many art galleries.

Milan is easy to get to. The main international airport is Malpensa, with a direct train link into the city center, and the city is also served by Linate and Bergamo airports. A comprehensive bus and tram network, supplemented by 3 metro lines, provide an integrated public transport service.

### Technical Sessions

With 680 papers over more than 90 sessions, Milan will be the biggest VTC held outside the US. The main conference includes tracks on Antennas and Propagation (9 sessions), Transmission Technology (28), Wireless Access (21), Mobile Networks (19), Mobile Applications (4), Satellite Networks (4) and Transportation (2). VPP papers will be covered at the VPP Symposium in Paris in October. There will also be a Special Workshop on WLAN/3G Interworking.



The 59<sup>th</sup> Vehicular Technology Conference, VTC2004-Spring will be held in Milan, Italy, from the 17<sup>th</sup> to the 19<sup>th</sup> of May 2004.

The full program is available at the VTC web site, [www.vtc2004spring.org](http://www.vtc2004spring.org)

## Panels

Following the success of the panels at VTC2003-Fall in Orlando, panels will be held bringing together experts from industry and academia to discuss future trends in mobile communications.

## Sponsoring and Exhibiting

VTC2004-Spring will feature a number of exhibits. If your company is interested in exhibiting, contact ICT Strategies Group, [TEStrong@verizon.net](mailto:TEStrong@verizon.net) (phone +1 508 359 9106).

## Web Site

For full details of the conference, as well as on line registration, visit the web site at [www.vtc2004spring.org](http://www.vtc2004spring.org)

## Tutorials

A wide range of tutorials will be held during the conference, given by experts from industry and academia.

### T-01 WLAN/3G Interworking

*Apostolis Salkintzis, Motorola*

The recent evolution and successful deployment of WLAN systems worldwide has fueled the need for interworking mechanisms between WLANs and cellular telecommunication networks, such as GSM/GPRS, UMTS, cdma2000, etc. Several forums and standardization bodies worldwide have already initiated activities for exploiting WLAN technology and integrating this technology into cellular telecommunication networks. In addition, several R&D projects are currently underway, which address vertical handovers between WLANs and UMTS, as well as common authentication, authorization and accounting procedures. It is evident that the integration of WLANs and cellular telecommunication networks is of paramount importance nowadays, from both business and technology points of view. This tutorial will concentrate on this integration and will thoroughly examine all the alternative architectures proposed to date for interworking between WLANs and 3G cellular systems. In addition, it will address the key technical issues, such as security, quality of service, billing, roaming, etc.

### T-02 High speed packet data support in IS-2000 (1xEV-DV)

*Srinivasan Balasubramanian, Wanshi Chen, David Comstock, Thawatt Gopal, Patrick Hosein, Anthony C. K. Soong, Shawn Shiau-He Tsai, Tao Wu, Rath Vannithamby, Young C. Yoon, Ericsson*

The wireless communication industry is currently in a state of transition from second generation (2G) to third generation (3G) systems — a move from circuit-switched, mainly voice services to multi-media services that include voice, packet data and video. The IS-2000 family of standards is based upon code division multiple access (CDMA) technology and is one of the defined modes in the International Telecommunication Union (ITU) 3G wireless standard. The early revisions of the CDMA2000 standard support high-speed data transmission (up to 307.2 kbps) using dedicated data channels. The latest revision, Revision D, significantly increases the efficiency of the air interface by introducing high-speed packet data channel support in both the forward (with peak rate of 3.091 Mbps) and reverse (with peak rate of beyond 1Mbps) link while maintaining back-

ward compatibility with previous revisions. This revision, commonly referred to as 1xEV-DV (for 1xRTT Evolution for high-speed integrated Data and Voice), will be completed by the first quarter of 2004 and will be submitted to ITU in May 2004 for inclusion in the next revision of its 3G standard. This tutorial covers a number of key features of 1xEV-DV as standardized in IS-2000 Revision D. It will discuss extensively the support for high speed packet data in both the forward (base station to mobile) and reverse (mobile station to base station) link. The former includes the design of the high-speed shared data channel, its components (Hybrid-ARQ, link adaptation, modulation and coding, scheduling, sector-switching, channel supervision, control/hold etc.), MAC, and the effect of mixing data and voice services. The details of how 1xEV-DV exploits channel variation, channel quality feedback and link adaptation to significantly increase the spectral efficiency will be given. The latter includes the design of enhanced reverse link high-speed packet data service, MAC operation, rate control and power control. Detail discussions into the enabling technologies and how Rev D exploits these technologies to improve the reverse link average per sector throughput by more than a factor of 2 over that of Rev C will be presented. System performance simulation results and implementation issues will also be discussed.

### T-03 Integrated Public Wireless Networks

*Milind Buddhikot, Lucent Technologies*

Local and wide-area wireless data networks are becoming increasingly important in providing ubiquitous seamless connectivity to end-users. Third generation wide-area networks such as CDMA-2000 and UMTS have been standardized and are gradually being deployed. In local-area wireless networks common in enterprises, home and public hot spots, the IEEE 802.11b standard is seeing explosive growth. This tutorial will provide detailed discussion of the state-of-the-art architectures, protocols, network elements, systems and open research questions in key broadband wireless technologies such as 802.11, CDMA2000 and UMTS. Particular emphasis will be on the aspects of security and service integration between different technologies, as seamless inter-technology roaming and ubiquitous connectivity are perceived as the key to the success of broadband wireless.

### T-04 Turbo Tranceivers for Wireless Communications

*Lajos Hanzo, University of Southampton, Tadashi Matsumoto, University of Oulu*

Discovery of the Turbo codes has driven research on the creation of new signal detection concepts that can, in general, be referred to as the Turbo approach. Recently, this approach has made a drastic change in creating signal detection techniques and algorithms such as equalization of inter-symbol interference (ISI) experienced by broadband single carrier signaling over mobile radio channels. A goal of this tutorial is to provide the course takers with broad views and knowledge of Turbo codes by explaining how the Turbo concept-based signal transmission techniques are developed in various applications, and how they improves performances. To achieve this goal, the two instructors (Prof. Lajos Hanzo and Prof. Tad Matsumoto) introduce the Turbo concept-based techniques from their own viewpoints and backgrounds.



### Special Reader Offer

VTS members may register for tutorial T-04 on turbo codes at a special member rate of \$50. Simply register online, using the voucher code VTS5002 on the front page of the registration site (see [www.vtc2004spring.org](http://www.vtc2004spring.org)) Note that you do not have to register for the conference to attend the tutorial.

### T-05 Distributed-MIMO Multi-Stage Communication Networks

*Hamid Aghvami, Mischa Dohler, Kings College, London*

The aim of this tutorial is to expose an industrial and academic audience to the challenges related to the analysis, design and deployment of recently emerged Distributed-MIMO Multi-Stage Communication Networks at PHY, MAC and network layers. The logical thread of the tutorial, ranging from the underlying Shannon theory to resource allocation and scheduling within distributed networks, proves vital in conveying the most essential issues relating to the design of these networks. The tutorial will commence with a brief overview of distributed-MIMO multi-stage communication networks, including their potential applications as well as engineers' objectives when designing such networks. This will be followed by a review of MIMO Shannon theory and relaying technologies, both of which constitute inherent ingredients to the understanding of the gains offered by distributed relaying networks. A thorough Shannon theory of these networks will then be presented with novel twists on closed form capacity formulas over ergodic and non-ergodic, traditional and orthogonalised MIMO channels obeying various channel fading statistics. The output from this will be shown to be useful in deriving explicit optimum fractional resource allocation rules such as to achieve optimum end-to-end throughput. The analysis, design and performance of distributed space-time block and trellis codes, concatenated with outer channel codes, will be dealt with in sufficient depth. The derived deployment guidelines will then be utilised to design properly functioning MAC protocols, which reflect the characteristics of the underlying distributed PHY layer as well as the served IP traffic. Performance examples will be given, and important cross-layer design guidelines elaborated upon. Finally, open research topics for academia and industry will be suggested.

### T-06 Time Division Duplex (TDD) - The Key Enabler for Future Services

*Harald Haas, Stephen McLaughlin, University of Edinburgh*

This tutorial aims to provide a perspective on the key drivers for present and future cellular communication systems and some of the key technologies. Future cellular systems need to support a plurality of different high data rate services with different load requirements for uplink and downlink efficiently. Therefore, the presenters see a major challenge of the future in research on and the deployment of the appropriate duplexing technique instead of multiple access technique as was the focus in the past. In this context, also using TDD in cellular systems seems to be the most appropriate choice. Therefore, in this tutorial the properties of TDD are discussed in detail especially when used in a cellular environment. This involves a discussion of combining strategies of existing FDD based air interfaces (e.g.

UTRA-FDD (UMTS terrestrial radio access)) and TDD based air interfaces (e.g. UTRA-TDD, IEEE 802.11, etc.).

### T-07 Software Defined Radio Design for 3G

*Paul Burns, Mark Reed, Simplexity Communications*

If you are a student, engineer or manager interested in learning more about software defined radio and its role in wireless telecommunications and 3G, then this seminar is one you must attend. The session covers the basic principles of the technology and its potential as well as delving into many areas of detailed design. The 3G air-interfaces for UMTS/WCDMA and cdma2000 are thoroughly discussed with coverage of TDMA-GSM. Topics include, hardware & software architecture, RF system design, ADC's, DAC's, DDC's, DUC's, DSP's, capacity improving algorithms, multi-user detection, smart antennas, EDA tools and the future of SDR for 3G. The seminar is presented by Paul Burns ("Software Defined Radio for 3G" author) and Mark Reed (Senior Researcher National ICT Australia) who have extensive industry and academic experience in software defined radio and 3G. Seminar contents Introduction and Baseline SDR Architecture 3G RF System Design Analogue To Digital And Digital To Analogue Conversion Signal Processing Hardware Components for 3G Software Architecture And Components for 3G Applications For Wireless Systems Capacity Improving Algorithms Using Software Radio - Introduction Capacity Improving Algorithms Using Software Radio - Multiuser Detection (MUD) Overview Capacity Improving Algorithms Using Software Radio - MUD Architectures with SDR 3G Physical Layer Basestation SDR Example Engineering Design Assistance (EDA) Tools The Future Of SDR Seminar

### T-08 Beyond 3G Networks: The Air Radio Interface Technologies

*Milica Pejanovic, University of Montenegro*

This tutorial addresses emerging air radio interface solutions for the future Beyond 3G (B3G) or 4G networks. The generations of mobile communication systems have been identified by the technology implemented at the air radio interface. The capacity, performance and the implementation complexity of the systems are determined with the main building blocks of this interface. It can be considered one of the most challenging segments in the process of B3G networks standardization. That is the reason for this tutorial to be focused on description of the main requirements and the state-of-the art achievements in the air interface technologies for the B3G networks. First, requirements for B3G air radio interface are identified as well as targeted spectral efficiency. Then, the main air interface building blocks are presented. The following topics are covered: multiple access techniques (based on spread spectrum and multi-carriers), advanced signal processing techniques (multi-user detection, turbo codes), multiple antennas solutions (transmit/receive diversity, smart antennas). In that way, the tutorial provides the full understanding of the all challenging and open issues related with the current and future research and development in the field of the air radio interface for B3G networks.

### T-09 MAC and Routing Protocols for Ad Hoc Wireless Networks Using Smart Antennas

*Somprakash Bandyopadhyay, Indian Institute of Management*  
Mobile Ad Hoc Networks (MANET) is a new paradigm of wireless local area network enabling instantaneous group communications immediately and easily without the aid of

any established infrastructure or centralized administration. Usually, the user-terminals in ad hoc networks are equipped with omni-directional antennas. However, ad hoc networks with omni-directional antenna normally use a medium access mechanism that wastes a large portion of the network capacity by reserving the wireless media over a large area. To overcome this problem, researchers have proposed to use directional or adaptive antenna that would largely reduce radio interference, thereby improving the utilization of wireless medium and consequently the network throughput. This tutorial will first present an overview of basic MAC and routing protocols in ad hoc networks with omnidirectional antenna to discuss the issues and challenges. Subsequently, the tutorial will focus on the use of smart antennas in ad hoc networks and discuss the strategies and techniques to be used in designing MAC and routing protocols for improved medium utilization and improved routing performance with effective load balancing. Finally, it will discuss some of the design issues related to QOS-Aware MAC and routing protocols with smart antennas to illustrate the potential of these antennas vis-à-vis omni-directional antennas in the context of ad hoc networks. Open problems and challenges for ad hoc networks with smart antennas and their applicability in inter-vehicular communications conclude the presentation.

## T-10 The role of High Altitude Platforms (HAPs) within the Galileo locally assisted services

*Mirko Antonini, Daniele Teotino, Marina Ruggieri, University of Rome "Tor Vergata"*

Galileo will provide the first satellite positioning and navigation system specifically for civil purposes. The mission requirements were developed with a service-oriented approach. Business plan and market researches studies have shown that commercial services should play an important role on producing Galileo revenues. Nevertheless, communication capabilities are a must for advanced navigation related services. In this frame, the Galileo local components, that aim at enhancing Galileo navigation performance and capabilities, will play a key role in the future navigation system. The paper aims at explaining this role, considering, in particular, the High Altitude Platforms (HAPs) as local components. Some integration scenarios with 3G and 4G terrestrial communication networks are shown and detailed. Therefore, commercial applications of the local component concept are foreseen. The scenarios propose a frame of guaranteeing service agreements for advanced telematics and info-mobility applications. Finally, this frame could drive the price of selling policies regarding to public utilities services, best effort commercial services and guaranteed commercial services.

## Standards

*Dennis Bodson, Senior Editor*

### IEEE-SASB Approves New VT Standards

The IEEE Standards Association Standards Board (IEEE-SASB) at their June 2003 meeting approved 2 new VT standards as follows:

- ◆ **P1474.2/D9.2 (VT/RT) Standard for User Interface Requirements in Communications Based Train Control (CBTC) Systems.** This standard establishes user interface requirements in communications-based train control (CBTC) systems. Project purpose: This standard will provide for consistent user interfaces that take advantage of the characteristics of communications-based train control (CBTC) systems to enhance service effectiveness of a rail transit system.
- ◆ **P1568/D4.2 (VT/RT) Recommended Practice for Electrical Sizing of Nickel-Cadmium Batteries for Rail Passenger Vehicles.** This recommended practice describes methods for electrical sizing of nickel-cadmium batteries for application of rail passenger vehicles used for battery backup of low voltage dc

auxiliary power systems. It encompasses various factors that govern the electrical size of the battery including but not limited to number of cells, rated capacity, maximum system voltage, minimum system voltage, correction factors, and margins. It does not describe methods for defining the dc load profile nor address the physical sizing, installation or maintenance of the batteries. Nor does it apply to batteries used for motive power or starting internal combustion engines. Design of the low voltage dc system and sizing of the low voltage power supply and battery charger(s), and consideration of battery types other than nickel-cadmium batteries are also beyond the scope of this recommended practice.

### IEEE-SA News Spotlights IEEE Incident Management Working Group (P1512™)

P1512 standard will be a base standard for Incident Management message sets, which will be used by all response

and/or dispatch centers such that the exchange of information will be standard and produce the needed responses(s). This standard will be limited to the common incident management message sets for use by emergency management centers. This project shall include the necessary research and compiling, analyzing, and the consolidation of the results into message sets for Incident Management communications.

Incident management represents a major element of the ITS infrastructure. Working in cooperation with the USDOT, the IEEE is developing a family of message set standards — known as 1512 — that enables the sharing of incident management messages among different ITS systems and public safety entities.

P1512 will result in consistent standardized communications among the many management centers including incident, emergency, fleet, freight, transit, and traffic, plus information service providers, and planning subsystems that will reduce duplication of messages among the various subsystems and increase effective response time.

Overseeing the work of P1512 is the IEEE Standards Coordinating committee (SCC) 32 Intelligent Transportation Systems (ITS). Organized in 1992, SCC32 is responsible for coordinating, developing, and maintaining standards, recommended practices, and guidelines related to ITS. The SCC32 work includes efforts under a cooperative agreement between USDOT and IEEE to expedite development of standards, including standards for ITS data dictionaries, the Message Set Template, and the message sets for Incident Management.

## **New IEEE 802.11g™ Standard Extends Data Rate of IEEE 802.11b™ WLANs to 54 Mbps from 11 Mbps**

IEEE 802.11b™, the most widely used wireless local area network (WLAN) technology, has gotten a long-awaited increase in speed through a new amendment to the IEEE 802.11™ standard ratified by the Standards Board of the Institute of Electrical and Electronics Engineers. The amendment, IEEE 802.11g™, raises the data rate of IEEE 802.11b networks to 54 Mbps (megabits per second) from 11 Mbps.

The added transmission speed gives wireless networks based on IEEE 802.11b (often called Wi-Fi) the ability to serve up to four to five times more users than they now do. It also opens the possibility for using IEEE 802.11 networks in more demanding applications, such as wireless multimedia video transmission and broadcast MPEG.

The new amendment allows IEEE 802.11g units to fall back to speeds of 11 Mbps, so IEEE 802.11b and IEEE 802.11g devices can coexist in the same network. The two standards apply to the 2.4 GHz frequency band. IEEE 802.11g creates data-rate parity at 2.4 GHz with the IEEE 802.11a standard, which has a 54 Mbps rate at 5 GHz. (IEEE 802.11a has other differences compared to IEEE 802.11b or g, such as offering more channels.)

“IEEE 802.11g gives WLAN suppliers and users added flexibility in choosing systems that best fits their needs,” said Stuart J. Kerry, IEEE 802.11 Working Group Chair. “Given the millions of 802.11b-based WLANs in place worldwide, the market demand for the extension to 54 Mbps has been quite strong. “One reason for this is that the higher speed extends the use of this widely deployed WLAN technology into a growing variety of home, consumer, business and public networking applications. In addition to making IEEE 802.11b networks more efficient, the new amendment

ensures users that the equipment in these networks will be interoperable.”

In terms of the effort needed to create the new amendment, Kerry noted that the IEEE 802.11 Working Group for Wireless LANs contains nearly 400 individuals with voting status who are affiliated with computer, networking and software companies, as well as with consultant organizations and academic institutions. “The members of the Working Group put forth a great deal of effort to make this standard a reality,” he said. “They are to be congratulated for their achievement.”

## **Wireless Rides on IEEE 802's Success**

The world is going wireless and the IEEE 802 suite of networking standards is helping to make it happen.

From wireless local-area networks in homes and fast-food joints, to broadband and fiber-optic wireless connections in office buildings, IEEE 802-based standards are the reason people are communicating more and more through high-speed Internet connections anytime and from nearly anyplace.

IEEE 802.11b, better known as Wi-Fi, has become one of the most widely adopted standards, and the extension to IEEE 802.11g will continue this process.

Another standard extension, IEEE 802.16a, was introduced last January. For so-called fixed wireless, it is meant for high-speed wireless access to businesses and residences over large metropolitan areas. Fixed wireless refers to a system in which client stations must stay within range of their designated base stations; there's no handing over of calls from one base station to another, as in an ordinary cellular system. Fixed wireless users can communicate over distances of up to 50 km at bit rates as high as 74 Mb/s. Sriram Viswanathan, a director of Intel Capital's Broadband and Wireless Networking Investments group, calls IEEE 802.16 “the next big thing after IEEE 802.11-based wireless LANs.”

Although it appears that the IEEE's wireless standards have burst on the scene out of nowhere, they have been in the works since 1990. At that time the first IEEE 802 standard, called the IEEE 802 10BASE-T Ethernet wired standard, was introduced to meet the emerging demand for high-performance, low-cost networking technology.

Similarly, low-cost chips and wireless products based on the IEEE 802 extensions coupled to consumer demand and volunteers' hard work all came together in the last few years to make the IEEE 802 suite of wireless standards one of the most widely accepted in the marketplace, says Senior Member Paul Nikolich, the IEEE 802 Working Group chair. He is a partner in YAS Broadband Ventures, a consulting company in Andover, Mass., USA, that provides advice on standards, technology, and investing.

“One of the biggest factors in the standards' success was being in the right place at the right time coupled with excellent execution,” Nikolich says. “There was a tremendous increase in demand for communications technology throughout the 1990s, and IEEE 802 happened to be focused on providing the standards necessary to meet the needs of that market.”

## **Breaking the price barrier**

Another factor contributing to the standards' success is that while the transmission speed and performance of IEEE 802-based products increased, their costs stayed low. Or, as Nikolich says, the “technology breached the magical price-performance barrier.”



According to Nikolich, while the speed of IEEE 802 wired and wireless standards continues to increase significantly, the price of products using these standards goes up modestly. "Prices continue to stay low because we've standardized the technology," he says, "plus there is more competition among chip and equipment manufacturers."

Nikolich adds that low-cost broadband access through digital subscriber lines and cable modems also has created new markets for wireless applications. Consumers with multiple home computers can now wirelessly network their equipment. AT&T Corp. recently announced that it will offer more than 2000 Wi-Fi access points, otherwise known as hotspots, in Asia, Europe, and the United States. Other companies already offer hotspots in public locations like airport lounges, Starbucks coffee shops, and McDonald's restaurants.

### **Dedication and reputation**

Many people toiled behind the scenes to make the wireless standards a success. As with other standards working groups, the volunteers for IEEE 802 consist of many individuals, some representing their companies and some just interested in advancing the technology.

"Hundreds, on into thousands, of people contributed to the work of IEEE 802 over the past 23 years," Nikolich says. "The work wasn't done by the IEEE itself or by the IEEE 802 Working Group alone, but by many engineers who dedicated a huge amount of time."

The IEEE's reputation in the standards development arena also can't be underestimated, according to Edward Rashba, manager for new technology programs at the IEEE.

"One of the unique things about the IEEE is that we are neutral and provide a level playing field," Rashba says. "We try to include as many folks in the standards development process as possible, because then you have a bigger, broader acceptance at the outset. When you have the interest of the user community, the manufacturers, and the general public all reaching an agreement, then you are more likely to get a standard that will be adopted."

### **IEEE Approves Standard for Assessing Radio Frequency Fields in the Human Head during Cell Phone Use**

The IEEE has approved a new recommended practice, IEEE 1528(TM), for assessing radio-frequency energy delivered to the heads of users of cellular phones and other personal communication devices based on a model of the human head filled with a fluid having the microwave electrical properties similar to a composite head tissue. IEEE 1528, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques," specifies experimental protocols and measurement and validation methods for hand-held wireless transceivers

operating between 300 MHz and 3 GHz. This new standard will help wireless device manufacturers and regulators assess compliance with the requirements of the U.S. Federal Communications Commission (FCC) and similar government agencies in other countries — that limit RF exposure from personal communication devices.

Measurements under the standard are made using an electric field probe that scans the tissue-equivalent liquid inside the model head and measures maximum SAR in volumes of one or ten grams. The model is intended to give a conservative estimate of the maximum peak spatial-average SAR that can be expected to occur anywhere in the heads of most people when they use hand-held communication devices held against their ear.

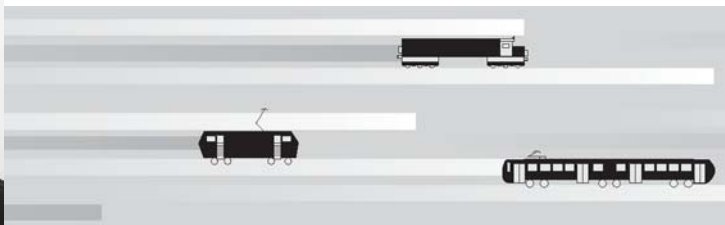
"This standard breaks new ground," says Howard Bassen, Chair of the IEEE 1528 Working Group and Chief of the Electrophysics Branch at the FDA Center for Devices and Radiological Health. "It is the first one to address the complex issues, instrumentation requirements, and uncertainty of performing accurate SAR measurements. "Many of the world's top experts in SAR measurement helped author this recommended practice. The importance of IEEE 1528 can be seen in the fact that the U.S. FCC utilized much of the standard's technical requirements in FCC Bulletin OET 65, Supplement C, while IEEE 1528 was still in draft form."

IEEE 1528 was sponsored by the IEEE Standards Coordinating Committee 34 for Electromagnetic Energy Product Performance Safety. It was developed with a number of members who also have common membership in the International Electrotechnical Commission's Technical Committee 106 to ensure harmony with the IEC's efforts. This IEEE standard does not set specific limits for exposures of users of cellular phones and other personal communication devices, but it may be used for assessing compliance with limits found in a number of contemporary standards and guidelines. These limits are set by the FCC in the U.S and are based in part on IEEE C95.1(TM)-1991, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz." Government agencies in other countries have adopted similar limits.

To learn more about radio-frequency emissions from cellular phone handsets, see the technical information statement issued by the IEEE Committee on Man and Radiation, "Human Exposure to Radio Frequency and Microwave Radiation from Portable and Mobile Telephones and Other Wireless Communication Devices," which is available at <http://www.ewh.ieee.org/soc/embs/comar/phone.htm>.

### **References**

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3. IEEE Institute, Kathy Kowalenko, September 5, 2003
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## Transportation Systems

*Harvey Glickenstein, Senior Editor*

**The Port Authority of New York and New Jersey restored service to the Exchange Place station of PATH on June 27.** Service to Exchange Place was stopped when the World Trade Center buildings in New York came down. The PATH station in lower Manhattan was damaged and no longer available. Exchange Place, the last stop in New Jersey had no provision to turn trains, so PATH service to Exchange Place was stopped as well as service to lower Manhattan.

The Port Authority took advantage of the elimination of service in the oldest tunnels under the Hudson River, tunnels that were almost 100 years old, to completely rehabilitate them. The tunnels were cleaned out and new track and new duct line installed.

The Exchange Place station was modernized as well. Although PATH operated eight-car trains from Newark to the World Trade Center station, the platform at Exchange Place was too short to accommodate the eight-car trains. The first car of all trains to the World Trade Center from Newark would not open its doors at Exchange Place. The rehabilitation of the Exchange Place station included boring new tunnels to allow crossovers to be installed at the west end of the station so that trains could turn back at Exchange Place before entering the tunnels under the Hudson River and lengthening the platforms to accommodate ten-car trains for the future.

PATH service to lower Manhattan is expected to resume by the end of November. A temporary station, using portions of the old World Trade Center station that were not destroyed, will go into service at that time. The temporary station will be open to the air with canopies. The design and construction of the new permanent World Trade Center station will be coordinated with the lower Manhattan redevelopment. It is intended to incorporate as much as possible of the temporary station into the permanent station in order to minimize cost and inconvenience to the passengers.

PATH is the process of modernizing its signal system and procuring new cars. As this issue of *VTS News* was going to press the project was in the process of being advertised. It consists of acquiring 246 new cars and rehabilitating 95 PA-4 cars that were acquired in 1986-1987. The signal system upgrade will start with a feasibility study of installing a communications based train control system vs. simply upgrading the existing fixed block signal system that uses physical train stops for speed and signal enforcement.

**New Jersey Transit is opening its new Secaucus Transfer Station on Amtrak's Northeast Corridor (NEC) in three stages.** The station is located on the NEC between Penn Station, Newark and Penn Station, New

York. It is a multi-level station that will provide for transfers between New Jersey Transit's Bergen County and Main Line service from Hoboken, New Jersey to Spring Valley, New York, Metuchen, New Jersey, and Port Jervis, New York and New Jersey Transit's service between Newark and New York City.

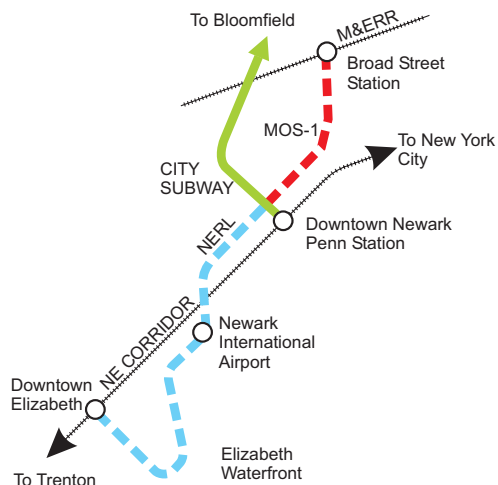
The station is also expected to spark development and has been built to accommodate office, commercial, and hotel space adjacent to or above it. A new interchange on the New Jersey Turnpike is being planned to serve the complex.

The first stage of the station opened in early August. It is on the lowest level of the station—the Bergen County and Main Line level. In order to accommodate new road access to the site the Bergen County Line has been relocated to join the Main Line north of the station. This eliminated service to the Harmon Cove Station on the Bergen County Line. New Jersey Transit (NJT) has instituted a free shuttle bus from the former Harmon Cove rail station to the Secaucus Transfer station. Commuters transfer between the busses and the trains on the lowest level of the new station.

This Fall the rest of the station will open on weekends only. The trains on the NEC will serve the second level of the station. The NEC has been widened from two tracks to three tracks east and west of the station. Four tracks are provided with the station itself. Provision has been made for the future construction of a connection from the lower level to the NEC level allowing a one-seat ride from the Main Line and Bergen County locations into Penn Station, New York. Due to the station's proximity to New York, NJT was concerned that conductors would not be able to collect tickets of passengers transferring at the station. Instead, NJT will require all transferring passengers to go to the third level, where station fare collection will be in effect. NJT will also institute a transfer charge that will be collected on the third level.

The original plan for the transfer station assumed that commuter trains destined for New York would have available seats due to the commuters who get off in Newark and transfer to PATH service to lower Manhattan. With the closure of the PATH service to lower Manhattan, these commuters stay on the NJT commuter trains. NJT will open the station during the week after the PATH service to lower Manhattan resumes later this year.

**New Jersey Transit is holding a public hearing on the Elizabeth segment of its Newark Elizabeth Rail Link (NERL).** The first of three minimum operable segments, MOS-1, is a one-mile extension of the Newark City Subway from Newark Penn Station, the Amtrak station in Newark, to Broad Street Railroad Station. New Jersey Transit's former Penn Central and Central Railroad of New



**Figure 1 Newark Elizabeth Rail Link (NERL)**

Jersey commuter trains serve Penn Station, while New Jersey's former Erie Lackawanna commuter trains serve Broad Street Station.

MOS-1 is currently under construction.

MOS-2 is a one-mile extension from Newark Penn Station to Camp Street in south Newark. MOS-3 is a seven-mile extension further south to Elizabeth, with a stop at Newark International Airport.

At the request of Union County, New Jersey Transit is revising the alignment of MOS-3 between downtown Elizabeth and the Airport. The change in alignment will require a modification to the previously approved environmental impact statement for the NERL, necessitating the new public hearing.

The 5.8-mile portion of MOS-3 will start in downtown Elizabeth. It will be predominantly double track using right-of-way of Conrail, CSX, and Norfolk Southern to the New Jersey Gardens Mall. From the mall to the Parking Lot D stop on the Newark Liberty International Airport Monorail the line will use a new right-of-way. There will be nine stations on this portion of NERL.

No dates have been set for start of design on either the MOS-2 or MOS-3 sections of NERL.

**Alstom has won a contract to provide 35 Citadis trams for Strasbourg, France.** These trams are 100% low floor.

These vehicle new trams will increase the capacity of the existing Strasbourg system by 60%.

The Strasbourg system is a standard gauge system with 750 Vdc overhead current collection.

Unlike the Citadis tram in Figure 4, the Citadis vehicles to be provided to Strasbourg will have 16 double doors and be 147.6 feet long.

The vehicles to be delivered will be 7 feet 10-1/2 inches wide and have a low floor height of 13-3/4 inches. They will have a capacity of 64 seated passengers and 224 standing passengers and be designed for a top speed of 37 mph.

Delivery of the vehicles is planned to begin in the middle of 2005 and be completed by 2008. The value of the contract is 98.3.

**Bay Area Rapid Transit (BART) opened its extension to the San Francisco Airport on Sunday, June 22, 2003.** The extension is 8.7 miles long. From Colma Station the new line operates through South San Francisco and San



**Figure 2 Alstom Citadis Tram**

Bruno Stations before ending at Milbrae adjacent to the Caltrain commuter line station. The San Francisco Airport station is on an aerial stub off the main line of the extension.

The extension carried more than 100,000 passengers in its first week of service — slightly more than the number of people who rode BART the first full week the transit system was open in September 1972.

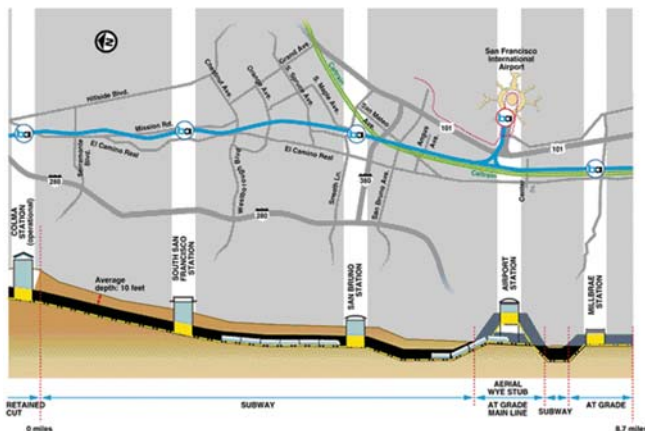
Construction of the \$1.5 billion project began in May 1998 and was completed in April 2003.

The Peninsula line brings BART to 104 miles of double track and 43 stations. BART opened as a 71.5-mile, 33-station system in 1972. Extensions in the Alameda and Contra Costa counties opened in 1995-1997.

**The Maryland Public Interest Research Group has issued a report on rail-based public transit systems in nine United States cities.** The study is entitled "Rail Transit Works: Light Rail Success Stories from Across the Country."

The study includes cities in six states plus the District of Columbia. Case studies are provided for Los Angeles; Dallas; Denver; Portland, Oregon; Salt Lake City; St. Louis; San Francisco; San Diego; and Washington, D.C.

The report documents the fact that property values increase along rail transit lines. In the cities studied, the property values along the rail lines increased in value substantially more than property values at a distance from the rail lines after the rail lines opened. In Dallas, property values along the rail line rose 25% more than properties at a distance from the rail line.



**Figure 3 BART Extension to San Francisco Airport**



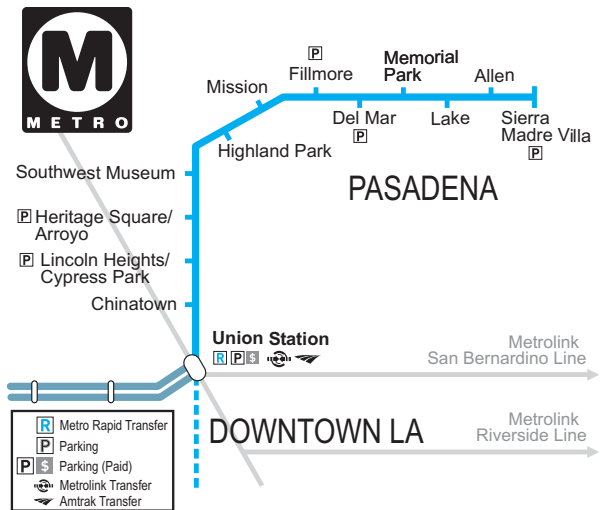
**The Los Angeles Gold Line to Pasadena opened on Saturday, July 26.** The 13.7-mile line runs from Pasadena to Union Station in Los Angeles, where it connects with the MTA Red Line, Metrolink commuter service, and Amtrak. A future extension will carry the line further east.

Including the light rail Blue and Green Lines and the heavy rail transit Red Line, the Metro Rail system is now 73.1 miles long with 62 stations.

Headways on the Gold Line are 10 minutes during peak hours, 12 minutes off peak, and 20 minutes during late night hours. The line will operate from 4:00 AM to 2:00 AM seven days a week. The line will use 26 light rail cars configured in two-car trains. Running time from Pasadena to Union Station is expected to be 36 minutes.

**The Orange County Transportation Authority (OCTA) approved an 8-mile Initial Operating Segment for the CenterLine light rail line.** After Irvine turned down the light rail line, OCTA reviewed their options including bus rapid transit, light rail lines to western and northern Orange County, and shifting the money to highway projects. Instead, they decided to go ahead with a light rail line connecting the John Wayne Airport, the South Coast Plaza shopping center, the Santa Ana Civic Center, the County Government Center and Courthouse, the Santa Ana Artists Village, and the Depot at Santa Ana. At the Depot, the light rail line will connect with both Amtrak and Metrolink commuter trains as well as with several OCTA bus routes.

**Portland Streetcar is proposing a second extension.** Last year it reported annual ridership figures of



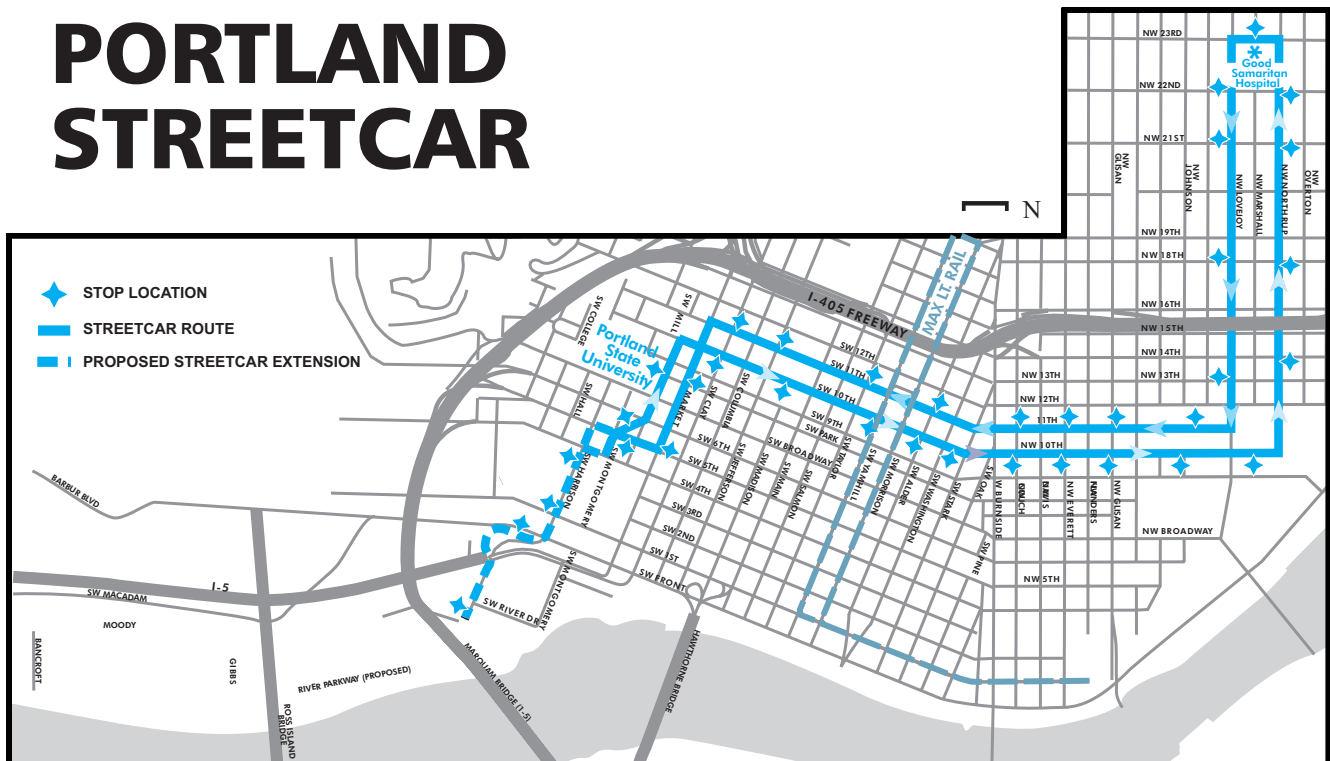
**Figure 4** New Los Angeles Gold Line to Pasadena

1,350,000 as against a projected ridership of 1,200,000. It expects to report ridership in excess of 1,500,000 for the second year of operation.

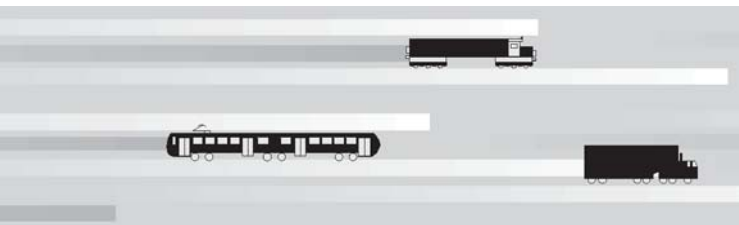
The first proposed extension is a 0.6-mile long extension to RiverPlace. Construction of this extension is now expected to start before the end of the year with opening in early 2005.

The second proposed extension is on the East Side. A steering committee has been holding public workshops and meetings to finalize a proposal for the alignment of the extension.

# PORTLAND STREETCAR



**Figure 5** Proposed extension to Portland Streetcar



## Chapter News & Meetings

*Gaspar Messina, Senior Editor*

### Smart Card Technology in Transit and Advanced Public Transportation Systems (APTS)

*Christopher Pacher, LTK Engineering Services*

The October 16, 2003 Technology Sharing Forum presented by the Vehicular Technology Society of the IEEE New York Section covered Smart Card Technology and Advanced Public Transportation Technology. The Forum was hosted by Cisco Systems, at their One Penn Plaza offices in Manhattan.

John Swanson of LTK Engineering Services discussed smart card technology and the current movement in transit to development regional and standalone smart card systems and their integration into other systems. David Tran of Siemens Transportation Systems discussed how GPS technology and data and voice communication networks allow for precise and automatic vehicle location, dispatching, routing and schedule management.

Mr. Swanson began by delivering a valuable smart card technology overview. The differences between smart cards and legacy ticketing and fare collection medium were discussed. As well as the differences between microprocessor and memory-logic smart cards systems. The growth of the application of smart cards in transit were discussed and examples of upcoming programs such as those in Houston and other new programs were pointed to as signs of greater acceptance and willingness to invest in the technology. Mr. Swanson also pointed out the benefits of accepted published technical standards such as ISO-14443. Standards significantly reduce the risk and costs for agencies implementing smart card systems. The standards allow agencies to specify interoperable standards based systems and equipment. Giving the agencies the flexibility in the management of expansion, upgrades and replacement of Smart Card systems they need to move forward. Mr. Swanson pointed out the ab-

solute need for a broad information campaign to educate customers as a requirement for successful smart card system implementation. As technology drives the costs of smart cards, standards reduce risks, and as public and private connectivity increase the future looks bright for smart cards. For additional information on John and LTK Engineering please go to [www.ltk.com](http://www.ltk.com).

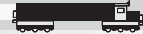
David Tran kicked off his presentation with a detailed overview of Siemens Integrated Local Government systems. The basic architecture of the Siemens APTS was reviewed for the dozen systems installed and the dozen in planning across the country. The architecture includes fixed base stations for Data and Voice Communications to and from vehicles, on-board GPS and communications controllers, connected agency operations and dispatching centers, back office report, storage and analysis work centers. The system provides dispatching and real time monitoring of fleet vehicle locations and route progress. The majority of the discussions centered on how the real time data and the collection of this data can be used to improve system performance. The system allows transit agencies to implement fully computer aided dispatching, active route updating for waiting passengers, passenger route transfer assistance. The two-way communications and real time mapping provided by the APTS allows operation agencies drive system improvements and improve customer satisfaction. For additional details on this system please go to [www.ilgsystems.com](http://www.ilgsystems.com).

For their efforts in fostering Technology Sharing the NY Section of the VTS presented John Swanson of LTK Engineering and David Tran of Siemens with Technology Sharing awards.

*Christopher Pacher is Secretary of the New York-Section of the Vehicular Technology Society.*



Left to right: Bob Pellegrino, John Swanson, Brad Craig, David Tran and Dave Horn



## Elections

Elections to the VTS Board of Governors for the term 1 January 2004 to 31 December 2006 were held over the summer. All four incumbents who stood in the election – Robert Mazzola, Raymond Trott, George McClure and Gordon Stüber – were re-elected, along with Tracy Fulghum, who has been Secretary for the past year. Making way for Tracy is Bob French. Bob has been the Society's ITS Council representative from the founding of the Council, and before that was actively involved in promoting ITS activities.

At the Board meeting in Orlando, elections to the Executive were undertaken. After the changes last year, this year sees no change, with the President, Executive Vice President, and three Vice Presidents all being re-elected to serve another year unopposed.

## VTC2003-Fall

A very successful fall conference was held in the Hilton at the Walt Disney World Resort in Orlando at the beginning of October. The location was unplanned, with the original venue, the Hyatt Orlando, closing up shop with 24 hours notice only 3 weeks before the conference was due to begin. Fortunately much midnight oil was burnt by those involved in the organisation, and the conference took place with the minimum of last minute hitches. A full report will appear in the next issue.

## VPPC Workshop

Rather than hold separate sessions within the main VTC conference as happened in Orlando, the Vehicle Power and Propulsion Committee has decided to experiment with a separate workshop to stimulate interest in the area. The International Symposium on "Vehicular Power and Propulsion" will take place on October 6-8, 2004, in Paris. Details on <http://www.univ-valenciennes.fr/LAMIH/VPP04/>

## Education Committee

Also at the Fall BoG meeting, Yu-Dong Yao (yyao@stevens.edu) was appointed to the position of Chair of the Education Committee. Yu-Dong has a number of plans for revitalizing this area of the Society's work, of which you will hear more in future issues of the *VTS News*.

## VTC2004-Fall

VTC2004-Fall, to be held in Los Angeles, CA from 26-29 September 2004, looks set to be the largest ever, with over 1,000 technical papers and posters. As well as the usual VTC technical areas, a particular theme of the conference will be the contribution wireless technologies can make to global security. For more details, see the Call for Papers on the back cover.

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# VTS Board of Governors Meeting & Teleconference

## 24 April 2003 and 10 May 2003

A VTS Board meeting had been planned for the 24th of April in Jeju, Korea, during VTC2003-Spring. A straw poll at the previous meeting had shown that enough Board members would be able to attend, but in the event the affect of SARS reduced the number attending to only six, plus the Society Secretary. As a result, that meeting was run as a special executive committee meeting, and a telephone conference held on the 10 May to ratify decisions from the executive meeting, and to discuss the budget and the BoG election slate.

The Special Executive Meeting discussed the financial performance of the Society during 2002, when the Society's net worth reduced by some \$242k, due to increased charges from the IEEE to cover its central deficit. TAB expects to break even in 2004, but with the IEEE asking for higher charges for its services the effects will remain in place beyond this. George McClure, Treasurer, reported that the cost of servicing each member was between \$2 and \$3 more than the membership fee. This had not been helped by a 10% fall in membership, mainly due to full members not being replaced by students as some other societies have managed.

On publications, the Editor of the Transactions, Greg Bottomley, is stepping down at the next board meeting in October. There was some discussion of recommended candidates, as were additional candidates. The President will

speak to the present editor and recommended candidates. James Irvine reported that he had attended the IEEE Panel of Editors meeting, and that the IEEE were not willing to archive newsletter content on Xplore, something which caused increasing difficulty in finding high quality feature writers. This reopened the longstanding issue of whether the society should have a magazine rather than a newsletter, and it was agreed to ask the newsletter editor to investigate this matter further and return with a proposal.

Additional discussion was held on the subject of a digital archive for the society. Sam McConoughey urged the need that the material needed to be held until it could be scanned. His personal holdings go back to pre-IEEE days, ca. 1949. It was agreed to draft a "wish list" for source materials that we would like in such a digital archive.

On conferences, George McClure discussed a proposal by Horizon House to organise exhibits at Orlando. There is no obligation for VTS, and the society will get 25% of the proceeds. VTC Spring 2002 has closed-out, with the audit presently in progress. The VTS has assumed full financial responsibility for VTC Fall 2003.

Gordon Stüber remarked on the need to get some consistency in the tutorials at the VTC's, particularly in terms of the honoraria, which seem to vary widely from VTC to VTC.



He noted COMSOC gives \$750 for a half day and \$1500 for a full day

tutorial. It was agreed that there should be standardized honoraria for tutorials, along with a contract with the tutorial presenter, although tutorials are the prerogative of the conference and not the society. There was some discussion about the conference committee for the Los Angeles VTC wanting to name the conference "VTC 60", to reflect the fact that it was the 60th VTC. It was the general feeling of the board members in attendance that the conferences should continue to adhere to the traditional naming scheme.

Jae Hong Lee presented a summary of VTC 2003 Spring. A healthy total of 657 registrations had been received, but as of the meeting, half way through the conference, only 412 badges had been collected. 73 registered authors had notified that they could not attend to present due to SARS. Professor Lee also noted that there were a few harsh comments regarding the requirement that at least one full registration accompany each paper.

The telephone conference held on 10 May reviewed the above points. Present during the telephone conference were BoG members Charlie Backof, Dennis Bodson, Bob French James Irvine Roger Madden Tad Matsumoto

George McClure Sam McConoughey and Gordon Stüber, along with Tracy Fulghum (Secretary) and Kent Johnson (Past President). It formally approved the 2004 VTS preliminary budget, which calls for around a \$88 000 (USD) surplus, as well as the actions on conferences. Dennis Bodson, how had not been present in Jeju further reported that the Rail Conference has closed out, and that VTC at Rhodes has closed out under "non-routine circumstances, with a surplus of \$19 000 to \$20 000 (USD). This meant that all old conferences, with the exception of VTC2002-Fall, have been closed out. That conference is presently being reviewed at IEEE headquarters.

The discussion of investigating options for the VTS News was also discussed and affirmed during the call, as well as membership development. Roger Madden had attended the IEEE meeting and had put together a plan to target ITS members, and the ITS arena, as well as promotion at conferences.

The telephone conference also agreed the slate for the election to the Board of Governors.

The next non-virtual BoG meeting was planned for 8 October 2003, at VTC2003-Fall.

## 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	
24-27 February 2004	European Wireless 2004	Barcelona, Spain	<a href="http://research.ac.upc.es/EW2004/">http://research.ac.upc.es/EW2004/</a>	
2-4 March 2004	Int Symp on Advanced Radio Technologies	Boulder, CO	<a href="http://www.its.bldrdoc.gov/meetings/art/">http://www.its.bldrdoc.gov/meetings/art/</a>	
21-25 March 2004	WCNC2004	Atlanta, GA	<a href="http://www.wcnc.org/2004/">http://www.wcnc.org/2004/</a>	
23-24 March 2004	Workshop in Intelligent Transportation 2004	Hamburg, Germany	<a href="http://wit.tu-harburg.de/">http://wit.tu-harburg.de/</a>	
6-8 April 2004	ASME/IEEE Joint Rail Conference	Baltimore, MD	See page 20	
17-19 May 2004	VTC 2004-Spring	Milan, Italy	<a href="http://www.vtc2004spring.org/">http://www.vtc2004spring.org/</a>	
14-17 June 2004	IEEE Intelligent Vehicles Symp	Parma, Italy	<a href="http://www.ieeeiv.org/">http://www.ieeeiv.org/</a>	
20-24 June 2004	ICC 2004	Paris, France	<a href="http://www.icc2004.org">http://www.icc2004.org</a>	
27-30 June 2004	IST2004	Lyon, France	<a href="http://www.mobilesummit2004.org">http://www.mobilesummit2004.org</a>	✓
30 August - 2 September 2004	IEEE Int. Symp on Spread Spectrum Techniques & Applications	Sydney, Australia	<a href="http://www.isssta2004.org/">http://www.isssta2004.org/</a>	✓
5-8 September 2004	PIMRC2004	Barcelona, Spain	<a href="http://www.pimrc2004.org">http://www.pimrc2004.org</a>	✓
20-22 September 2004	ISWC'04	Mauritius	<a href="http://www.uon.ac.mu/events/iswcs04.htm">http://www.uon.ac.mu/events/iswcs04.htm</a>	✓
26-29 September 2004	VTC 2004-Fall	Los Angeles, CA	<a href="http://www.vtc2004fall.org">http://www.vtc2004fall.org</a>	✓
3-6 October 2004	ITSC04	Washington, DC	<a href="http://www.ewh.ieee.org/tc/its/conf.html">http://www.ewh.ieee.org/tc/its/conf.html</a>	✓
29 May - 1 June 2005	VTC 2005-Spring	Stockholm, Sweden	<a href="http://www.vtc2005spring.org">http://www.vtc2005spring.org</a>	
September 2005	VTC 2005-Fall	Dallas, TX	<a href="http://www.vtc2005fall.org">http://www.vtc2005fall.org</a>	
Q2 2006	VTC-2006 Spring	Melbourne, Australia	<a href="mailto:fzheng@ieee.org">mailto:fzheng@ieee.org</a>	

Conferences marked '✓' have open calls for papers as of 31 December 2003. This list is based upon the conference calendar at our web site, which is updated more frequently than this list can be. To access it go to the following URL: <http://www.vtsociety.org/>, then click on "Conference List" in the left frame.

Corrections and additions to this list are most welcome. We are particularly interested in adding listings for Automotive and Transportation conferences. Please send corrections and additions to Tom Rubinstein at [t.rubinstein@ieee.org](mailto:t.rubinstein@ieee.org).

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# Calls for Papers



The Vehicular Power and Propulsion Symposium will focus on all aspects of vehicle power and propulsion area. The symposium is an opportunity for researchers and practitioners to meet each other and share new developments and opportunities. It is co-sponsored by the IEEE Vehicular Technology Society, LAMIH (Laboratory of Industrial and Human Automation, Mechanics and Computer Science) University of Valenciennes and Hainaut Cambrésis,

## Relevant Topics

Topics of interest include (but are not limited to) the following.

- ◆ Vehicle power system architectures
- ◆ 42V vehicle power systems
- ◆ Higher voltage vehicle power systems
- ◆ Vehicle power electronics
- ◆ Vehicle motor drives
- ◆ Advanced vehicle electrical loads
- ◆ Drive by wire
- ◆ Brake by wire
- ◆ X-by wire
- ◆ Electrical power steering
- ◆ Vehicle power system dynamics and controls
- ◆ Military vehicle power systems and loads
- ◆ Electric vehicles
- ◆ Hybrid electric vehicles
- ◆ Mild hybrid vehicles
- ◆ Fuel cell hybrid vehicles
- ◆ Fuel cell vehicles
- ◆ Engine electrical controls
- ◆ Hybrid electric power trains
- ◆ Advanced electrical drive trains for Rail vehicles
- ◆ Track vehicles
- ◆ Multi-wheeled vehicles
- ◆ Heavy vehicles
- ◆ Starter/generators
- ◆ Power management and distribution
- ◆ Off-road vehicles
- ◆ Automatic Cruise Controls
- ◆ Active suspension
- ◆ Transportation system

## Important Dates

- ◆ Invited sessions due April 1, 2004
- ◆ Extended abstract (3 pages) or full papers May 1, 2004
- ◆ Acceptance notification June 1, 2004
- ◆ Camera ready manuscripts and deposit payment due July 15, 2004
- ◆ Early Registration before July 15, 2004

## Paper Submission Guidelines

Authors MUST submit an extended abstract (min 3 pages) or a full paper before May 1, 2004. Forms for submission are soft copy in PDF. The submission must include the name, complete mailing address, telephone and fax numbers and the email address of the author(s). Summaries should be submitted electronically (Plain text).

The best papers of the conference will be proposed for publication (after revision and additional refereeing) in a special issue of the IEEE Transactions on Vehicular Technology.

## Venue

The Vehicle Power and Propulsion 2004 Symposium will be held in Paris, October 6-8 2004 at the Union Internationale des Chemins de Fer near the Eiffel Tower.

## Invited Session Proposal

Invited session should be proposed before April 1, 2004. Proposal should include a session name, an overview of session topic, one page abstract of each paper (4 papers by invited session) and a perspective chair.

## Contact

For more detailed information, please visit the symposium website at <http://www.univ-valenciennes.fr/LAMIH/VPP04/> or contact the symposium secretariat

VPP2004 Secretariat  
Melanie Lecq - Systèmes Flous  
LAMIH UMR CNRS 8530  
Université de Valenciennes  
Le Mont Houy  
59 313 Valenciennes CEDEX 09  
France  
Email : [vpp04@univ-valenciennes.fr](mailto:vpp04@univ-valenciennes.fr)



IEEE VTC 2004 - Fall

Wireless Technologies for Global Security

SEPTEMBER 26-29, 2004 LOS ANGELES, CALIFORNIA

In a world where nations are faced with new and unprecedented types of threats, how are wireless technologies and systems enhancing global security?

At the 60th IEEE Vehicular Technology Conference, VTC 2004-Fall, communications, sensor and power experts from around the world will come to Los Angeles to discuss the development and application of wireless technologies for global security. More than 1000 technical papers are expected, and the insights and ideas of professionals in industry, academia, and government will be offered through informative tutorials, poster and panel sessions, exhibits, and keynote speeches from some of the leading experts in the field. Registration begins June 2004.

### Technical Subject Areas

1. Antenna and Propagation
2. Wireless Access
3. Transmission Technology
4. Multimedia, Networks, and Systems
5. Wireless Personal Communication Systems
6. Digital Signal Processing for Wireless Applications
7. EMC issues for Wireless and Mobile Network
8. Mobile Satellite Systems
9. GPS Technologies and User Equipment for Mobile and Handheld Communications
10. Modeling and Simulation
11. Wireless Sensors and Data Fusion
12. Power Switches and Systems
13. Urban Radio Communications
14. Wireless Technology Applications to Global Security

Don't miss this important international event and find out how wireless technologies are enhancing global security.

For more information and updates visit our Web site  
<http://www.vtc2004fall.org>

#### General Chairs

Dr. Sumner Matsunaga	Dr. Martin Roden
The Aerospace Corporation	California State University at Los Angeles
310.336.0669	323.343.4510
<a href="mailto:vtc2004fall-general@aero.org">vtc2004fall-general@aero.org</a>	<a href="mailto:vtc2004fall-general@aero.org">vtc2004fall-general@aero.org</a>

### Important Dates

Nov. 1, 2003	First date for submission of abstracts (Authors <b>MUST</b> submit the short <b>AND</b> extended abstracts at the <b>SAME</b> time)
March 6, 2004	Last date for submission of abstracts, for papers and posters and proposals for tutorials and panel sessions
May 16, 2004	Notification of acceptance
July 3, 2004	Last date for submission of camera-ready version of accepted papers and posters

### Paper Submission Guidelines

Authors **MUST** submit an extended abstract (up to 2 pages) at the **SAME** time of their short abstract submission (approx. 150 words). Summaries must be submitted electronically by March 6, 2004, via the conference Web site: <http://www.vtc2004fall.org>

The submission must include the name, complete mailing address, telephone and fax numbers, the designation number of the technical subject area of the paper and the email address of the author(s).

### Exhibitions

Exhibitions of company products are solicited for the Technical Subject Areas.

Interested parties should contact the Financial Chair:  
Sam Lim, 310.336.0669

#### Technical Chair

Dr. Tien Nguyen  
The Aerospace Corporation  
310.336.0243  
[vtc2004fall-technical@aero.org](mailto:vtc2004fall-technical@aero.org)

#### Financial Chair

Samuel Lim  
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310.336.0669  
[vtc2004fall-financial@aero.org](mailto:vtc2004fall-financial@aero.org)

See you in Los Angeles...

