The Future Mobile Life Style, the Players and the role of IPv6 in the UMTS Era

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ABSTRACT

In this paper, we consider first the ways that the 3rd Generation wireless services might be used. We then consider the different players who are determining the protocols to be used in the services. We state that the dominant groups determining these standards are the 3GPP/3GPP2 groups determining these standards from the side of the 3G wireless providers, and the Internet Engineering Task Force from the Internet Standards side. There has been a decision in principle, from the 3GPP side, to adopt IPv6 for many of their services. We consider some of the questions that are unresolved in this decision, and the symbiosis of systems like UMTS and Wireless LANs.

1. INTRODUCTION

I am awaiting eagerly the coming availability of good quality wireless facilities. Many of us spend large parts of our lives at different places, including home, office, public spaces and vehicles. We may want to use desktop equipment, hand-held, wearable and stationary devices at different times there. While we will compromise on the quality and range of services, depending on where we are, we would appreciate as little difference as can be arranged. Thus we would often appreciate the availability of the services we should be able to achieve through the mobile digital services exemplified by UMTS, while having as similar a feel as possible to what we can achieve at home or stationary in a public place. We often will be prepared to pay more for achieving the service wherever we are, but there is a limit on how much we are prepared to pay.

With these assumptions, I discuss in Section 2 the sort of activities we may wish to do. Then in Section 3, I discuss the players and what some of them may expect and receive. I show that the relationship between the different wireless access networks is particularly significant. This theme is developed further in Section 4, on the interaction between UMTS and IETF protocols. In a short talk like this there is no effort to be exhaustive; I concentrate on some of the areas where change or clarification are needed.

2. APPLICATONS AND PROJECTS

Applications

In many ways, I am a very poor ambassador for the goodies that the mobile services can provide in many areas where the maximum early application is expected. I have never had a Walkman, I do not have a portable MP3 player, I seldom care about football match scores – and never watch their games. I usually know what restaurants I want to visit. Such passive leisure services are envisioned as possible candidates for the new wireless services – but only if they do a better job than the broadcast industry. The audio version of audio services can be attractive; it provides more choice if one can access large libraries of audio content. However, it is not yet clear that the audio quality will match that attainable on disc – at least until much wider bandwidth is available. The making of personal recordings, derived from audio libraries prior to embarking on trips, may well be a cheaper and more satisfying solution. Similar considerations apply to many forms of video entertainment – with the additional factor that visual output on the small screen of a Personal Organiser or telephone is not attractive.

I personally am not attracted to the Short Message Systems (SMS); this is clearly partly a generation thing, and is dependent on the near universal availability of mobile phones in the relevant age groups. I find the attraction of normal electronic mail-based services much easier to understand; the always-on paradigm is very attractive here, and allow new retrieval and interactive services. Multimedia content may well help in these; advertising content providers will often welcome that the small screen makes it more difficult to see detail of some of their wares.

For the truly mobile user, voice communication with the terminal will prove essential. This requires either all the power of voice recognition in the handset, or higher bandwidth to transfer good quality audio to a base-station with voice recognition. Voice recognition is notoriously inadequate; hence feedback – either audio or textual to the user will be vital. One reason for audio is the difficulty of seeing screens whilst driving cars. It is difficult to use very small keyboards for long periods of time. Applications work is needed to reduce the need to type quantities of text. The work done so far on a mixture of voice input, menu selection and simple pointing requires further input on Human Computer Interactions. Future education and training may well involve how to speak in order to obtain the best results from voice recognition software – in addition to more technical aspects.

While many higher bandwidth human-computer interactions will be useful in their own right, others will depend on closer integration with person-person audio and video services. This integration will be a key ingredient to the services flourishing, but puts critical constraints on the network service parameters, which

even audio services do not meet in current GPRS.

The trend to put power points in aeroplanes, airports and long-distance trains is welcome; while provided for the use of laptops, their applicability is much wider. It will allow conventional entertainment devices to have much longer utilisation life. Where there are concentrations of people, provision of media service over local wireless facilities is an attractive alternative – for which it is simple to develop a business model. We must deal not only with mobile terminals, but also mobile networks; this is a still-unresolved standards question.

There is a whole new branch of collaborative video games. Their afficiados believe vital the capability raised both by the interaction in real-time between players and position sensing. These include the ability to use, or possibly block, location information, and have multi-user games –using location information. The low bandwidth needed for position information, and the use of locally generated graphics, make this a quite sensible application – provided that the screen size is adequate.

The scope for interactive information acquisition and exchange is high. The normal range of directory information, interactive services, active web transactions should be possible. In general one need only look at the range of activities for which laptops are used now, to realise the potential of the applications enabled by the wireless paradigm. A number of specific services are already being prepared. One particular example is the set envisioned in cars.

Relevant Projects

Cars have a particular advantage; they have plenty of power, though the driver should not be bothered with unnecessary information. For example, in the Japanese WIDE project [wide1], they have equipped a significant number of cars with radio, and have connected many components of the car to a Local Area Network (LAN) inside the car. They have formed maps of the traffic density, which can be downloaded by other cars. This can be used for traffic control; it can also help in automated route planning. Another possible use is in remote diagnosis, in the case of car problems. Of course the telemetry data can be supplemented by video data where this is indicated. In the traffic case, the output can be audio instructions to reduce the load on the driver; in the diagnosis case, video can be particularly helpful. A number of European IST projects e.g. DRIVE [drive] and COMCAR [Comcar] have addressed the same areas – though often more with entertainment in mind.

In the European IST 6WINIT project [6winit], one application is communication with ambulances in accident and emergency situations. Here they plan to send telemetry data on the patient's vital functions to the A & E Department both to prepare for the patient's arrival and to advise in treatment while in transit. Here again, the audio and video aspects will also be vital. There are two new EC projects 6NET [6net] and Euro6IX [Euro6ix]. In these projects, the emphasis is on the deployment of a wired IPv6 infrastructure and the deployment of applications over it. There is also mention made of interconnection with wireless facilities. In [wide1] in Japan], there is an all-embracing activity to deploy IPv6 in the research community – with a wide range of wired and wireless applications; there is a major activity on the Internet Car [wide2]I will return later to why these projects are relevant to this conference.

Most of the interest in the applications planners in third generation wireless services hinge around the feasibility of providing higher bandwidth services and their integration with multimedia. The financial plight of European wireless operators, partly due to the high cost of licenses, is threatening to reduce the density of base stations – and hence to the speeds on offer. If this proves to be the case, then the attraction of the services will be greatly reduced – and the real-time video may be unusable. Similarly their take up depends critically on charges; here again the operators may face some less pleasant choices. I return later to the question of speed and costs of UMTS versus their alternatives.

I discuss below both the use of, and the meaning of, IPv6. To achieve the wide scenarios of usage, with a maximum commonality of terminal devices and procedures, it is essential to move eventually to an all-IP world. If the devices and applications of wireless devices achieves the penetration envisioned, then eventually this world must be IPv6 – if only to cater for the number of devices, which must be accessed.

3. THE PLAYERS

Who are the players

The current assumptions are that the main players are at least the following (many others can be included with appropriate definitions):

- The Equipment Suppliers, who provide the hand-sets, the wireless interfaces, the base station equipment and the back-end networks
- The Wireless Network Operators, who provide the UMTS service provision, and also back-end networks.
- The Wired Network Operators, who interconnect with the Wireless-based networks
- Content suppliers like News, Entertainment, Sports providers
- Conventional E-Business operations – geared now also to the new medium of mobile access at higher speeds
- Business and Consumer organisations, who are prepared to fund large-scale applications as part of their business operations
- The users who are the customers of all the above.
- The regulatory authorities, which allocate the bandwidth, who monitor and decide on what uses are appropriate and valid, and try to assure that certain policy considerations are observed.

- Many Standards bodies, who define standards which all must follow to the extent interoperability is to be achieved
- Various independent financial bodies, with which the services must interact – unless one of the other players also takes on that role.

These are not the only players, and most have incomplete control over their areas of competence. Of particular importance in the standards setting at the network level are those setting the 3rd Generation wireless standards the 3GPP [3GPP] and 3GPP2 partnerships [3GPP2] and those setting the Internet Standards, the Internet Engineering Task Force [[ietf]. There is collaboration between the. groups, but also significant differences. It is clearly beyond the scope of this talk to discuss exhaustively these protocols, however some salient differences will be highlighted.

The UMTS and Wireless LANs Relationship

The symbiosis of UMTS and WLANs One of the striking successes of the second-generation mobiles in Europe has been the universal agreement on GSM. Most countries adopted it; this has had a vital impact on the popularity of the service, on the cost of equipment, and on the ease of international roaming. The standards in the North American countries were incompatible. While there are on-going intercontinental differences, with North America going their own way for the 3rd Generation, the differences inside Europe have been resolved – at least as regards the UMTS operators and handset manufacturers.

Nevertheless, some issues remain – the question of putting 3G inside buildings and the relevant cost implications, which may greatly impact its attraction in that environment. The threat actually goes much further. Even if there is no systematic attempt to build an alternate infrastructure covering all urban areas with Wireless LANs running 802.11, it could easily develop from a bottom-up approach. The technology is already deployed in many hotels, restaurants and airports. It is possible to establish a business strategy, which would make these much more universal. This strategy would be much simpler to implement, if there were large-scale deployment of "always-on" services like DSL to link the WLANs back into the Internet. It is no surprise that serious proponents of this approach have been made in the US, Finland and Sweden – all of whom have such deployments. Of course WLANs could not cover large-scale areas outside the heavily populated ones, but in those areas there are at least two models. First much of the traffic comes from people who are not actually on the move, but are stationary in the sort of location, which would attract such installations. Second, if it was sufficiently attractive, some entrepreneurs may go further, and get franchises to combine repeaters and relays with commonly available components that do not need new "rights of way" such as streetlights. Such a service cannot have the range to compete with UMTS in the less populated areas – but it could impact considerably some of the rosy predictions of traffic and revenue growth. We must remember here that GSM effectively killed the satellite telephone; again there was no complete duplication of function, but the heavy take up of GSM by corporate users removed the vital base traffic on which all cost models of satellite telephony relied.

The potential threat of the WLAN will certainly put a cap on the charges, which can be made under UMTS for certain classes of service – and will have an impact on who gets the revenue. For this reason even if the UMTS operators are against this development, other players may welcome it. Provision of dual phones, with choice of WLAN or UMTS, is already planned. Cards for laptops and PDAs will be either closely ahead or behind. For the user, the two may have a symbiotic relationship; it remains to be seen what is the viewpoint of the UMTS operators.

Common Procedures for UMTS and WLANs I have mentioned the symbiosis of UMTS and WLANs. At the level of the twin access ports, this is straightforward to engineer – though to keep within weight and power levels is a challenge

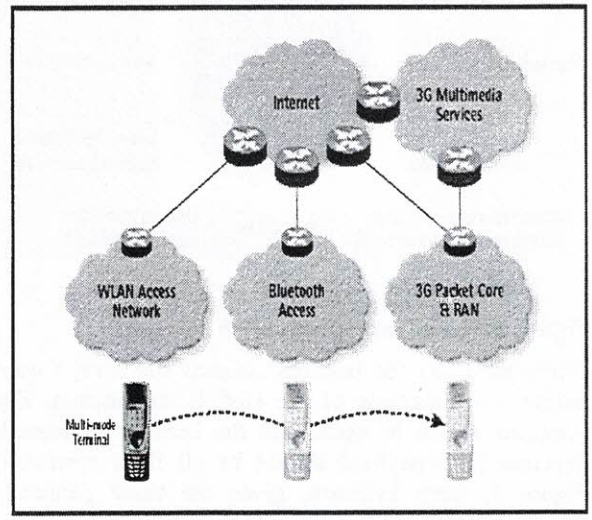

Figure 1 The Multi-access Scenario for different access networks

.The principle of having terminals that can access this and other networks is termed multi-access.

It is not unduly difficulty to include different drivers below the IP level for the two access mechanisms. If, however, all the high level procedures like security, mobility and billing were to be different, then it would become very difficult to provide a uniform interfaces to the applications across the access media. It will be interesting to see the outcome of the different pressures – on the one hand from the users to maintain a common set of applications, and on the other from the suppliers who have not agreed on the procedures.

The protocol incompatibility between WAP [wap] and the Internet protocols caused severe problems, this problem is addressed in its later versions – like WAP-2.

4. INTERACTION OF THE IETF AND UMTS

The IPv6 protocol suite and Multiaccess

There are areas where the developments of the UMTS industry and the Internet industry have a warm – but uneasy – symbiosis. Many of us have argued that the huge growth expected in mobile phones – many wanting Internet access – necessitates a rapid move to IPv6 by the 3GPP. This move is now the official policy of the 3GPP. What it means, however, is not yet clear either to the IETF nor the 3GPP. Some fundamental compromises must be made – at least in the public statements of the IETF, for this to be a reality. On paper, IPv6 has great advantages; I quote below from [Ericsson] at the March 2002 IPv6 Forum meeting in Barcelona [IPv6-Madrid]:

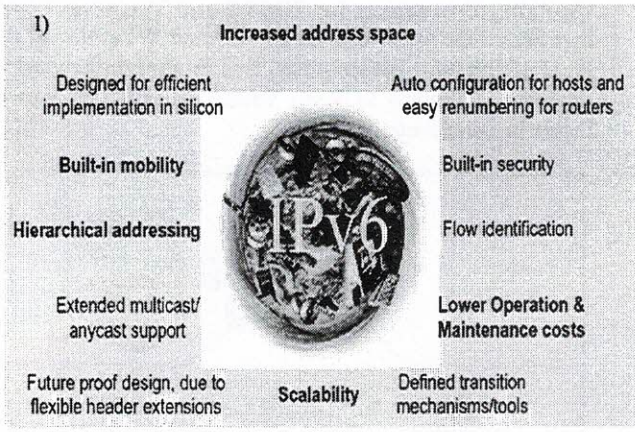

Figure 2 The advantages of IPv6

While these are the benefits claimed for IPv6, I quote below also diagrams of the UMTS architecture. First everyone seems to agree that the Internet Multimedia Services IMS payload should be all IPv6 eventually. Figure 3, from Ericsson, gives the basic picture. It shows the IMS payload using Mobile IPv6.

The more general protocol stacks are shown in Fig. 4. These show that the correct IP stacks can be passed right through the system – though there may be some inefficiency in carrying them through the networks. It is clearly possible for this IMS payload to be all IP – including IPv6.

It is currently mandatory in the IETF for a conformant IPv6 implementation to support mobile IP (MIPv6) for mobility; Fig. 3 implies that this is accepted also in 3GPP. Indeed, a number of providers, including Nokia and Ericsson, have argued strongly that Mobile IPv6 is the best way of providing multi-access. However, the way that binding updates for Mobile IPv6 are authenticated is not yet agreed in the IETF; I will discuss in the next section some 3GPP ideas here that may not be acceptable to the IETF.

Security is a major point of difference, but there are others. IPv6 includes, according to the IETF, IPSEC for security and multicast. Neither of these two is in the UMTS Standards documents. Indeed, there are still strong arguments whether these are relevant there. On the other hand, the 3GPP proponents need Header Compression – and this is currently incompatible with IPSEC. At this level compromises will be made. I will describe, moreover, others where compromise may be more difficult.

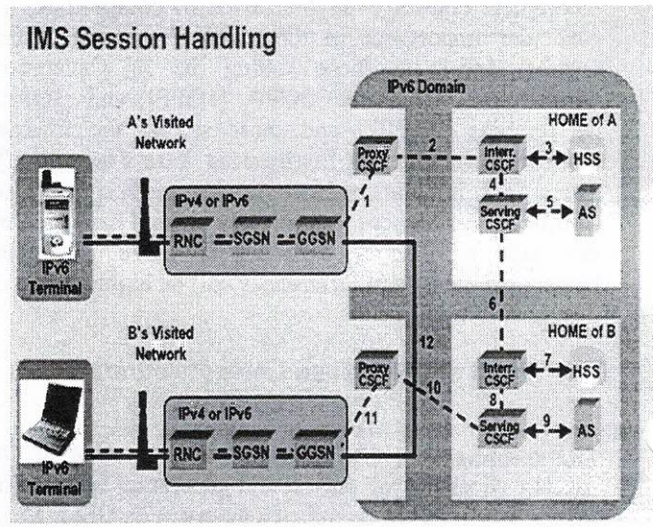

Figure 3 IMS Session Handling in UMTS,

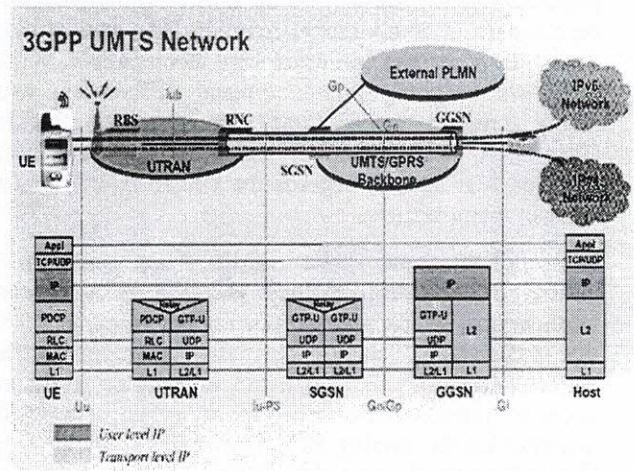

Figure 4 The 3GPP UMTS Network

The Security Model

One very difficult area of compromise between the IETF and the 3GPP will be security. There are several historical, commercial, political and technical reasons for this. Traditionally, the 3GPP standards have their roots in the work of ETSI and Telecom operators. These have strong interests in controlling the security framework – and indeed governmental regulation has required such control in many countries. As a result, the Standards have usually allowed for interception points inside the operator's facilities – albeit enforceable only under the relevant national safeguards. The official stance has normally been that only link encryption is needed into the operator's facility; the operator can provide the keys possibly in conjunction with a SIM

card. Where there has been a more general Public Key Infrastructure, government has tried to ensure that it still has interception capability. One example is the attempt to force through the US Fortezza system; this was resisted by the European governments not because it allowed interception, but because of concern that the US would be able to monitor the resulting traffic. The IETF has had a tradition of much greater openness in its discussion of security. It has discussed the issues vocally, and has had a great distrust of any authorities. It has consistently advocated end-end security, and been scathing about attempts to compromise it with key escrow by the government. The technical implementation of these ideas has been one of the main driving functions in the mandating of IPSEC for security in the IPv6 stack, and the extent to which even the IP headers are encrypted when confidentiality is invoked. From the IETF viewpoint, the operators do not have any privileged position on interception; if anything, they may be part of the threat!

To illustrate the different positions, I quote below a schematic of the provision of security from [Nokia]:

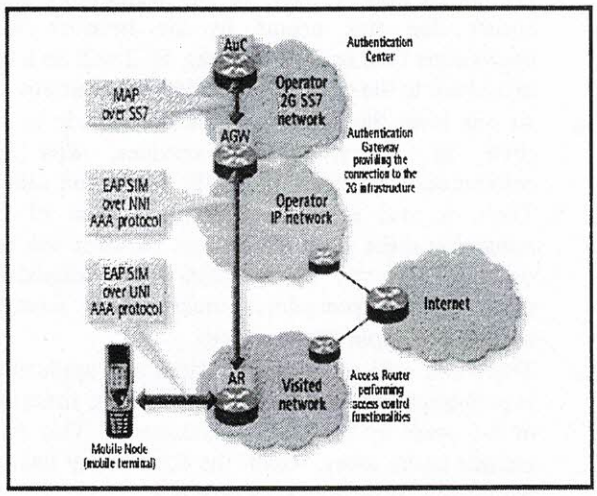

Figure 5 The Nokia SIM-6 Security Architechture

Here the authentication is closely related to the use of the SIM card provided by the mobile operator. As long as this is only for authentication, this use of the SIM card may well be acceptable to the IETF also; if it was used also for confidentiality, this would no longer apply.

It is realised even in the IETF that some technical compromise in IPSEC is necessary to meet the legitimate *technical* demands of wireless networks. Active participation of components in or near base-stations may be essential for performance reasons – both for end-end transport and link level considerations.

Some of this participation is impossible unless more can be revealed about the packet header; others can be achieved by modification to allow plain-text hints, which are outside the end-end encryption. So far the 3GPP has rejected IPSEC; it remains enamoured that all security can be ensured by use of SIMs. It is not obvious that the commercial and regulatory constraints would allow a compromise on use of IPSEC, which would go far enough to meet IETF technical and political concerns. Of course neither 3GPP nor the IETF are all of one mind. Individuals in each organisation may be willing to compromise; whether the standards will reflect such a compromise is another matter.

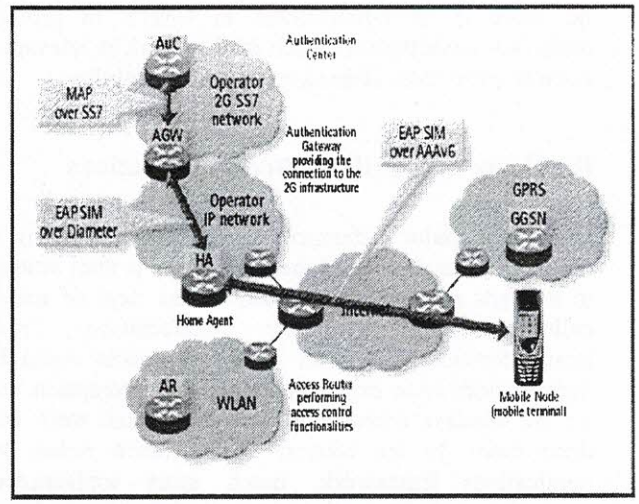

Figure 6 Establishing a binding authentication key for WAVELAN

There is a realisation also in the IETF that IPSEC does not meet all the security needs. For this reason, other end-end security procedures have been defined (e.g. secured RTP for audio-video streams [srtp]) Whether their adoption is acceptable to the UMTS supplier community is not clear – this time because it may interfere with some of the business models of added services that this community may desire.

There is another potential question in the security area. Operators make potential of the capability of wireless systems to pinpoint the location of users. Indeed in the US the very system makes this mandatory to only a few metres – ostensibly for reasons of the emergency services. On the telephone system, even Calling Line Identification (CLI) raised many privacy concerns. It was legislated that users to be able to over-ride the possibility of CLI to the correspondent -nevertheless, it remained a feature always available to the Systems operators. The whole question of unique identifiers, which can be linked to identity, is a key object of concern by some sectors of society. At first it would seem that the needs for billing make this essential; however, the great success of pre-paid services make this a less compelling argument. It is only necessary to be able to introduce a means of introducing anonymous micro-payments, which is quite feasible. Whether governments should be permitted to mandate self-identification at all times remains a contentious issue.

Common Interest between UMTS and the IETF

So far I have mentioned points of difference between the IETF and the UMTS. There are many potential areas of overlap. The UMTS has agreed to embrace IPv6 from Release 5 onwards. Thus it can take advantage of any work done in the IETF above the IP level. Although some in the UMTS milieu are not yet convinced that continuous media should use the IP path, there is much

useful work in the IETF at the application and network levels in this area. Some examples are the work with SIP, secure RTP, geographic location and privacy, security policies, micro-mobility and edge services. So far there is no commitment in UMTS to provide multicast; nevertheless, much of that work is relevant – in error correction, layered coding and reliability.

Problems in the UMTS Working Practices

One of the major differences in the way of working of the IETF community and the UMTS one is their attitude to testbeds and experimentation. In the days of simple cellular telephony, the applications were straightforward, and most of the protocols could be defined with little experimentation. The exception was on the wireless access side, and very much work was done there. In the context of the much richer 3G applications framework, much more sophisticated procedures will be used – many at higher levels being worked on in the IETF and not really part of the UMTS Forum activity. However, the performance and viability of these applications is not clear *a priori*; very significant amounts of testbed effort is needed to establish this viability and to modify many of the IETF procedures to accommodate the wireless parameters.

I have certainly been frustrated so far in the lack of experimentation in this area. Indeed, even if other groups would like to do the experimentation, there has been very little interest by the wireless operators themselves. Their pure research arms have been involved (e.g. parts of BT and Deutsche Telekom in the 6WINIT project). However direct involvement by the operators themselves, or even much provision of wireless resources, has been grudging in the extreme. This is mainly because these operators have not had the tradition of such experimentation, and do not yet see its need. This has had the obvious result that some of the early non-voice services introduced have had poor performance and an uncertain commercial future.

It is to be hoped that this reluctance to participate in experimental work will be overcome, as it has, for example in Japan. There the experimentation, which is being done under the WIDE project, is very impressive – and non-voice services can be expected to be very successful. I will give just one example. A number of cars have been instrumented for remote sensing, and many sensors have been provided with IPv6 addresses. Many types of experiment have been done including ones on remote sensing for diagnostic purposes and vehicle location sensing for traffic management – and then driver feedback. These experiments have uncovered many needs in instrumentation and protocols, and the pitfalls in building services based on the ideas proposed. For example, they used taxis in many of their experiments. The first results seemed to indicate horrible congestion in areas near stations; in reality this only reflected the taxis that were waiting in queues to pick up passengers. This result is trivial; others on the protocol requirements at higher levels are less obvious – and can be uncovered only by experimentation.

There are clear delays in the introduction of some of the non-voice services. It is to be hoped that the operators will use this delay to participate in longer-range experimentation in some of the current projects, and will help in the definition of larger scale ones in the future.

5. CONCLUSIONS

I summarise some of the points made in the talk:

- UMTS will be an important service, and will impact all our lives. It is not, however, a service in isolation. Wireless LANs overlap its activity in an important way. The two will have to work together – including easy transition from one to the other.
- UMTS will have important roles to play. These will be much more significant if the system remains capable of speeds much higher than GPRS – at affordable cost, and reasonable delay.
- Some key applications will depend on voice recognition. Either the terminal must be powerful enough to support this, or the technology must ensure that this occurs in the network with appropriate feed back to the user. HCI will be a key ingredient to the success of the new applications.
- At one level the agreement has been made to use IPv6 in future UMTS services, and for collaboration between the IETF, 3GPP and others. There is still a need to resolve some of the remaining quite deep differences between the two cultures. The two communities must collaborate more in the procedures surrounding security, routing and application services.
- There is a critical need for system and application experimentation, with a reasonably long timescale of 3-5 years by the UMTS community. This must include many areas, which the community has not previously considered their concern.

ACKNOWLEDGEMENT

Figures 1, 5, 6 are courtesy [Nokia] and Figs 2, 3, 4, are courtesy [Ericsson]. This work is largely under the auspices of the EC 6WINIT project [6winit].

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