

## Notes from the WLAN workshop organised by DG INFSO/E4

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### **Background**

The European Commission, DG Information Society E.4, organised a workshop on "WLAN - A Research Perspective", on the 17th October 2002, in Brussels, Belgium. The workshop brought together the aspects of WLAN standardisation, WLAN deployment on Campuses, public WLAN offerings, WLAN-UMTS integration, market issues, spectrum issues, etc. The objective of the workshop was to allow participants to exchange experiences, discuss problems found in the deployment of WLANs (scalability, security, user support, etc), assess ongoing standardisation work as well as R&D towards next generation WLANS.

### **Technology and Service Aspects**

HiperLAN2 - Peter C Karlsson, Telia Research  
email : peter.c.karlsson@telia.se

Telia Research has contributed to BRAN & IEEE standards, active in HiperLAN global forum and has contributed to standardising of WLAN, cellular and 3G interworking

A review of the 5 GHz spectrum situation in Europe was given, including the issue of accommodating Radar systems in this band. HiperLAN2 is seen as the enabling standard, offering high data rates of up to 54 Mbit/s, authentication and encryption, plug and play automated section of RF channels by access points and QoS Support in the DLC layer. The key element is the Medium Access Control for wireless access with the aim of processing being done on a chipset for better efficiency and throughput compared to 802.11b. HiperLAN2 also has superior throughput and extended range over 802.11a. Telia has developed smart access point sector antenna for improved throughput and extended range.

One of the key issues facing WLAN today is interworking with 2G, 2.5G and 3G cellular systems with user service transparency, Telia prefer integration takes place at layers 1 & 2

## QoS (Quality of Service) Issues - Jean Pierre Coudreuse, Mitsubishi Electric

As the digitisation of the consumer market takes off, devices in the home will cooperate and converge on the private home network. Interconnections requires high speed firewire that 802.11 cannot offer. Access to bandwidth in an efficient manner requires QoS, HiperLAN2 has capacity for QoS at the physical layer, making the allocation of bandwidth efficient and with minimal impact at the application layer.

Mitsubishi labs has conducted various scenarios using 2 terminals and access points. Each terminal was web browsing and videoconferencing, but 1 terminal was MPEG video streaming with best effort, whilst the other does the same but with QoS. QoS performed well in all scenarios (TCP/IP traffic increase, Access Point partially masked, Access Point fully masked). The key points were that QoS processes should be implemented on ASICs with source code on the embedded processor. Throughput and range is still limited, a decentralised operation is required, and an IEEE standardisation is needed to encourage deployment.

## IEEE 802.1x - Kimmo Kaitala, Nokia Networks

WLANs are being integrated into existing cellular and fixed services and will complement 3G. The building up of a customer base, WLAN infrastructure and backend operations are costly, it is simpler and more cost effective to work with cellular suppliers who have the customers, the infrastructure and the service know-how.

Cards are being shipped that offer GSM, GPRS and WLAN access, 3GPP v6 can offer WLAN too. Services will be bundled (GSM, GPRS, 3G, WLAN, SMS) together with international roaming. Deployments of wireless hotspots is growing fast, the key areas currently are where business travellers subscribe (e.g. hotels and airports) and where the value of the service increases as a function of distance.

National roaming needs to be allowed or a technical solution put in place to offer multiple WLAN operator access that Nokia has trialled and works.

The lack of standardisation is affecting the take up of WLANs, open standards are needed.

## **IST Projects**

### BRAIN / MIND - Dave Wisely, BT Exact

<http://www.ist-mind.org>

BT is launching 20 hotspots (2002), 1000 hotspots (2003) and 2,000 hotspots (2004). BT no longer has a 3G licence but is working on WLAN integration to 3G networks instead.

BRAIN / MIND are EU IST projects looking at IP solutions beyond 3G. BRAIN focused on campus coverage of real time applications using HiperLAN2. MIND is an extension of BRAIN looking at extending connectivity outside of the campus, focusing on GSM, 3G and WLAN handover / roaming and sharing the network via handheld devices and the implications for QoS and Security.

An architecture has been developed to interface IP to wireless, this architecture also supports IPv4 and IPv6. Mobility management is difficult for seamless handovers, parameters need to be set up in advance to compensate for degradation before handover takes place to negotiate and adapt QoS, this has to be done at the IP layer.

A tunnelled solution down to the Access Router from an “anchor point” to get an IP address using non-specified routable protocols with reverse tunnelling to support QoS is working in two implementation trials.

WIND-FLEX - Luigi Agarossi, Phillips Research Monza  
<http://www.vtt.fi/ele/research/els/projects/windflex.htm>

WIND FLEX is a flexible radio interface architecture for short-range high speed wireless networking, essentially aimed at 4G short range high speed network devices (mobile and fixed) connected in a fully meshed architecture. The main characteristics are 17 GHz RF, OFDM based, very high bit rate with very high spatial efficiency. The Wind-Flex applications areas cover areas of high speed mobility for data rates of up to 10 Mbit/s. Higher data rates are compromised by the speed the mobile device is travelling. There are four frequency channel bands in the 17 GHz frequency to cope with both high and low data rates with no interference. Coverage of up to 100m is possible for Line of Sight and up to 10m where there is no line of sight.

A “Supervisor” acts as the smart control unit at the physical layer, and processes run-time optimisation of any flexible transmissions systems. The supervisor chooses turbo and constellation rates and channel conditions and reconfigures in realtime every 0.5 ms. The network is able to operate on an ad-hoc basis, in a meshed configuration with a single cluster and frequency with a master and slave entity.

When compared against other WLAN standards, WIND-FLEX has a higher RF of 17 GHz, higher bandwidth at 50 MHz, up to 250Mbit/s physical rate, TDMA/TDD media access control, OFDM frequency selection, a choice of four modulations but a lower no line of site coverage of up to 10 metres.

Wind-Flex is aiming to be the next generation WLAN/WPAN or WLAN backbone as it has a very high speed and capacity density, high flexibility, multi-hop architecture, dynamic self-configuring with guaranteed QoS and intrinsic security.

## WLANS on Campus

University of Bremen - Manfred B. Wischnewsky

<http://www.tzi.de>

The new educational landscape consists of a global education market with new providers, corporate universities, on and off campus university networks and the ethic of lifelong learning for all.

Students want next generation services, links to the global education market and the need to make education more learner friendly and learner oriented are the motives for a virtual provision. The University of Bremen has achieved this by working in partnership with international and national universities and industry to raise funds and solve problems together.

The University campus is based on 802.11b with commodity based equipment (tried and tested) and has no vendor lock in. The wireless network has >490 access points costing approximately 2 EURO per square metres of floor space.

### Network planning & implementation

The wireless network planning was based on building drawings for the location of Access Points; also the fixed network was prepared to integrate to the wireless network. A simple 25 MHz channel plan based on channels 1,6,11 was set up. This may move to the 20 MHz channel using channels 1,5,9 and 13 as fill in. There may also be a move to 802.11a to accommodate 8 additional channels. Students are able to buy dual band cards for wireless access. When QoS was switched on, it was used for peer-to-peer traffic, this was disallowed, however screen sharing is still a problem. Multicast has yet to be enabled.

### The obstacles

In a fixed network with fibre to the desktop, wireless LANs are very difficult to deploy. In Germany staff committees much be involved as early and often as possible, there are often issues related to electromagnetic interference and privacy to overcome. Sabotage from within the University is also a major concern.

### Security

WEP has been broken and 802.1x has no products as yet. Any network security must have deep security, based on VPNs for mobile users with SSH, PPTP and IPSec available. There is no Access Point based security. The standard architecture is to offer a public or open WLAN / VLAN that is unsecured for DHCP, DNS servers and free Internet access. However, to access the Campus network, users must get access via VPN Gateways first. This architecture is being developed across Germany, as it is scaleable, the aim is to

connect these unsecured wireless LANs together as a WBONE to enable national roaming. The Terena Mobility Group is addressing this activity.

A variety of EU Projects (IDEELS, COSIGA, Radio, DERIVE & BREVIE) were also mentioned in the presentation.

University of Tromso - Tage Stabell -Kulo

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Tromso presented their IPv6 -only in production network to approximately 30 stations. The network uses Mobile IPv6 to overcome roaming issues in IPv4, IPSec for built in security and is fully routed for every station. Network Load is high at 90% as network devices are binary.

IPv6 challenges are multi-homing; machines that have more than one network connected to it (e.g. wireless and wired), handoff; when moving this is an issue, Access; simple in IPv6 but what about IPv4, and QoS; Tromso don't believe in QoS and prefer to buy more capacity instead.

Lancaster University - Stefan Schmid

<http://www.mobileipv6.net>

Lancaster University reviewed their previous project work in the GUIDE Project (1997) using 802.11, COGENT (1998), MOBILE IPv6 to improve performance and QoS, LandMARC Project (1999 - 2001) to develop a mobile IPv6 stack platform and EdNet/CLEO (1997 - ) to connect all schools north of Lancaster & Cumbria.

The current initiative was Mobile IPv6 systems research lab in collaboration with Cisco, Microsoft and Orange. A 4G test network for 4G applications and services is being developed with a wireless overlay network for ubiquitous connectivity of 802.11b, Bluetooth and GPRS. (see mobileipv6.net). Lancaster University's main concern with the 4G network is with how it can develop a scaleable network design.

Lancaster University main areas of interest are connectivity to the home, out and about in the city centre and public places and the workplace. Lancaster has set up a wireless network in its own department for work, at the university campus and at homes with IPv4/6 connectivity as well as wireless networks in residential areas and around the city of Lancaster and its parks.

Williamson Park has a central point of focus at a memorial where 4 access points provide the wireless footprint. A demonstrator application has been developed that allows a collaborative game to take place in the park whereby a PDA displays location and orientation from a built in compass and also the location of team mates so that virtual "monsters" can be found and eliminated in the park. The game is due to be trialled in Jan 2003, issues of GPRS and WLAN handoff need to be resolved.

## Standardisation and Spectrum Issues

### 3GPP activities - Thomas Haslestad, Telenor

Telenor are working on WLAN and integration in 3GPP system to cover areas with appropriate radio technology, provide high-speed Internet access to 2G and 3G customers and more efficient access to local services.

3GPP has been working on Service and Architecture issues since October 2001. A Wireless Interworking Group(WIG) (IEEE 802.11 (USA), BRAN (Europe), MMAC HSWA (Japan)) have been involved in WLAN - 3G interworking.

3GPP v6 extends access to packet domain services from WLANs, whilst v7 when finished will cover Mobility (Mobil IP is a proposal) covering session continuity between WLAN and 3GPP systems ad seamless services.

Further work is required to create interaction between 3GPP and WIG for a harmonious standard definition.

### European Landscape - Soren Hess, ERO

HyperLANs (draft EN301 893) and Wireless LANs (802.11) cover the frequency range of 5150 - 5350 MHz with 5150 - 5250 MHz for indoor use without Dynamic Frequency Selection (DFS) and Transmitter Power Control (TPC) Radars are in band 5250 to 5350 and need protecting.

A table of the frequency bands can be seen below

Frequency band	Power level	Standard?	Use	Notes
2400 - 2482.5 MHz	100 mw	EN 300 328	WLAN, Bluetooth, Voice Access, Home Networking, Fixed Wireless Access	Harsh environment, allowed in some but not all EU countries
5150 - 5350 MHz	200 mw	No decision on ERC (99) 23	HiperLAN2 for indoor use	Use depends on RADAR use
5470 - 5725 MHz	1 W	ITU -WRC03 harmonisation taking place	Indoor and Outdoor Use	

### Futures

HiperLAN and Fixed Wireless Access in the 5.8 GHz range  
The use of the Ultra Wide Band in 3 - 10 GHz

## **Business Experiences and Market Perspectives**

Telia HomeRun - Peter C Karlsson, Telia Research

<http://www.homerun.telia.com>

HomeRun is a service concept for the traveller that offers nomadic broadband wireless IP access based on Wi-Fi (IEEE 802.11b). Users are able to flexibly migrate their place of work maintaining broadband connectivity. The service offer travel intensive locations (e.g. hotels, airports etc) to improve their competitive offer towards their guests.

A PDA or portable computer with a Telia HomeRun subscription and a standard 11 Mb PC/MAC card IEEE 802.11b compatible (WiFi) is all the user needs.

Telia has recently launched a special subscription plan for GSM and GPRS customers combining it with Telia HomeRun for high speed and dual capabilities to reach the Internet or Intranet with increased flexibility and cost savings.

Wireless Metropolitan Network - Kostas Vlahodimitropoulos, CosmOTE

The projected number of WLAN hotspots worldwide will increase to over 40,000 by 2006. WLANs are a mature technology with a cheap infrastructure and to some extent scaleable (GSM-GPRS-3G). Compatible devices are in use.

Mobile Operator advantages and fitting WLAN to the mobile operator network was discussed finalising in a future architecture diagram of a mobile network.

The challenges for roaming and WLAN/GPRS interworking are roaming management, authentication including signalling, security, billing and accountability. There are also regulatory issues as some EU countries require a licence to operate.

WLANs in public transportation - Jean Noel Temem, SNCF

The current status is that Kiosks and mobile applications are in use for operational purposes in train stations, on board trains, in freight marshalling yards and as mobile applications for travellers (wireless hotspots).

Experimental projects are

TV - NOMAD - A last minute ticket exchange terminal.

AGORA - A supervision tool in large train stations for real time information access.

ACCELIO - A mobile terminal for commercial staff with on board ticketing and operational information.

PIF - An information point / kiosk with bluetooth and 802.11b links to mobile devices and Agora networking respectively.

SAFARI - An integrated network architecture for adhoc and wired services.

WLAN in market perspectives - Ross Pow, Analysys Research

<http://www.analysys.com>

- There is a lot of pWLAN activity taking place worldwide.
- Device shipments are being driven by prices, standardisation and competition.
- Service players are targeting high end business users with simple needs.
- WLAN prices should be significantly less than other wireless services.
- A simple service proposition is to connect the different WLANs together (Private WLANs, Public WLANs and Home WLANs).
- The greatest growth area is the developing markets to connect users for the first time.
- There are plenty of system integration issues to resolve before revenues increase.