Experiences and Future Outlook of @450

Kari Heiska, Digita

9.10.2007

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Agenda

- Digita / TDF
- Background of @450
- Network sharing
- @450 services
- Flash-OFDM technology
- @450 Network
- Pilot projects
- Future visions
- Summary

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- Turnover € 103,7 million (pro forma 2006)
- 374 employees of whom 200 around Finland
- Owned by: the TDF Group

tdf

- Turnover € 945 million (2006)
- 3,852 employees
- Owned by:
  - Texas Pacific Group 42%
  - La Caisse des Dépôts et Consignations 24%
  - AXA Private Equity 18%
  - Charterhouse Capital Partners 14%
  - Management and personnel 2%

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Digita Services

" Digi-TV (DVB-T)
" Radio
" @450
" Mobile-TV (DVB-H)
" Network and site services
" Transmission services

"We deliver your content"

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Background of @450 in Finland

- NMT 450 network was closed at the end of 2002
- Ministry of Transport and Communications (MinTC) opened the operating licence of wireless broadband network for application in February 2005 including 2 x 1,25 MHz Block A
- MinTC received seven applications. The operating licence was granted to Digita in June 2005.
- Special conditions of the operating licence:
  - Flash-OFDM technology
  - Digita cannot act as a service provider
  - Digita must offer its network services to all service providers under equal and non-discriminatory conditions.
  - Construction obligation: country-wide network by the end of 2009

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Flash-OFDM in brief

- Developed by Flarion technologies (1997⇒)
- Now in the roadmap of Qualcomm-Flarion Technologies (QFT)
- Frequency bands: 450 and 870 MHz

Broadband and Interactive

- 5.3 Mbps downlink peak data rates
  - Typical 1 - 1.5Mbps per user
  - 256 QAM
- 1.8 Mbps uplink peak data rates
  - Typical 300 - 500Kbps per user
- Sector throughput ~1.5 Mbps
  - Capacity depends on the service profile
- Average packet latency 50 milliseconds
  - Min ~20 ms
- Fast transitions between terminals stages (Hold → Active 55 ms)

Always-on Wherever You Are

- Seamless wide area coverage, vehicular mobility
- IP based mobility - interoperable with 802.11

Standard IP

- No changes to IP network, host device, applications or content
- Leverage IP infrastructure, devices and channels

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Wireless technologies

	Flash-OFDM	WiMAX	3G/HSDPA	GPRS/EDGE
Frequency	450 MHz	3.5 GHz	2.1 GHz	900/1800 MHz
Coverage	National	Areal	Biggest Cities	National
Line-of-sight needed	No	Yes	No	No
Mobility	Yes	No	Yes	Yes
Average data-rate	~ 1 Mbps	~ 1 Mbps	~ 1 Mbps	100-200 kbps
Latency	20-50 ms	20-50 ms	>80 ms	>150 ms
Usage in other parts of Europe	No	No	Yes	Yes
Terminal type	Modem + PC	Modem + PC	Mobile	Mobile

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Flash-OFDM 450 advantages

- Low frequency enables good coverage
  - Fast rollout
  - Reliable and high data-rate connections almost everywhere
  - Good indoor coverage
- Low latency and connection set-up times
  - Enables usage of existing application
  - Wireline user experience
  - Low latency services
- High spectral efficiency
  - Fast airling re-transmissions, efficient coding, 256QAM, efficient usage of airling resources
- High mobility
  - Mobile speed up to 300 km/h
  - Fast handover
- Frequency re-use 2 or 3
  - Using different frequencies in different sectors increases the SIR at the cell edge
  - Higher QoS at the cell border compared to N=1
- All-IP radio network
  - Simple protocol stack
  - Intelligent edge
  - IP routing infrastructure and protocols
  - MVNO model through IP layer

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Network Sharing in Telecom Sector

O2 – T-Mobile
O2 CEO announced O2 contemplate sharing network with T-Mobile 01/03/07

Vodafone – Orange
network sharing 3G announcement
02/07

Hutchisson → Ericsson
network outsourcing
12/05

Vodafone – Orange
network sharing 3G for < 25,000 inhabitants Town 11/06

Yoigo → Hutchisson
network outsourcing
11/06

- **Orange → Ericsson**
  network outsourcing
  02/07
- **Vodafone → Ericsson**
  network outsourcing
  03/06
- **T-Mobil → Nokia**
  network outsourcing
  02/07

Hutchisson → Ericsson
network outsourcing
01/05

Mobistar → Ericsson
network outsourcing
02/07
Base → Alcatel
network outsourcing
01/04

Telia – Tele2
network sharing
04/02

P4 - Polkomtel
National roaming on Polkomtel network for P4
06/06

E-Plus → Alcatel
network outsourcing
02/07

O2 T-Mobile
- Site sharing
- Network roaming until 31/12/08

One → Alcatel
network outsourcing
01/04

- *"Instead of seeking to differentiate themselves on coverage, operators will differentiate on content and services, with shared network resources, rather like power distribution networks"* Industry analyst
- *"Our company is financially driven and we are open to any cooperation with another operator"* Operator

Recent network sharing announcements
Network outsourcing deals
Older network sharing deals

Source: A.T. Kearney

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Finland: some numbers

- 5.2 mln inhabitants; 338,145 km^2
- > 50 % of population live in the South (South of Pori and Tampere)
- 500,000 holiday houses and cabins
- 75,000 recreational vehicles / mobile homes
- 40,000 boats (large sailboats and motorboats with over 100hp)
- Strong forest industry in the North and Southeast
- Availability of broadband access is quite good (>95% of households are covered by ADSL or CATV offering)
- UMTS coverage limited to urban areas (Mobile operators announced HSDPA would not cover more then 40% of population)

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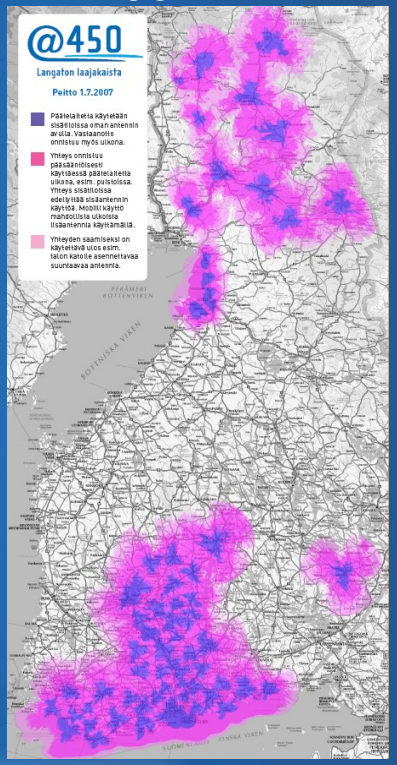
@450 service

- Opened 1.4. 2007
- Finland is one of the first countries in Europe to roll out a nationwide mobile wireless broadband network
- Digita acts as the network operator supplying access technology
- The network rollout will be carried out based on Service operator wishes, cusomer demand and Digita's own vision
- Nationwide coverage by the end of 2009

1.7.2007



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@450 Customer Segments 1/2

- Digita has expected to reach the following end-user segments with its 450MHz wireless broadband offering:
  - **Homes**: i.e. Households living in either non-ADSL or max 1Mbit/s ADSL service coverage
  - **Leisure related**: Household looking for a broadband connection that would function both at their summer cottage / boat / mobile home and at their primary residence
  - **Leisure subscribers**: Households looking for a connection exclusively for their summer cottage / boat / mobile home

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@450 Customer Segments 2/2

- **Mobile businessmen**: Workforce whom would benefit from a nationwide wireless broadband network – most probable use case would be a hybrid UMTS+450MHz terminal

- **Industrial**: Industrial users utilizing the 450MHz network to enhance their processes e.g. logistics companies, forestry companies, utility companies, health care etc.

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@450 Exisiting / Future Services

- Broadband Internet
  - Wireless internet access
- Delay critical personal applications
  - VoIP, Net meeting, Online games, Chatting, …

- Delay critical enterprise applications
  - Locationing
  - Mobile office: maintenance, health care
- Others
  - Video surveillance, radio delivery, …

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@450 Service: Service Provider's Role

Service operator produces network services to the end user by utilizing the own and Digita network infrastructure

- Additionally the service operator takes care of
  - Terminal provisioning
  - IP addresses of the end user
  - Service marketing
  - End user billing
  - Service advices, end user error messages, other end-user services
  - Terminals
- Service operators can be e.g. mobile operators and broadband operators / ISPs

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@450 Service: Network operator role

- Strategic guidelines and 450 license restrict Digita to be in pure network operator role
- Digita is responsible of
  - Technical planning
  - Implementation
  - Maintenance and
  - Operating the 450 network

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Finnish market players

- 3 Incumbents
  - TeliaSonera and Elisa are both fixed and mobile operators
  - Finnet Group includes DNA, a mobile operator and several local Telcos
- Challengers
  - TDCSong focusing on corporate sector, community built networks outsourced operators
- CATV operators
  - the largest being Welho
- IT & telecom services integrators
  - Fujitsu Services
  - WMData
  - TietoEnator
- Nearly all of the service providers have tested the @450 service and all that have tested have been satisfied with the performance.

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Service Operators 10/07

Oy M & P Systems Ltd

- Private and enterprise customers
- Connections
  - M & P 512/256 38 €/month. 5GB/month data transfer limit
  - M & P 1024/512 48 €/ month. 5GB/month data transfer limit
  - M & P 1024/512 + 75 €/month . Mainly for Wlan hotspot backbone and for local offices. 10GB/month data transfer limit
  - Opening fee 39€
- Terminal prices
  - Modem 279,99 €
  - PCMCIA-card 249,99 €

• Fujitsu-Service

- Enterprise customers

• Telia-Sonera Finland

- Private and enterprise customers
- Starting 1.12.

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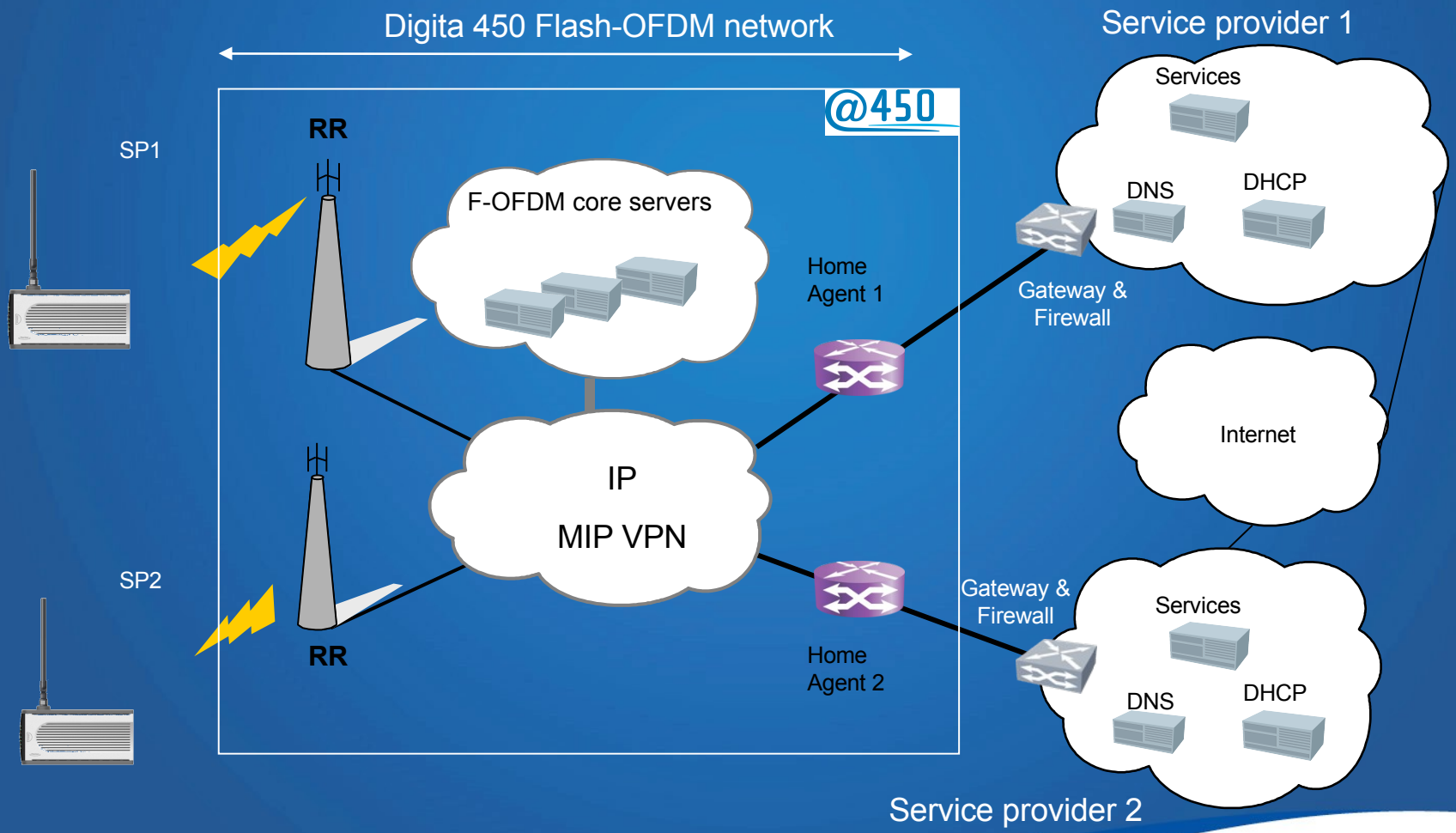
Flash-OFDM network architecture



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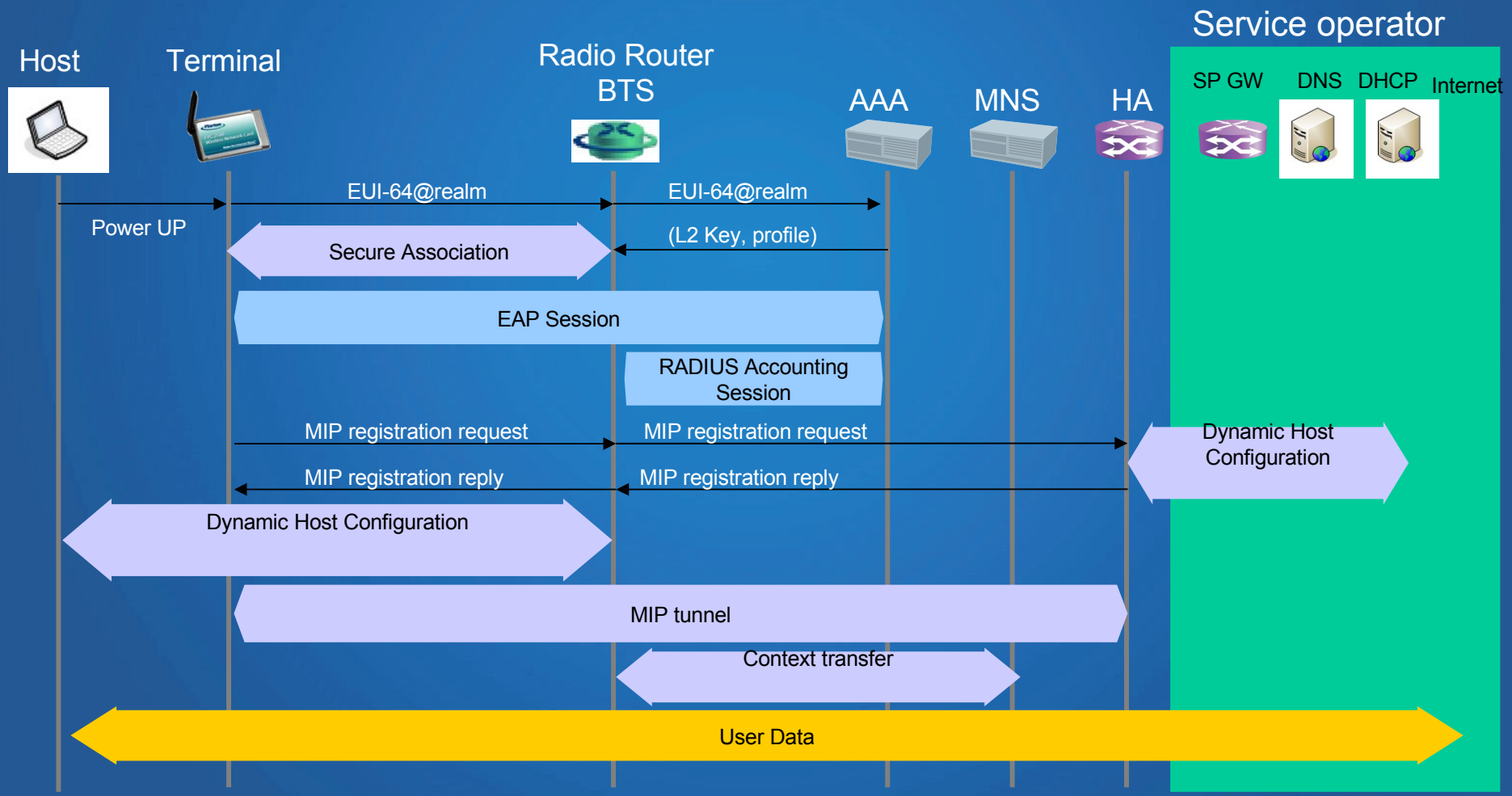
Flash-OFDM: main protocols



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Flash-OFDM terminals

Desk Top Modem

PCMCIA card

WLAN routers

Future

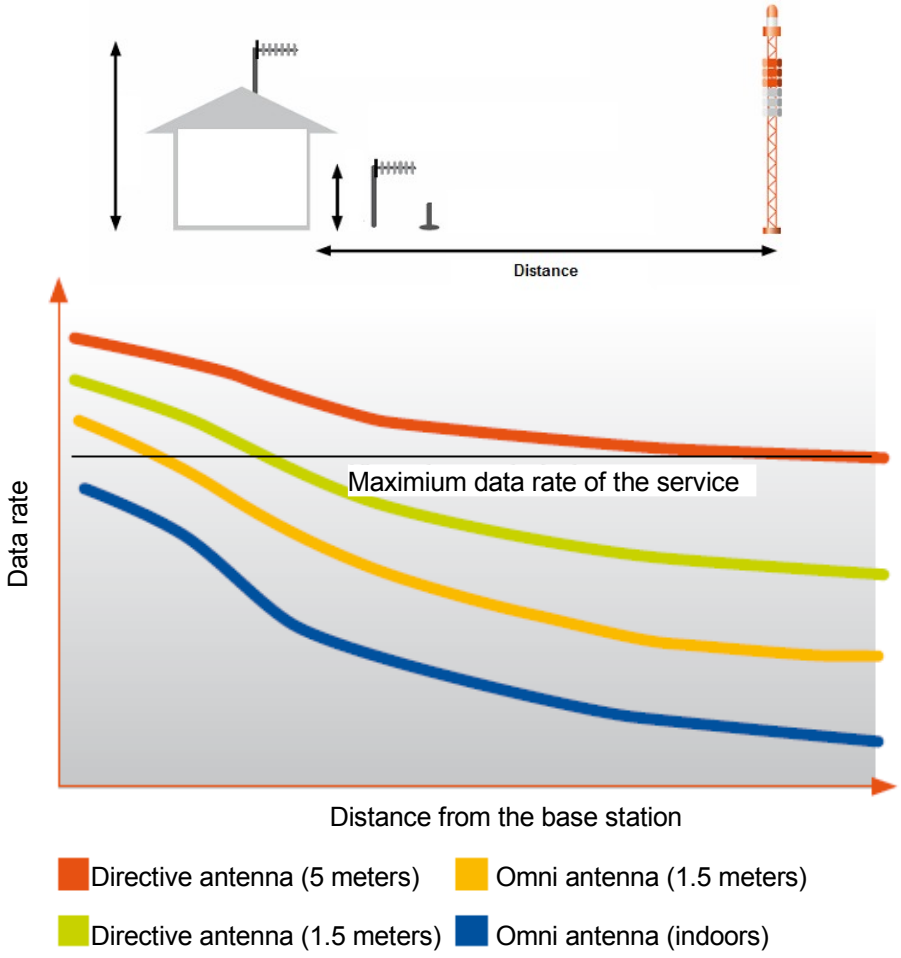
- **Exotec handheld device**

- **USB modem**
- **PC Express card**

Data-rate of the connection

Data-rate depends on the

- Terrain and building shadowing
- Distance from the base station
- Indoor penetration losses
- Antenna gain and direction
- Antenna height
- Interference
- Network load



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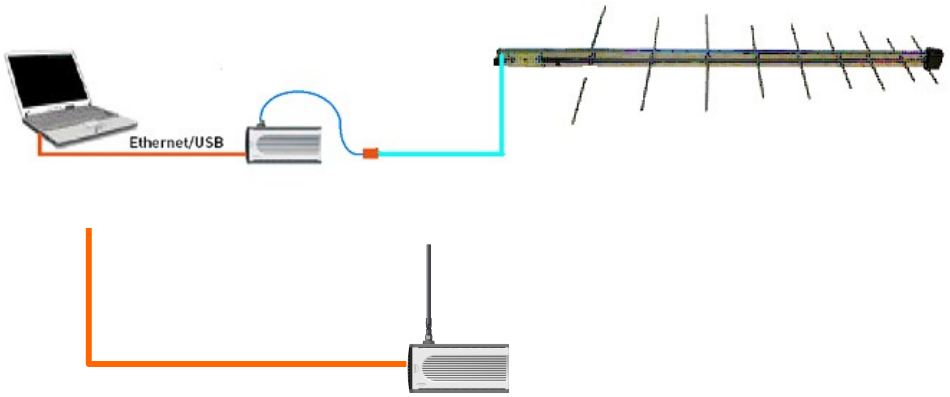
@450 Usage Examples

Desk-Top modem

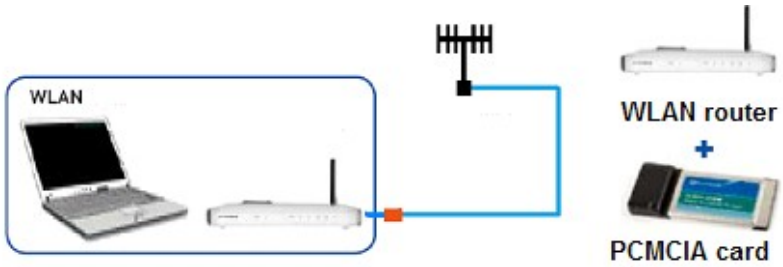
With or without external antenna



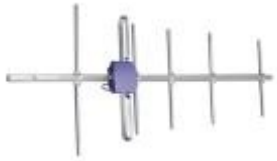
PCMCIA data card

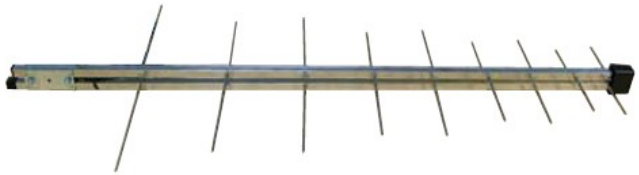
With or without external antenna

WLAN router



@450 Antennas





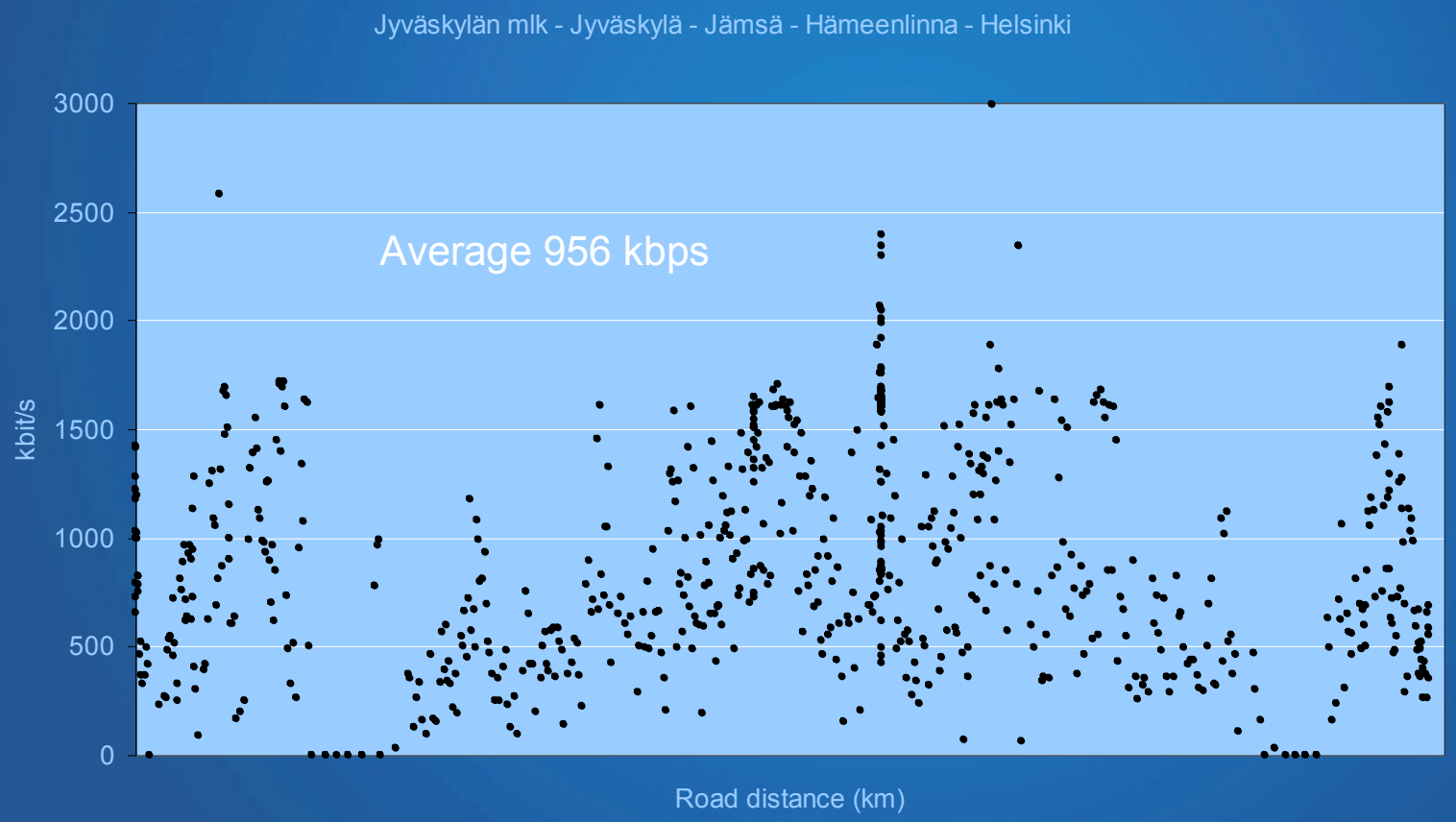
Directive antennas

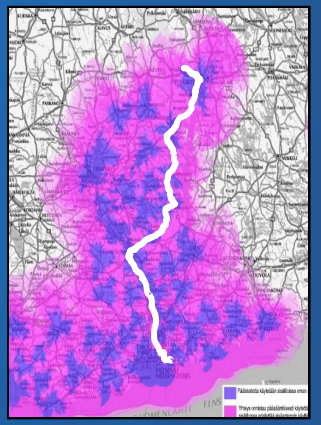
- Summer cottages
- Residental buildings
- Caravans
- etc

Mobile antennas

- Laptops
- Cars, trucks
- Boats
- Harvesters
- jne

Car measurement example: Data rate





Source: TeliaSonera Finland Oyj, with permission

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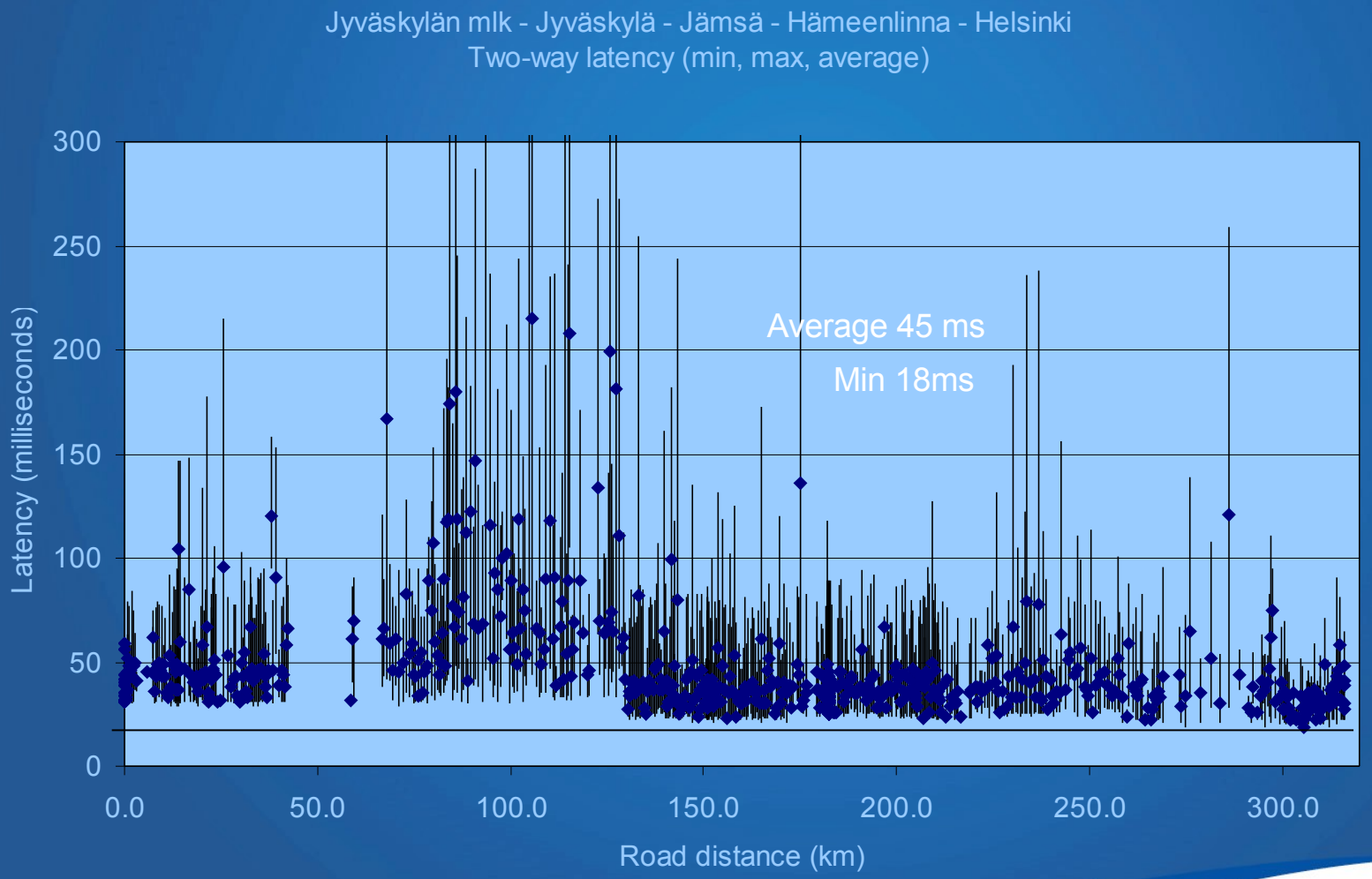
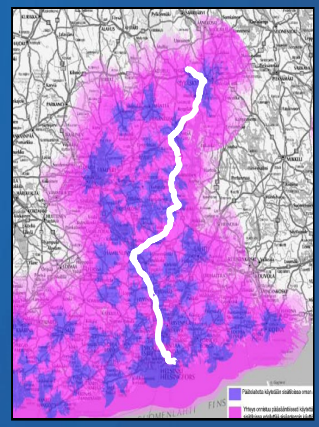
Car measurement example: Latency





Source: TeliaSonera Finland Oyj, with permission

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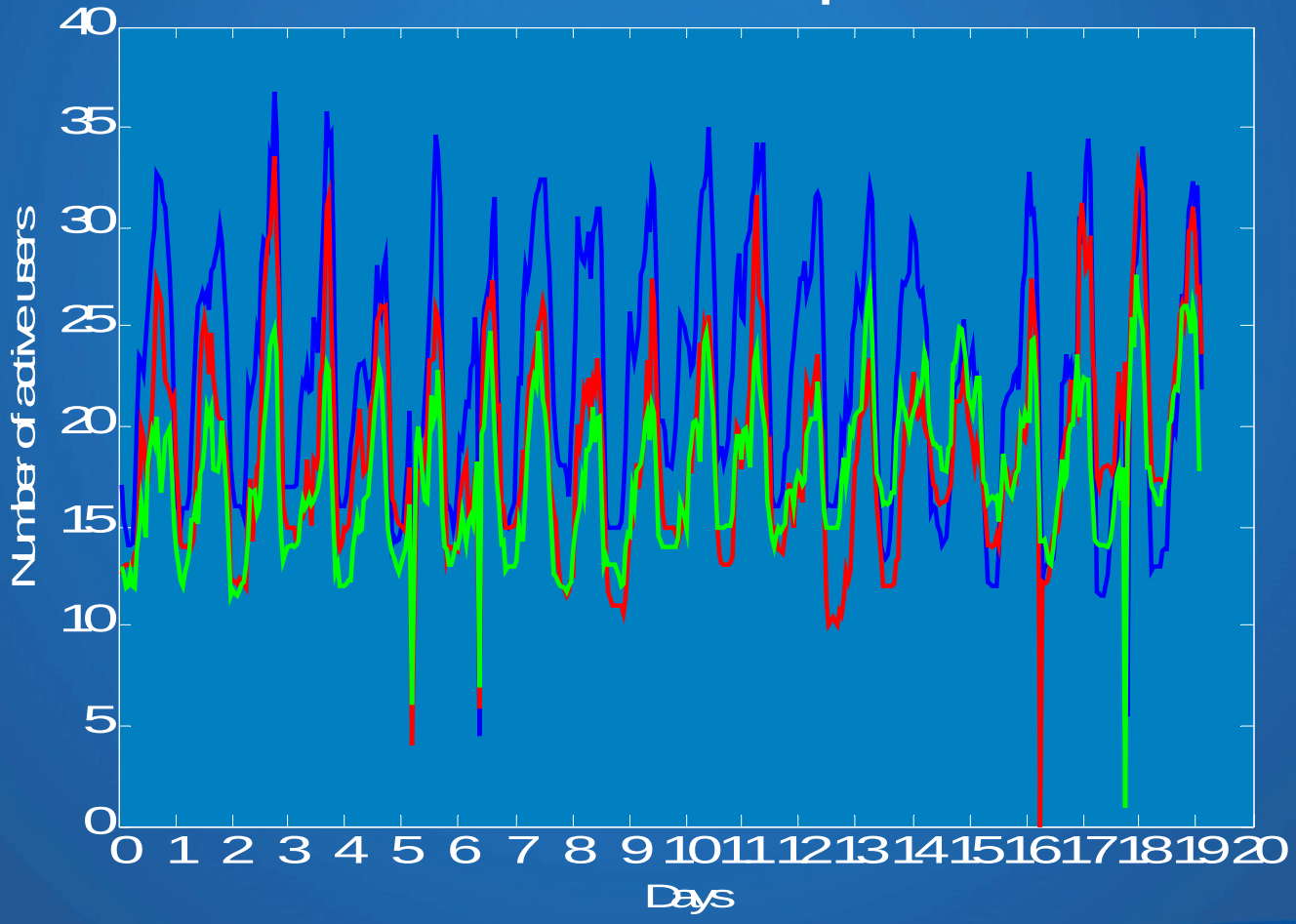
@450 usage example: Number of users per sector



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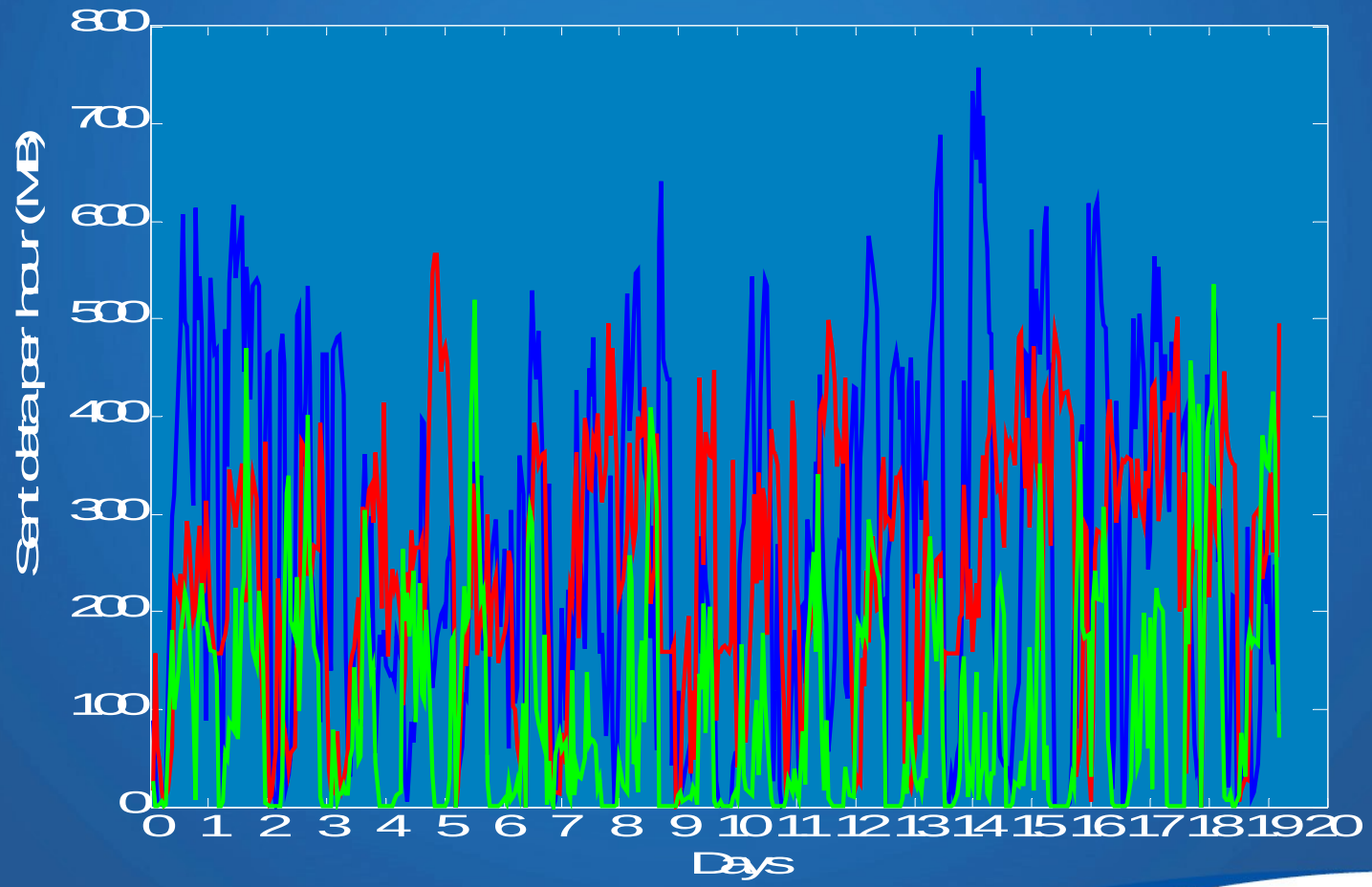
@450 usage example: Sent data (MBytes) per sector



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GSM: Voice Anywhere

1980's

time

1990's

Same applications

Voice service
- *High quality service*
- *Easy to use*

Similar but mobile devices

- *Easy to use*
- *High quality user experience*

Mobile usage

- *Anywhere, Any mobile speed*

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@450 Vision: Internet Access Anywhere

2000's

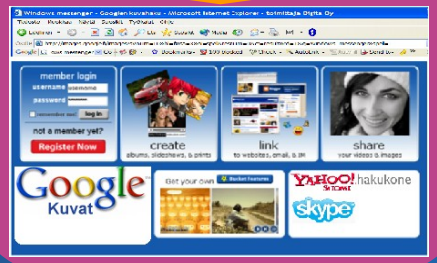
time

2009

Same applications

Access to internet services

- *High quality screen / keyboard*
- *Multiple parallel sessions*
- *Easy to use*
- *IPTV, voice, browsing*
- *Enterprise web applications*



Similar but mobile devices

- *Easy to use*
- *Big screens and keyboards*
- *High quality user experience*

Mobile usage

- *Anywhere, Any mobile speed*

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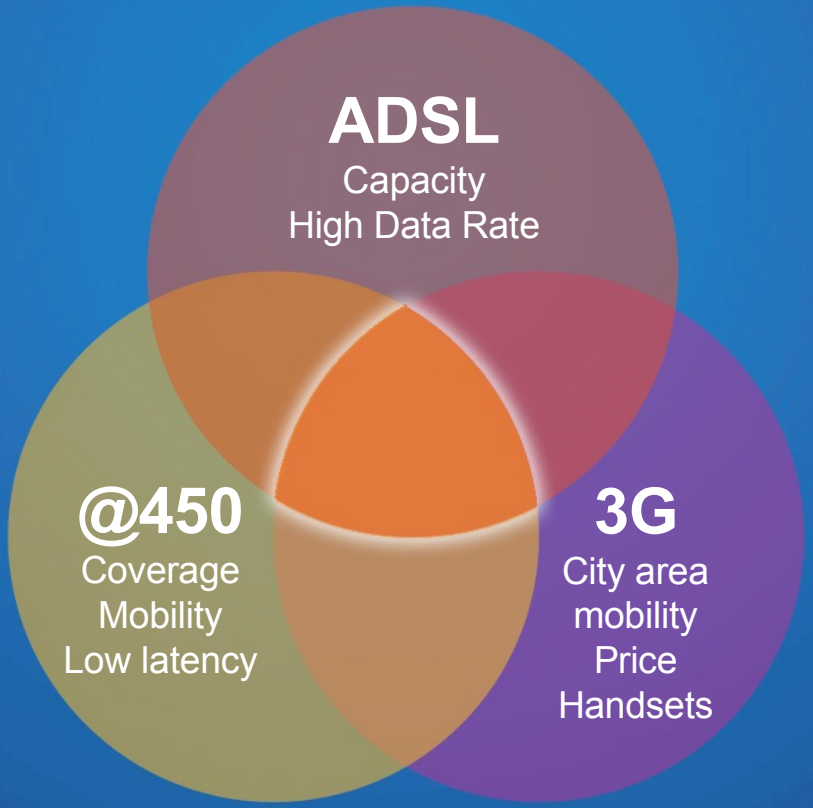
Complementing broadband data services



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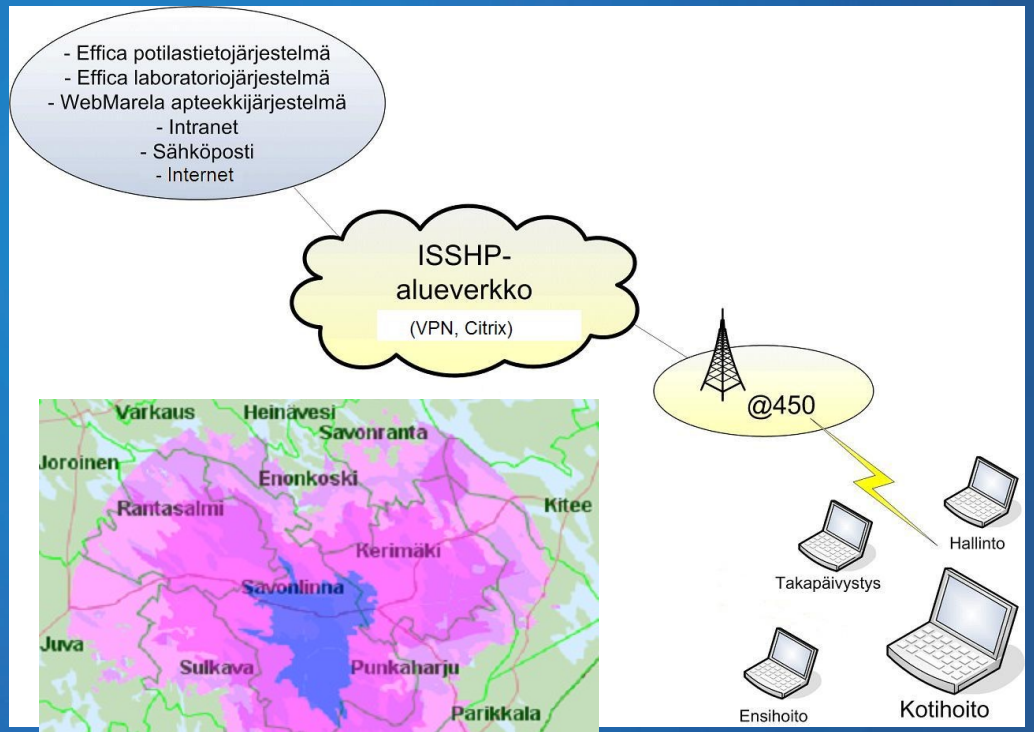
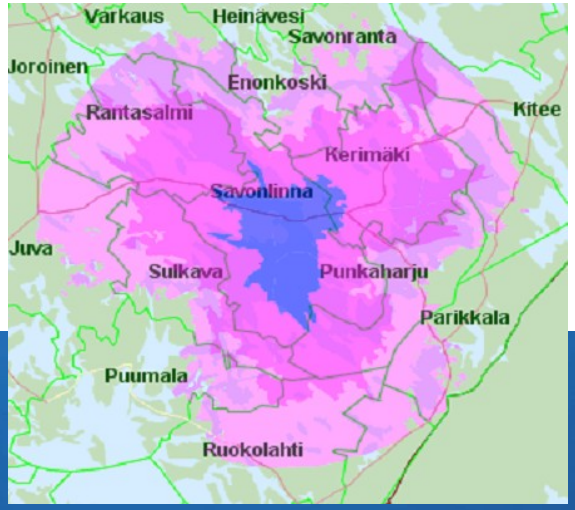
Case ISSHP: Home Care Pilot Project

- Participants: Fujitsu-Service, Digita, ISSHP
- Idea of the project has been to have time and location independent connection to
  - Patient information systems
  - LAN of the hostpital
  - Needed Web-applications
- Programs (through Citrix) related to care visit
  - Medical records through Effica
  - Appointments, home care
  - Laboratory results
  - Medicine orders
- Others
  - Internet, intranet
  - Team post programs





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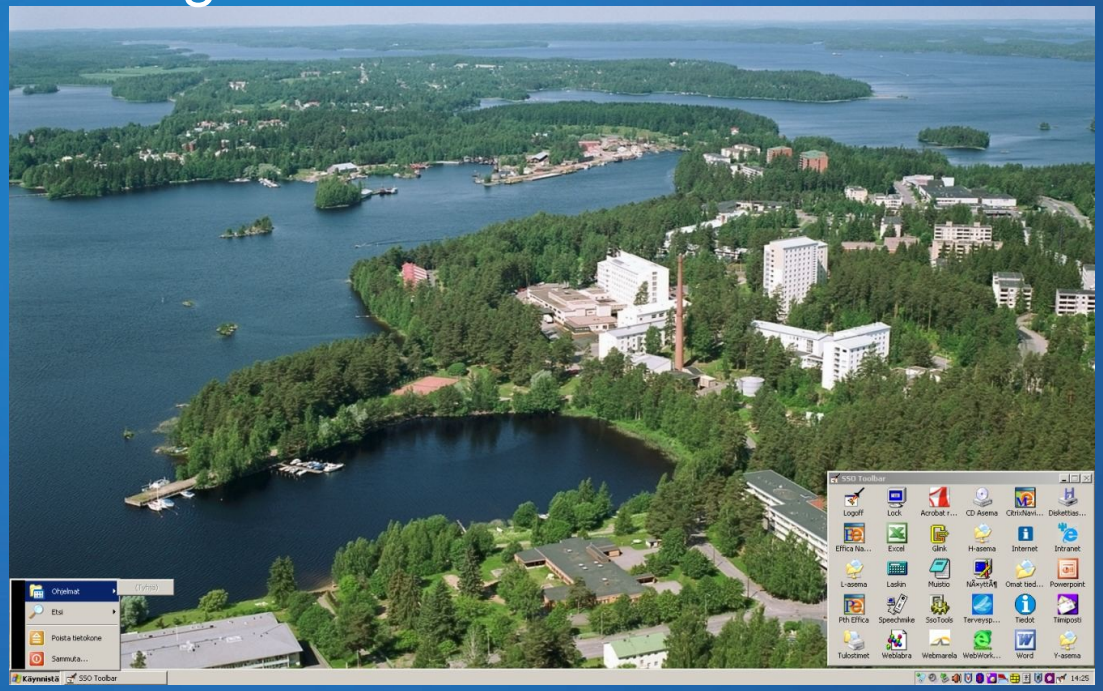
Case ISSHP: Home Care Pilot Project

Nurse work station

Working window of the home care nurse



- The new home care process has many impacts to the reduction of costs and increasing the efficiency and convenience of the work
- The project has been succesfull and the pilot will go on
- Following phases: production 2008, further development

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Other Pilot Projects Cases

- Locationing services, Indagon
  - Bus locationing, WLAN, traffic light advantage
  - http://transport.wspgroup.fi/hklkartta/
- Long distance busses, Matkahuolto
  - Locationing, broadband connection, information systems for passangers, advanced ticket systems
- Telecommunication services for community sector, e.g. Posio
  - Broadband connection, health care, community workers

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Summary

- Many operators have been testing the @450 Service and the feedback has been very positive
- @450 as a service innovation platform
- Competitive advantages of shared wireless networks:
- Competitive advantages of Flash-OFDM
- Only nationwide wireless broadband service in near future

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Thank You

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