Heterogeneous Home Networks:
Concepts of the OMEGA Research Project

presented by

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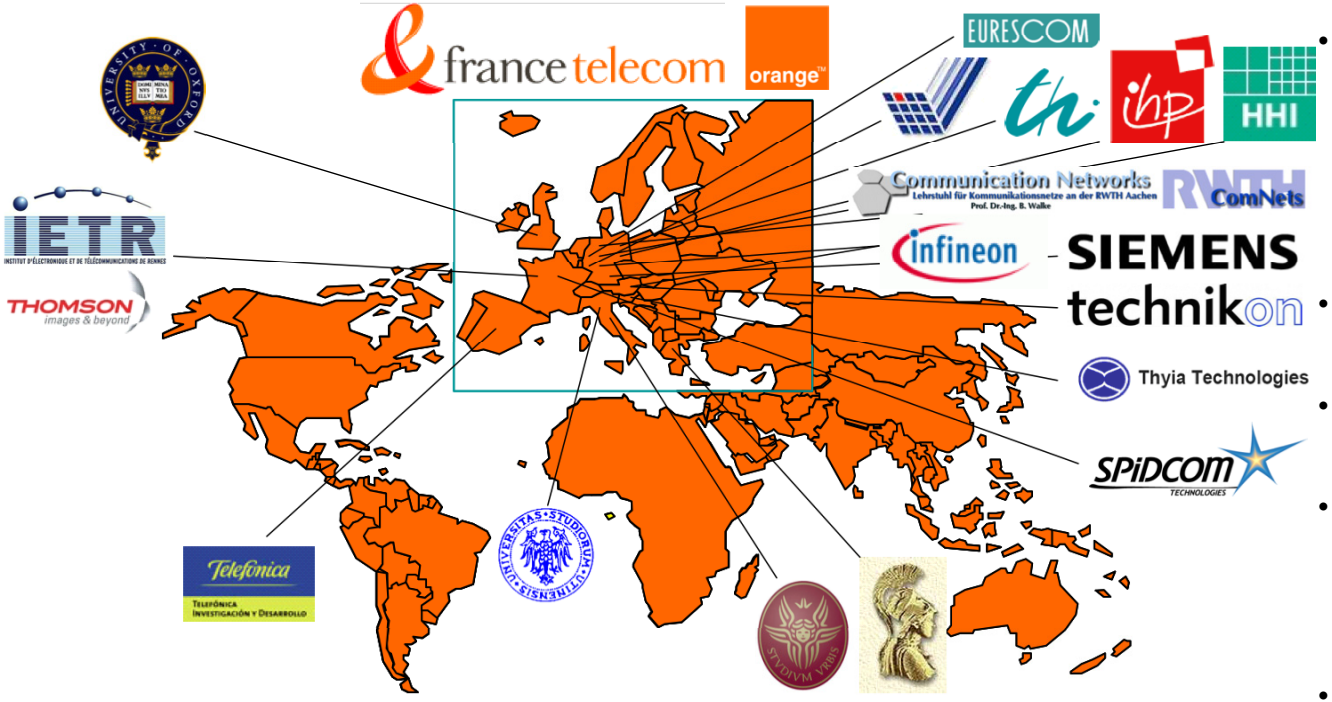
OMEGA FP7 project

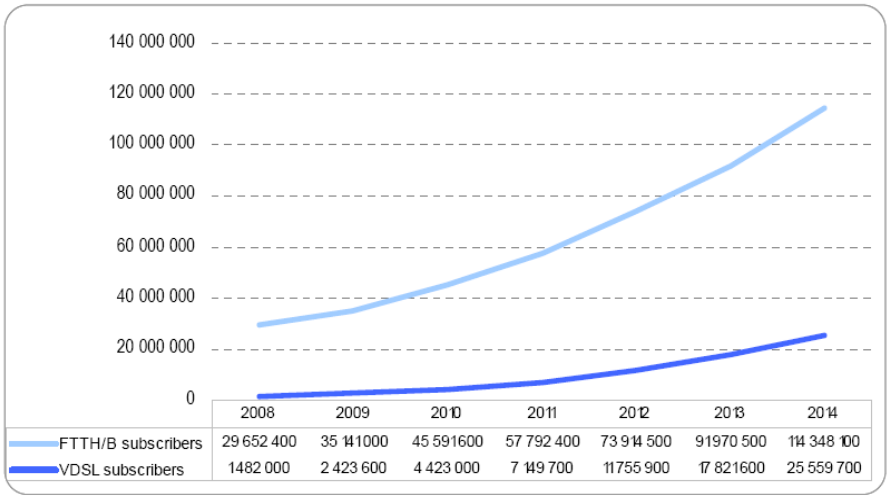


- Collaborative project
  - Funded by the European Commission
- 20 partners
  - From industry and academia
  - Orange coordinates the project
- 3-year project
  - Jan. 2008 – Dec. 2010
- Goal: Define and implement a Gbps home network over heterogeneous technologies
  - Demonstration of HW prototype home networks planned in 2010
- Project website:
  - http://www.ict-omega.eu
- Contact for general information:
  - info@ict-omega.eu

Perspective on Home Networks

- Home Networks represent a growing market
  - Broadband access bandwidth is increasing
    - Already 100 Mbps symmetrical with FTTH
  - More and more homes connected with cable, xDSL or FTTH
    - Already over 100 million subscribers in Europe
- The Home segment must not become a bottleneck for delivering operator services
  - Need for higher rates as well as better QoS in the home
- The user will have the final choice → Heterogeneous technologies will be used in the home
  - Wired
    - Ethernet over CAT5, CAT6, CAT7
    - PLC
    - Fiber
    - …
  - Wireless:
    - IEEE 802.11
    - Short range radio (e.g. 802.15.3c, .11ad)
    - Wireless Optics (e.g. 802.15.7)
    - …

Growth of FTTH/B and VDSL subscribers around the world between 2008 and 2014

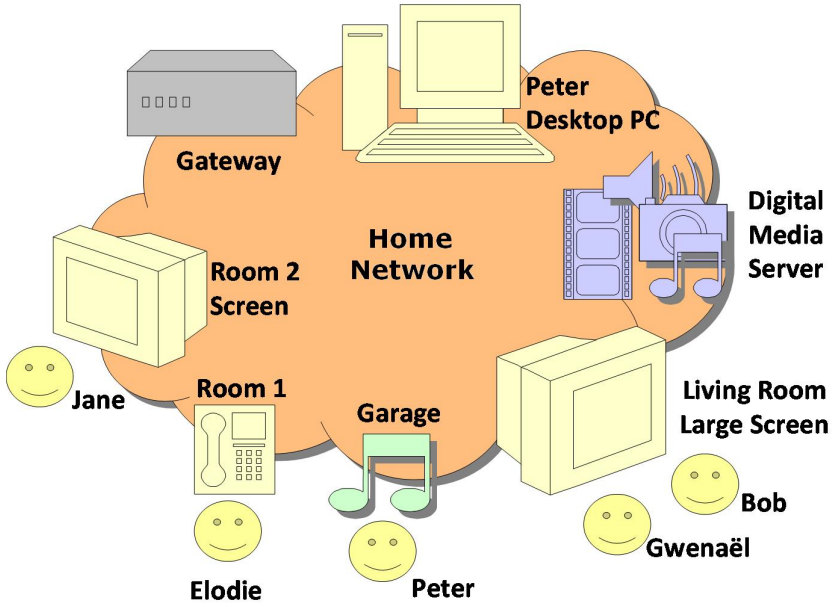


	2008	2009	2010	2011	2012	2013	2014
FTTH/B subscribers	29 652 400	35 141000	45 591600	57 792 400	73 914 500	91970 500	114 348 100
VDSL subscribers	1482 000	2 423 600	4 423 000	7 149 700	11755 900	17 821600	25 559 700

Source: IDATE

Home Network use cases

- 2 typical use cases
  - Watching movie sourced from NAS in the garage at the TV in the living room:
    - RJ45 plug in the living room is several meters from the TV set
    - Wireless link(s) to be used from the plug to the TV
  - Use of VoIP phone while wandering around the house:
    - The device will hand off among several APs
- One typical scenario: Evening in a family home:
  - 4-5 people with one significant QoS-demanding flow per person:
    - Watching HDTV (from the access network)
    - Watching HDTV (from NAS/Digital Media Server in the home)
    - Remote video “family visit”
    - Wireless VoIP
    - Mobile music connection throughout the house
    - Etc.



Related achievements of IEEE 802

- QoS:
  - AVB: Synchronization, Resource Reservation, QoS classes (A,B, others …)
- Cross-technology / cross-access-provider handover:
  - 802.21: Access Network convergence (WiMAX, WI-Fi …)
    - Measurements reports for handover
- Path (re)-selection:
  - 802.11s: Mesh routing of .11
  - 802.1ah (MAC-in-MAC)
  - 802.1aq: Shortest-Path Bridging
- Security: Identification & authentication of home devices, encryption
  - 802.1 security groups

Motivation for further work

- Time-varying bandwidth:
  - Due to unstable environments for media such as PLC, Wi-Fi (wireless in general)
- Support of QoS for legacy devices:
  - Support for priority classes other than A and B
- Meshing over a heterogeneous network
- ‘’Green policy’’: Optimise power consumption
- Remote management: QoS logs, discovery of network topology

Goals of OMEGA project

- Support interworking of heterogeneous technologies
  - *Wired communications: Ethernet*
  - *Radio communications: 802.11, UWB, 60GHz*
  - *Power Line Communications*
  - *Optical Wireless: Infrared and Visible Light Communication*
  - *Indoor fiber: POF*
- L2 convergence for interworking, providing seamless services and technology-independent features: QoS, security …
- HW prototype to demonstrate proof of concept for an ultra-broadband Home Area Network in an apartment to evaluate roll-out scenarios with actual services.

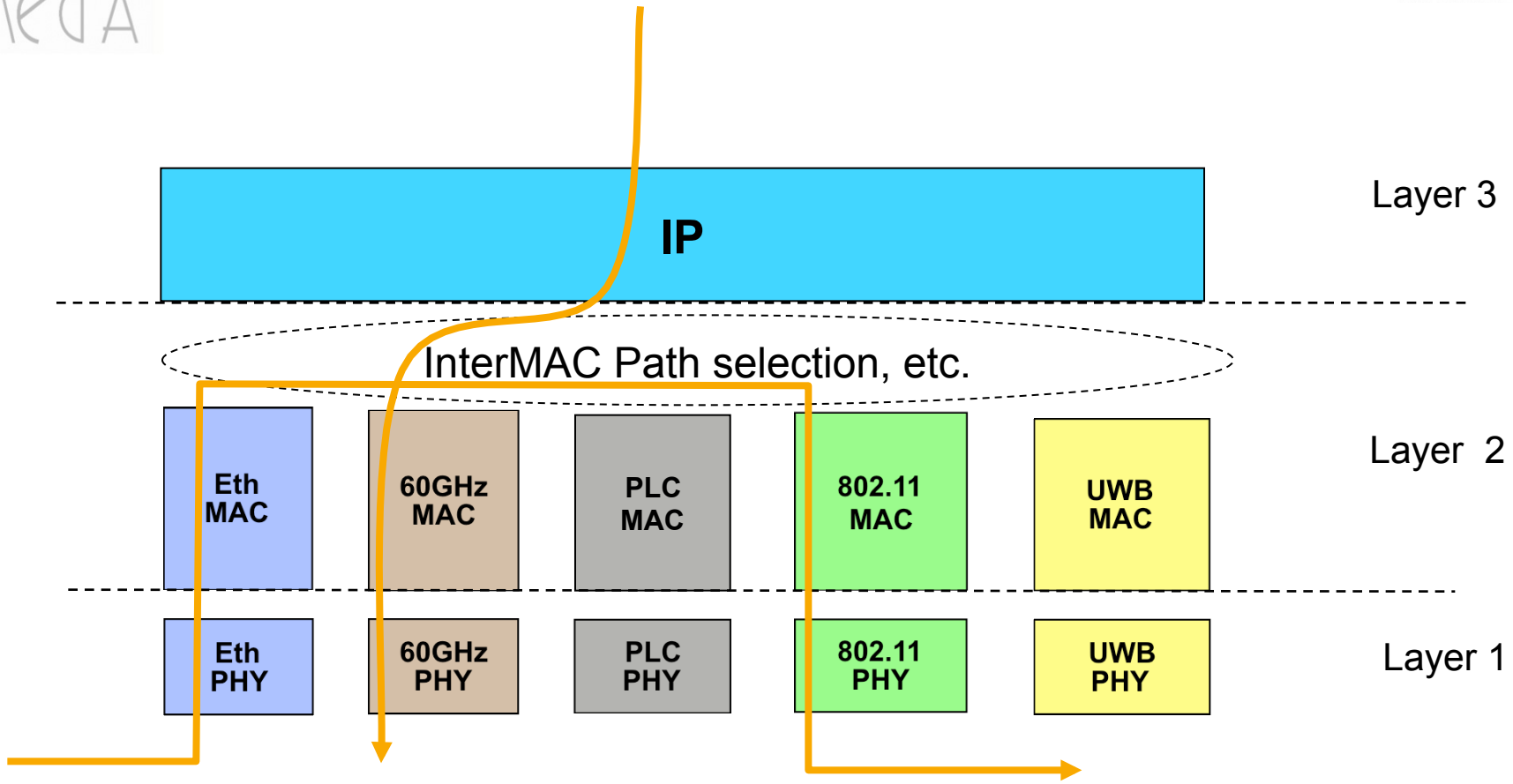
Some OMEGA driving requirements

- The final link of the in-house communication will likely be wireless:
  - Flexibility for device installation
  - No cable clutter
  - Nomadism and mobility
  - ➢ Efficient wired-wireless convergence needed.
- The QoS for Gbps wireless must be acceptable beyond one room:
  - Wireless technologies do not attain Gbps-rate connections through walls even under favourable conditions
  - Need to accept limited range and architecture of the links in a mesh network.
- Quality of Experience must be guaranteed for the user:
  - This implies challenging QoS criteria in the network, but also:
  - Easy to use: simple installation and maintenance, with minimal manual set-up and configuration
- Other requirements for the future Home Network:
  - Ensure backward compatibility: Should work with the legacy technologies in the home network
  - Modular and reconfigurable network to adjust to varying topologies and introduction of new interfaces (for example using SFP modules)

"InterMAC" concept

- Path selection in a mesh
- Technology-independent encryption
- End-to-end QoS mechanism throughout a heterogeneous network
- Full compatibility with existing MACs
- Hiding technologies from the upper layers

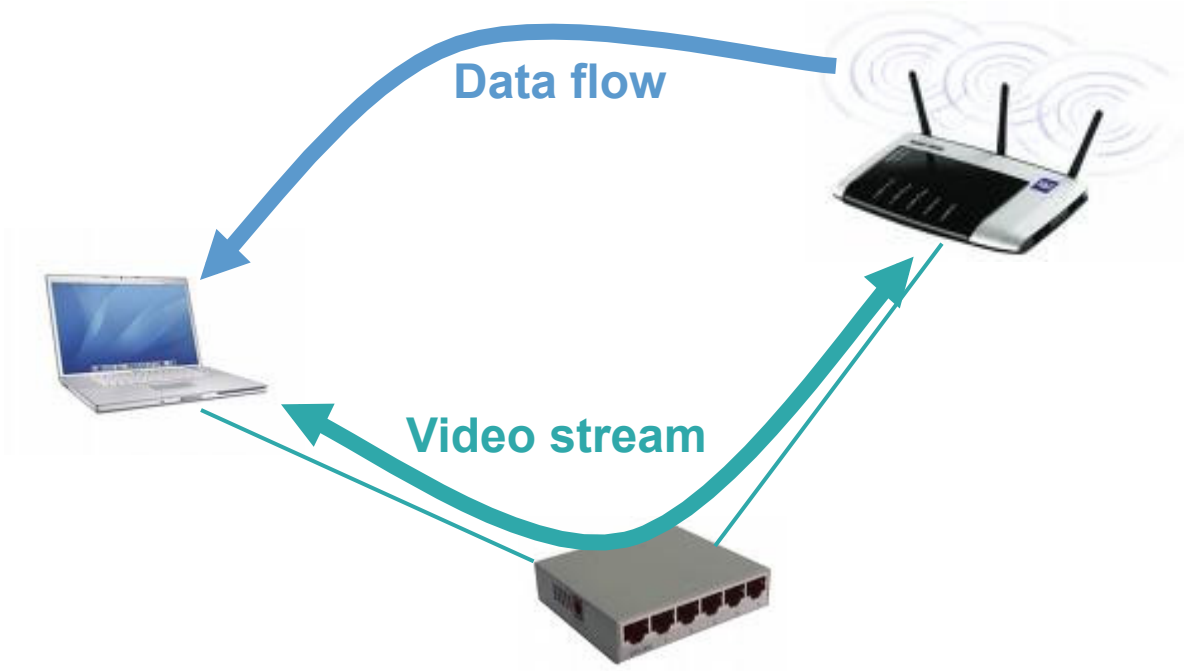
InterMAC in protocol stack



InterMAC path selection

- Seamless mobility within Home Network
- End devices can also provide extension to coverage of the Home Network for remote devices
- Multi-technology “bridge” or “mesh” network
- Path selection according to QoS requirements, type of traffic (uni-/broad-/multi-cast), …
- All interfaces can forward frames; load balancing by Class of Service over multiple links:

InterMAC goal: Simultaneous utilization of multiple heterogeneous links



InterMAC security

- End-to-end encryption
- Procedures for establishing trust and membership in the Home Network
- Incorporation of Trusted-Computing principles

InterMAC QoS control

- Admission control for flows
- Frames marked for QoS
- Resource reservation
- More support for QoS requirements of flows sourced from legacy devices
- Help for dynamic bandwidth availability

Conclusion

- Home Networks must deal with heterogeneous network technologies; in many cases, the last segment will be wireless
- The OMEGA project has developed some ideas
- Challenges remaining: time-varying bandwidth, finer QoS prioritisation for legacy flows, discovery for network topology
- Feedback requested:
  - Are we missing something? Overlooking something?
  - Is everything in the right place?
  - Do you have ideas to suggest?

Contacts

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