Very High Data Rate Home Area Network,
A new convergence arena

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Summary

1 2010 trends
   ▪ Home terminals
   ▪ Uses and services
   ▪ Access Networks
   ▪ Convergence of Networks

2 Technology challenges
   ▪ "No new wires" connectivity
   ▪ Wireline and wireless hybridization
   ▪ Probable impacts on access

3 Possible research areas

4 Conclusion
1

2010 Trends

2010 trends (1/4)
Home Terminals

- Increasing use of mass storage devices (Terrestrial and Satellite DVB, Digital Video Recorder, NAS,…) > TeraByte (DVB-T, DVB-S, PVR, NAS, …)

- These terminals could be anywhere at home
- Customer expectations:
  ✓ Integrated services and maximum connectivity[3]
  ✓ Easy Installation and maintenance
  ✓ User friendly
2010 trends (2/4)
Uses and services

- WAN services:
  - triple play => multiple play
  - Increase of UGC (User Generated Contents)
- New services
  - LivePresence (Video Conference at home)
  - LiveMedicine
  - Gaming3D FPS immersion ...

- Increasing complexity of applications, in terms of composite data rates and latency,
- Simultaneity of LAN-WAN and LAN-LAN flows
- Symmetric data rates

VHDR$^1$ throughout home with excellent quality becomes a MUST

2010 Trends (3/4)
Access Networks

- Exponential increase of access bit rates [6], FTTH [4]
  - Dynamic Bandwidth Assignment
  - Decrease of latency times

<table>
<thead>
<tr>
<th></th>
<th>vDSL</th>
<th>FTTH GPON 2,4Gb</th>
</tr>
</thead>
<tbody>
<tr>
<td>DL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>55Mbps</td>
<td>48 Mbps (50 users.)</td>
</tr>
<tr>
<td>Max</td>
<td>55Mbps</td>
<td>&gt; 400 Mbps</td>
</tr>
<tr>
<td>UL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>20Mbps</td>
<td>24 Mbps (50 users.)</td>
</tr>
<tr>
<td>Max</td>
<td>20Mbps</td>
<td>&gt; 400 Mbps</td>
</tr>
<tr>
<td>Latency</td>
<td>2000ms</td>
<td>&gt; 16 ms</td>
</tr>
</tbody>
</table>

- How can these data rates can impact home gateway?
  - Relay downlink streams inside home
  - Collect and upstream to the network
2010 trends (4/4)
Network convergence

Evolution

Technology Challenges
"No new wire" connectivity (1/3)

Wireline?

- Existing wireline standards are heterogeneous:
  - Ethernet IEEE 802.3 series: 1 Gbps
  - Power Line Communications (PLC): ex: HomePlug (AV)
  - ADSL indoor: HomePNA
  - No worldwide standard for optical fiber

- Weaknesses:
  - European profile of housing is heterogeneous: pragmatic use of exiting cabling
  - Weak performance/cost ratio, except ethernet
  - AND severe interference due to "home made" installation

⇒ Solutions:
  - Improve existing standards
  - Evolution of cabling standards in building engineering
  - Severely competed by wireless approach
"No new wire" connectivity (2/3)
Wireless?

- Contrasted candidate VHDR WxAN connectivities
  - WLAN 802.11 a/b/g/n series:
    - Success of wifi
    - Too many options forgotten by manufacturers
  - WPAN [5]:
    - No world wide even if Wimedia[9] seems to take over
    - Bluetooth 3.0?
  - Free Space Optics [7]: extrapolation of IR remote control but VHDR
  - Even PHY are different, some common MAC features could be convergence opportunities

"No new wire" connectivity (3/3)
Fixe – mobile convergence?

- 3GPP vs. fixe-mobile convergence?
  - Pros:
    - Fully standardised architecture
    - E2E QoS negotiation
    - Cell load balancing
  - Cons:
    - Variable implementations
    - Upward compatibility not easy (UMA, I-WLAN)

⇒ Solution: inter-MAC convergence layer
  - QoS management of radio metrics (RSSI, CRC,…) and … wireline (hybridization)
Connectivity wireline - wireless Hybrid?

- Constraints:
  - Low cost
  - QoS
  - Simple
  - Hybrid solutions:
    - Radio over fiber
    - Radio over PLT
    - Hybrid mesh
    - Autonomic

Possible impacts on access

- QoS LAN-WAN management:
  - What is the impact of LAN-LAN traffic?
  - How classify the streams (BER/FER … or video/audio/internet) and manage them easily?

- Continuity access to the terminal, yes, but at which level?
  - Service independent from terminal (ambient concept?)
  - Photon ? Electric ?
  - Logic ?
  - Paquets ?

⇒ Solutions:
  - IPv4 to IPv6 migration offers opportunity
  - Probable migration of access functions to the gateway (AAA, DHCP …)
  - WHILE the gateway remains a trusted network element
  - Convergence layer above MAC (IP type)
Possible impacts on access

3 New Research Areas
Research fields

Field 1: Race to (Multi)Gbps connectivity

Field 2: multi-connectivity Scalable mesh

Field 3: Accessibility Network connectivity To the home terminal

New Research fields

Field 1: Race to (Multi)Gbps connectivity

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Field 3: Accessibility Network connectivity To the home terminal

Free Space Optics
Radio over Fiber
WiMAX
PLT
Fiber

IPv6
New protocols

inter-MAC
Convergence layer
Hybrid mesh
Autonomic
Conclusion

- Home Area Network is a booming market that raises numbers of Very High Data Rates challenges
- Suggested solutions could be:
  - Multi Gbps connectivity
  - Hybrid and scalable convergence at home
  - Continuity to the access network
- France Telecom, provider of integrated network and services under ORANGE brand, would be glad to address these research fields
References

- [5] Very High Speed pilot program (“Fiber To The 
  Home”): 
- [6] Turbo-coded MC-CDMA techniques applied to WPAN UWB/WB 
  systems at 60 GHz (IST MAGNET Project) 
- [7] GPON 2.4 G 
- [8] "Optical wireless indoor systems: how to improve data rate". O. Bouchet, 
- [9] "1.92Gbit/s MB-OFDM Ultra Wide Band Radio Transmission over Low Bandwidth 
  Multimode Fiber". A. Pizzinat, B. Charbonnier. Soumis à OFC 2007 

France Telecom Group