GIGABIT ACCESS AND ITS IMPACT ON THE HG AND HOME NETWORK

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HGI CLOSING SYMPOSIUM
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WHAT IS GIGABIT ACCESS?

• Downstream rate very much higher than available from today’s widely deployed Broadband technologies

• *Up to* 500 Mbps – 1 Gbps
GIGABIT ACCESS IS COMING

BT Press Releases

BT CEO sets out ultrafast broadband vision
“G.fast” to deliver speeds of up to 500Mbps to most homes
Premium fibre services of up to 1Gbps to be developed

BT CEO Gavin Patterson today (30/1/2015) set out the company’s ambition to transform the UK broadband landscape from superfast to ultrafast.

He revealed that BT plans to deliver much faster broadband for homes and small businesses via a widespread deployment of “G.fast”. This is an innovative technology that BT will test in two pilot locations starting this Summer.

G.fast will help BT deliver ultrafast speeds of up to 500Mbps to most of the UK within a decade. Deployment will start in 2016/17, subject to the pilots being successful

First customers connected in trial of G.fast ultrafast broadband
Residents of Huntingdon – a market town in Cambridgeshire – today (25/8/2015) became the first people in the UK to take part in the field trial of a new type of ultrafast broadband technology from BT.
Two thousand homes and businesses will be covered by the trial in the coming weeks. It is already delivering speeds of up to 330 megabits per second (Mbps) - more than ten times the current UK average - using G.fast, a new technology that has been pioneered by BT’s R&D division.
The company believes that G.fast will enable it to make speeds of a few hundred megabits per second available to millions of homes by 2020 and deliver up to 500Mbps to most of the UK within a decade as the technology is developed further.
WHY G.FAST RATHER THAN FTTP?

• Customer experience better
  – Customers understand the concept of just needing a new box to get higher speeds
  – Allows self-install – no appointments
  – Box can be located anywhere
  – No new internal wiring

• Cost of connection lower
  – No need to install fibre to, into and around the home on demand for each new customer
DRIVERS FOR GIGABIT ACCESS

• Applications
• Competition
• Marketing
HIGH BIT-RATE APPLICATIONS

Large file download = video

5 Gbyte download takes:
• 6.7 mins @ 100 Mbps
• 1.3 mins @ 500 Mbps
• 40 secs @ 1 Gbps
• None of these is ‘instant’
• If storage is in the Cloud, why do I want to download, rather than stream when I want to watch?
  • also avoids having to manage local storage

4k TV
• Currently ~50 Mbps
• Likely to decrease to 25 Mbps (2020)
HIGH BIT-RATE APPLICATIONS - II

Cloud Office apps
A 10 Mbyte up/download takes:
• 8 secs @ 10 Mbps
• 0.8 secs @ 100 Mbps
• 0.16 secs @ 500 Mbps
• 0.08 secs @ 1 Gbps

Not browsing
• Download times already dominated by DNS look-up and TCP ramp-up times
Conclusions

- No *single application instance* needs Gigabit access
  - the much higher, albeit not Gigabit, upstream will however provide a much better user experience for Cloud office apps, photo upload etc.

- This is mainly about serving *multiple devices* and so very high speed home networking is a key part of providing Gigabit access

- ....and the HG itself must not be the bottleneck into the home
HIGH SPEED IN-HOME NETWORKING

• The answer is WiFi, what’s the question?
• Customers expect:
  – wireless connectivity for everything except possibly large, fixed devices (TVs)
  – to be able to use mobile devices anywhere in the home
  – to be able to use several devices at the same time

• Is wireless up to the task?
• A few years ago there was a significant HGI effort to determine the real-world performance of WiFi
• Also looked at PLT, as this is next in the hierarchy of customer acceptability (no new wires)
PLT - daily performance examples - WiFi

Short term variability low except for steps

Correlated and uncorrelated steps

Significant path performance differences

Typically less correlation between paths than with PLT

Short term variability can be much greater than with PLT

Significant house to house variations

Reliable, whole house distribution of rates >25 Mbps a challenge for both Wi-Fi (even 802.11n/5GHz) and PLT
Real World Performance - Today

![Graph of download bitrate vs. coverage (brick walls) for MacBook Air. The graph shows two bands: 5 GHz and 2.4 GHz. The 5 GHz band is higher and drops more sharply as coverage increases. The 2.4 GHz band is lower and drops more gradually.]

Download Bitrate (Mb/s)

Coverage (Brick Walls)
Wireless Home Network Conclusions

- Wi-Fi performance is limited due to real world constraints.
- Throughput depends on the location of the HG, the number of walls a signal passes through and their construction material.
- 5 GHz provides better performance but drops off at higher rate (i.e. less coverage)
  - higher frequencies are more susceptible to attenuation through walls.
- Typical real world performance in same room
  - 802.11n (2.4 GHz): 35-70 Mbit/s
  - 802.11ac (5 GHz): 200-300 Mbit/s
- The client quality and design is absolutely critical to performance.
- Other devices sharing the spectrum will further limit real-life performance.
- Supplementary APs will be needed to fill in poor coverage ‘not spots’
- But how many, how are they connected, what do they need to cost?
AP BACKBONE OPTIONS

• New Wire
  – Ethernet – Cat 5/6 + GBE
  – PoF + GBE
  – New, thin, (single) twisted pair + G.hn
• Existing Wire
  – Existing phone extension wiring + G.hn
    • but depends on G.fast not using the same wiring
  – MIMO PLT (if performance/interference balance obtainable)
• Wireless (single and/or multi-hop)
  – High Power WiFi
  – 5GHz WiFi
  – Bonded 2.4/5GHz WiFi (to increase aggregate bandwidth)
  – LTE (licenced spectrum, less interference)
  – Bonded Wi-Fi/LTE (to increase aggregate bandwidth)
POSSIBLE SOLUTION

Wi-Fi Distributed Access Points (2.4/5/60GHz)

In-home backbone (Wired and/or Wireless)
GIGABIT ACCESS AND THE HG - 1

• Access connectivity
  – Want to provide a wires-only, wholesale access service
  – This needs a single box solution, day 1
  – Requires good, performant G.fast interop (DPU-HG)
    • Being looked at by BBF

• Reverse powering
  – ‘Gigabit’ G.fast will need to be located close to the house
    • At the copper DP, or the front door
  – This requires reverse powering
    • An integrated, managed RPF in the HG is highly desirable for this deployment scenario

• Performance
  – HG must not be the performance bottleneck
  – Basic forwarding at Gigabit line speeds may not be too difficult
  – Need to be able to maintain this while also doing possibly CPU-intensive actions
    • WiFi
    • QOS
    • ALGs
    • Firewalls
    • USB attached devices
GIGABIT ACCESS AND THE HG - II

• High speed Home Network support
  – Support for distributed wireless access points
    • SSID inheritance, credentials transfer....

• Speedtests
  – Users will do speedtests, anywhere and everywhere
  – Not all users understand ‘up to’
  – Some will be disappointed
  – Some may even complain
  – The Home Network may be the problem
  – Need to be able to a speedtest to the HG, and from the HG to any end-device
WHAT HGI HAS DONE SO FAR - IN RWD044

• Access connectivity
  – G.fast is one of the specified WAN interfaces in the new Residential Profile

• Performance
  – Forwarding Performance requirements related to access line speed, and in the presence of other HG operations

• High speed Home Network support
  – Support for distributed wireless access points via IEEE1905.1 - SSID inheritance etc.

• Speedtests
  – Basic Requirement for embedded HG speed tester support
  – Needs to be both from the WAN, and to any end device

Not covered
• Reverse Power Feed, still under development in ETSI and BBF
WHAT STILL NEEDS TO BE DONE

• Main problem is Gigabit class in-home distribution
• Best option looks like distributed wireless APs but...
  – This ‘only’ gives a few hundred Mbps at present
  – Need to find a user friendly backbone
• Further G.fast requirements will be needed, including performance
SUMMARY AND CONCLUSIONS

• Gigabit Access is coming
• The HG has a key role in delivering the high access speeds to the end devices
  – not forgetting there will also be in-home LAN traffic
• Main area of outstanding work is finding a robust, user-friendly, Gigabit-class home network solution
• Where is this now going to be done?
### SOME PERFORMANCE REQUIREMENTS EXAMPLES

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<tr>
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<th>Requirement</th>
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<tr>
<td>1</td>
<td>The HG MUST be able to forward downstream packets (WAN to wired LAN) at 100% of the physical layer rate of any of its WAN access interfaces</td>
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<td>2</td>
<td>The downstream, WAN to wired LAN, forwarding performance MUST NOT be impacted by a USB connected mass storage device operating at a sustained read/write transfer rate of at least 50 Mbps.</td>
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<td>3</td>
<td>The downstream, WAN to wired LAN, forwarding performance MUST NOT be degraded by more than 5% when the Firewall is enabled at its highest level.</td>
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<tr>
<td>4</td>
<td>The downstream, WAN to wired LAN, forwarding performance MUST NOT be degraded by more than 5% when at least 2 ALGs are being invoked.</td>
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