



Overview of G.fast

Summary overview and timeline

**Frank Van der Putten,
Rapporteur ITU-T Q4/SG15
Alcatel-Lucent, Belgium**

**Extended ITU-T G.fast overview presented
by Les Brown in the tutorial session**

Overview

- What is FTTdp?
- FTTdp/G.fast “raison d’être”
- Applications
- Service provider requirements
- FTTdp standards body eco-system
- FTTdp deployment use cases
- G.fast key functionalities
- *ITU-T G.9700 overview (see tutorial)*
- *ITU-T G.9701 overview (see tutorial)*
- Standards time-line
- *Backup material (see tutorial)*

What is FTTdp ?

- A broadband access solution taking fibre to a distribution point (FTTdp) very close to the customers premises, with total wire length to the customers' transceiver up to 250m.
 - It is expected that the bulk of the loop lengths may be in the order 30 to 50m. On 30 m loops, aggregate data rates up to at least 500 Mbit/s should be supported on a single pair.

FTTdp/G.fast “raison d’être”



- To provide the best aspects of ‘Fibre to the home’ and ‘ADSL’:
 - Fibre-to-the-home (FTTH) bit-rates
 - Customer self-installation like ADSL
- Complements FTTH where
 - Customer is unavailable for a service call
 - Customer is unwilling to have his property excavated or interior redecorated

Applications

- Next-generation IPTV service at well over 100 Mbit/s
- Access to small and medium business sites at well over 100 Mbit/s
- Backhaul for very small wireless cell sites, including HetNet
- Backhaul for WiFi hot spots

- What is FTTdp?
- FTTdp/G.fast “raison d’être”
- Applications
- **Service provider requirements**
- FTTdp standards body eco-system
- FTTdp deployment use cases
- G.fast key functionalities
- ITU-T G.9700 overview
- ITU-T G.9701 overview
- Standards time-line
- Backup material

Service provider requirements (1/6)

- Low Power/Cost/Complexity
- Reverse power feed for the remote device from the customer's residential gateway
- Mandatory customer self install
 - triple-play services with home network bridge taps, on loops up to 200m

Service provider requirements (2/6)

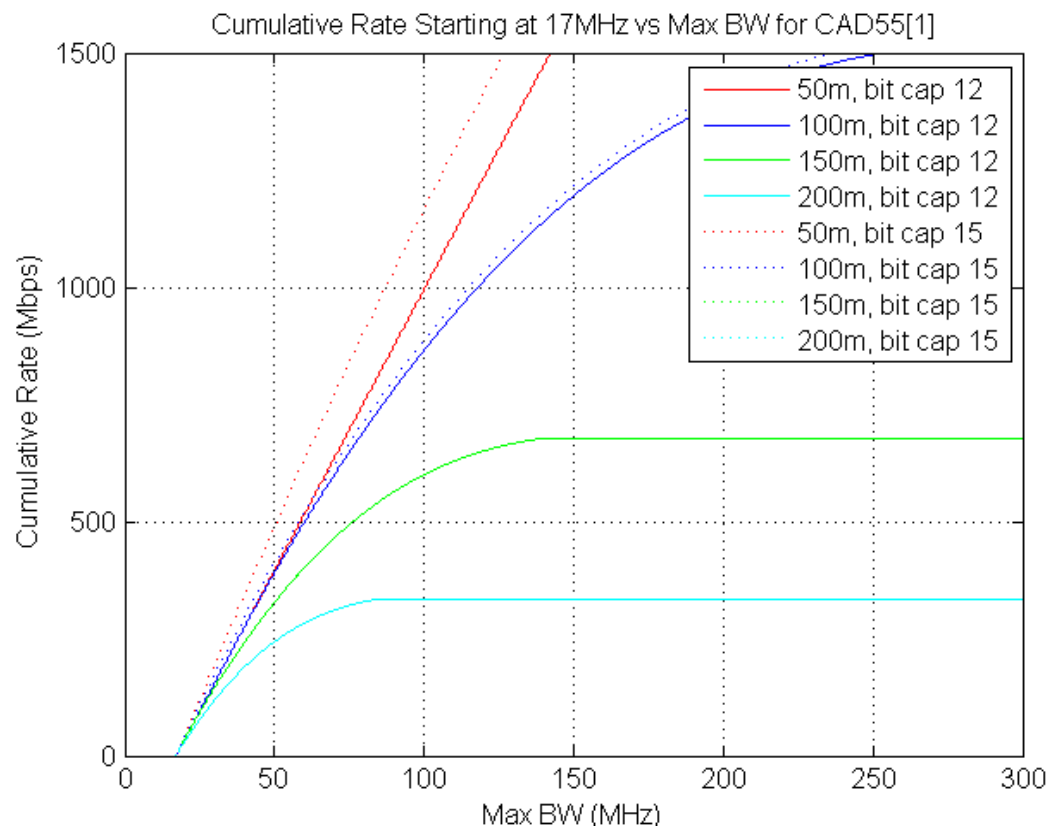
- Zero Touch OAM
 - ➡ To provide for remote management of user connections – for connecting of new users or switching users to or from legacy exchange or cabinet hosted services)
- Node sizes typically 1 to 16 ports
- Support for exchange and derived POTS

Service provider requirements (3/6)

- Service rate performance targets over 0.5 mm straight loops
 - 500-1000 Mbit/s for FTTB deployments @ <100m
 - 500 Mbit/s at 100m
 - 200 Mbit/s at 200m
 - 150 Mbit/s at 250m
 - ≥ 500 Mbit/s at 50m with start frequency of 23 MHz with FM band notched

Service provider requirements (4/6)

- Capacity vs. Max Bandwidth in AWGN=-140 dBm/Hz (100% crosstalk cancellation)

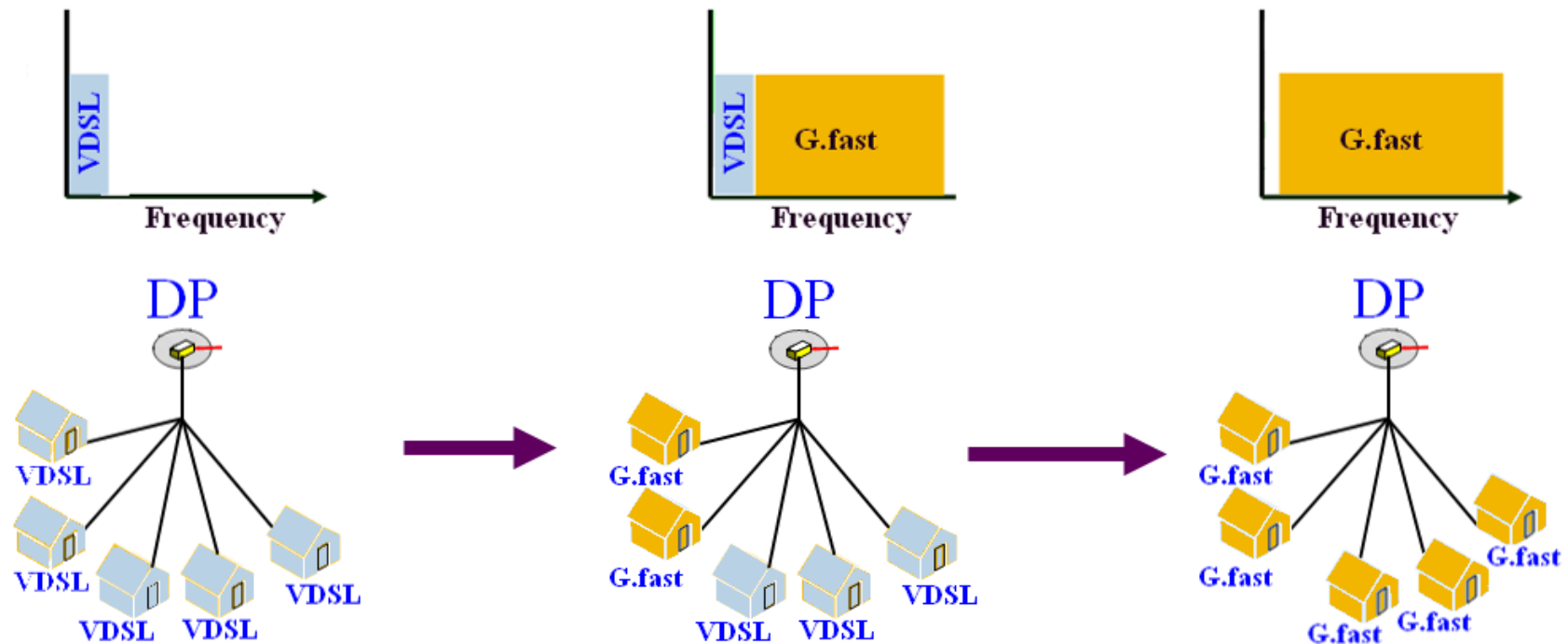


Service provider requirements (5/6)

- Control of downstream/upstream asymmetry ratio
 - Mandatory: 90/10 to 50/50
 - Optional: from 50/50 to 10/90
- Interoperability with VDSL2
- Coexistence with xDSL
 - Start frequency greater than: 2.2, 8.5, 17.664, and 30 MHz

Service provider requirements (6/6)

- Coexistence with xDSL: VDSL2 to G.fast migration



FTTdp standards body ecosystem

- ITU-T Q4/15 is specifying the G.fast PSD limits (G.9700) and transceiver (G.9701)
- ITU-T Q2/15 specifies the PON related aspects
- Broadband Forum (FAN and E2E Architecture WGs) are specifying the architectural aspects (WT-301)
- Broadband Forum (MT WG) has initiated a testing program for G.fast, which may lead to a certification program
- ETSI TM6 is specifying the reverse power feeding aspects
- IEEE specifications for Ethernet & clock synchronization (for ToD)

- What is FTTdp?
- FTTdp/G.fast “raison d’être”
- Applications
- Service provider requirements
- FTTdp standards body eco-system
- **FTTdp deployment use cases**
- G.fast key functionalities
- ITU-T G.9700 overview
- ITU-T G.9701 overview
- Standards time-line
- Backup material

FTTdp deployment use cases 1/2

- BBF is developing a Working Text for a new type of access node to support FTTdp.
 - Includes a number of deployment use cases ranging from large Multi-Dwelling Units (MDUs) to small multiport and single port units, focusing on the smaller units.
 - Considers the following copper drop technologies:
 - G.fast
 - VDSL2
 - 802.3 BASE-T Copper Ethernet

FTTdp deployment use cases 2/2

- Have identified 23 deployment use cases so far, including:
 - FTTdp as a competitive, high-speed overlay
 - FTTdp with G.fast drop
 - FTTdp in VDSL blackspots and for VDSL cabinet offload
 - Multi-dwelling unit (both indoor and outdoor)
 - FTTS (fibre to the street) and FTTB (fibre to the building) nodes
 - Business customer
 - Cell backhaul

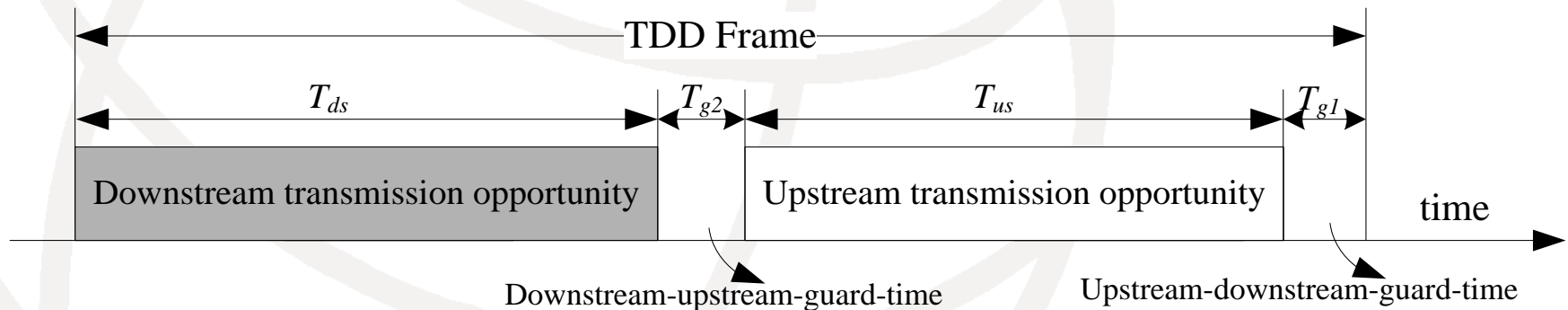
- What is FTTdp?
- FTTdp/G.fast “raison d’être”
- Applications
- Service provider requirements
- FTTdp standards body eco-system
- FTTdp deployment use cases
- **G.fast key functionalities**
- ITU-T G.9700 overview
- ITU-T G.9701 overview
- Standards time-line
- Backup material

G.fast key functionalities (1/5)



■ Duplexing method: TDD

- Can easily vary DS/US asymmetry ratio
- Easily supports low-power states
- Discontinuous operation allows trade-off of throughput vs. power consumption



G.fast key functionalities (2/5)



■ Bandwidth:

- 106 MHz profile in the 1st version
- 212 MHz profile in a future amendment
- Configurable start and stop frequencies, PSD shaping and notching

■ Modulation:

- Discrete multi-tone (DMT)
- 2048 sub-carriers for 106 MHz, 4096 sub-carriers for 212 MHz
- Sub-carrier spacing 51.75 kHz
- Default symbol rate 48.00 kHz
- Bit loading of ≤ 12 bits/sub-carrier

G.fast key functionalities (3/5)



- PHY layer retransmission
 - improved robustness against impulsive noise events (up to 10 ms duration) without loss of data while maintaining low latency
- Mandatory support for vectoring
 - Far-end self crosstalk (FEXT) cancellation
 - Linear precoding in the 1st version, non-linear precoding in a future amendment
- Forward error correction (FEC)
 - Trellis code + Reed Solomon of VDSL2 (G.993.2) with the retransmission block (DTU) interleaving defined in G.998.4

G.fast key functionalities (4/5)



- Fast rate adaptation (FRA)
 - To quickly adapt the data rate depending on changing channel or noise conditions
 - Uses a robust management channel (RMC) to make rapid changes (TDD frame rates, <1 ms)
- Expected reach
 - Intended to operate over loops up to approximately 250 m of 24 AWG (0.5 mm) wire pair
 - VDSL2 is approximately 2500 metres of 26 AWG (0.4 mm)

G.fast key functionalities (5/5)



- Provides transport of network timing (8 kHz NTR)
- Support for Time of Day (ToD) – IEEE 1588
 - in order to support services that require accurate ToD at both sides of the G.fast link to operate the higher layers of the protocol stack (e.g., cellular backhaul)
- Support for both TR-156 and TR-167 Broadband Forum architectures

- What is FTTdp?
- FTTdp/G.fast “raison d’être”
- Applications
- Service provider requirements
- FTTdp standards body eco-system
- FTTdp deployment use cases
- G.fast key functionalities
- ITU-T G.9700 overview
- ITU-T G.9701 overview
- **Standards time-line**
- Backup material

Standards time-line 1/3



- September 2010: Broadband Forum (BBF) Service Provider Action Council (SPAC) agreed to develop a white paper capturing network operators' potential requirements.
- January 2011: At request of BBF, ITU-T Q4/15 agreed to study the transceiver aspects of FTTdp, and issued a call for papers.
- February 2011: Q4/15 opened G.fast project and assigned an Associate Rapporteur/Editor
- June 2011: Q4/15 agreed to develop a new Recommendation
- July 2012: agreed to a goal to Consent the G.fast standard in July, 2013

Standards time-line 2/3

- 6 March 2013: Decided to separate G.fast into 2 Recommendations: one part containing PSD related material that has regulatory impact (G.9700), and the other part containing all other transceiver functionality (G.9701)
- 12 July 2013: Determined G.9700 “Fast access to subscriber terminals (FAST) – Power spectral density specification”
- 6 December 2013: Consented G.9701 “Fast Access to Subscriber Terminals (FAST) – Physical layer specification”
 - ◆ Support for low-power link states removed, plan to include in Amendment 1
 - ◆ Last call comment resolution started 10 February 2014
- 4 April 2014: Approved G.9700

Standards time-line 3/3

- 1 October 2014: Initiate LC2 (second last call comment period for 4 weeks) for G.9701
- 5 December 2014: Approve G.9701 at the closing plenary of the SG15 meeting (if not sooner).
- 5 December 2014: Consent G.9701 Amendment 1 with support for low power states
- February – March 2015: Approve G.9701 Amendment 1

A large, faint, light gray globe is centered in the background of the slide, composed of several overlapping circles.

The end
Thank you