Day 1: The Future Broadband Access Technologies

Up to 8 Gbit/s broadband with ITU standard MGfast and longer reach with G.fastback

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ITU-T SG15/Q4 experts group

- Study Group 15: Networks, Technologies and Infrastructures for **Transport**, **Access** and **Home**
- Q4: Broadband access over **metallic conductors** (twisted pair and coax)
- Projects: xDSL, G.(mg)fast, G.fastback, bonding, testing, management
- Main liaisons: **ITU-R**, **ETSI TC ATTM** and **Broadband Forum**
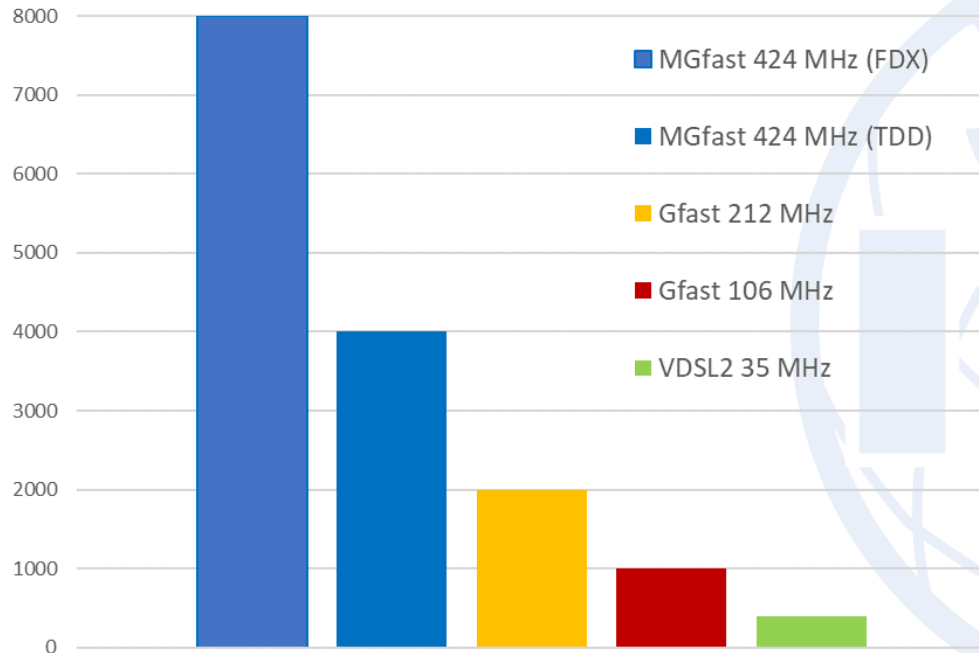
- G.fast was approved in Dec 2014, revised in March 2019
- **MGfast was approved in April 2021**
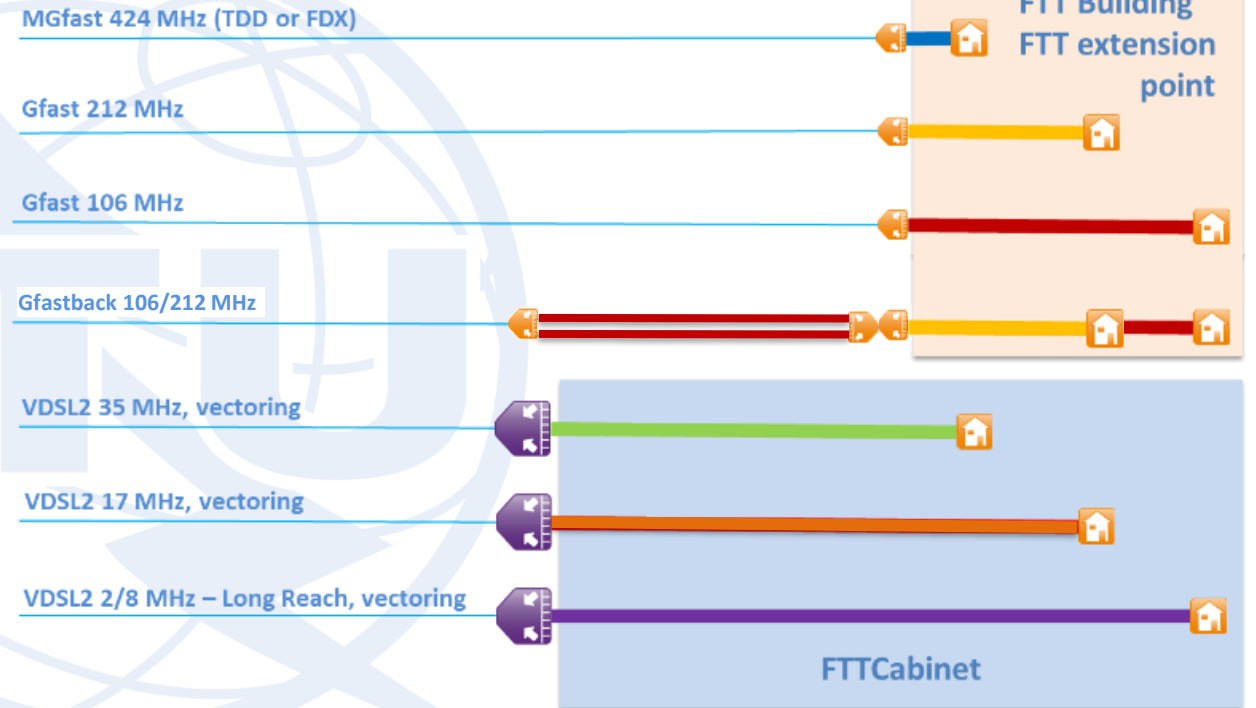- **G.fastback was approved in April 2022**

Overview Copper Access Network Solutions

Maximum aggregate (DS+US) bit rate (Mbit/s)

■ MGfast 424 MHz (FDX)

■ MGfast 424 MHz (TDD)

■ Gfast 212 MHz

■ Gfast 106 MHz

■ VDSL2 35 MHz

Typical Reach

MGfast 424 MHz (TDD or FDX)

Gfast 212 MHz

Gfast 106 MHz

Gfastback 106/212 MHz

VDSL2 35 MHz, vectoring

VDSL2 17 MHz, vectoring

VDSL2 2/8 MHz – Long Reach, vectoring
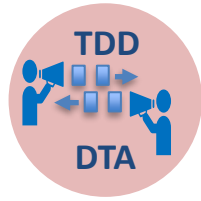
FTT Building
FTT extension point

FTTCabinet

Fiber to the most economical point

G.fastback & MGfast inherit G.fast features

- **Half-duplex** (Time-Division-Duplexing)
- **Easy service rate split down/up**
- Dynamic based on instant traffic needs
- Independent / Coordinated

- **Spectrum notching** for electromagnetic immunity
- Narrowband Radio Interference
- ITU-R defined bands for restricted emission

- **Impulse noise protection**
- Data retransmission
- Repetitive and isolated signal erasures

- **Noise cancellation** (Far-end Crosstalk)
- Pre/post-compensate useful signal with predicted noise
- Receiver sees "noise-free" signal
- Higher channel capacity due to lower noise level

- **End user self-installation**
- Deployment made easier (no truck-roll)
- VoIP replacing POTS on access wiring
- Operate in presence of bridged taps

- **Frequency and time synchronization**
- Some apps/deployments need precise network timing
- Deliver "wallclock" at user side with ~10s of nanoseconds precision to network-wide time
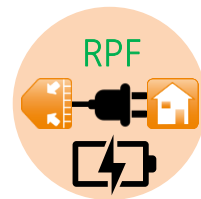
- **Reverse power feeding** (power DPU from the CPE/premises)
- Defined for point-to-point operation
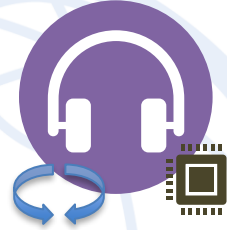- Addressed in collaboration with ETSI ATTM
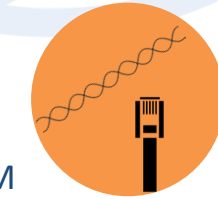
- **Cable Types**
- Telephone wires and CAT5
- Coax wires

G.fastback main new features

FAST BACK

- Using **multi-pair G.fast for backhaul** DPU uplink
- Up to backhaul 12 pairs and up to 20 user links
- Cascade multiple fastback DPUs for longer reach
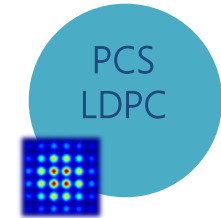- Multi-hop TDD alignment requires timing control

- **Noise cancellation** (Front-back near end crosstalk)
- "Back-to-back DPUs" causes near-end crosstalk to be cancelled by vectoring
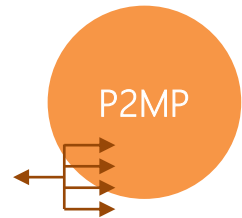
MGfast main new features

424 MHz
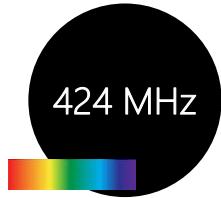
- Up to **4Gbit/s operation** per direction
- Maximize the reach and coverage of a **'universal' 1 Gbit/s symmetric service**
- Co-existence with G.fast

PCS LDPC

- Low Density Parity Check (**LDPC**) coding
- Probabilistic Constellation **Shaping**
- Gap-to-capacity of < 2dB
- 5-10% data rate increase over TCM+RS

P2MP

- **Point-to-Multipoint operation** over twisted pair or coax
- DPU resource sharing over multiple CPE
- Flexible Bandwidth Reassignment – each CPE uses part of spectrum
- CPE authentication with IEEE802.1X
- **Faster Dynamic Bandwidth Redistribution (DBR)**
- Better support of user traffic driven redistribution with p2mp operation
- Improved capacity re-allocation between multiple devices in the user premises sharing the MGfast bandwidth
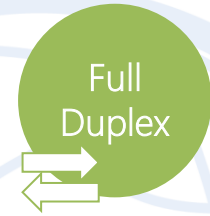
Full Duplex

- **Support for Full-duplex (FDX)** on twisted pair and coax; nearly doubles the data rate capacity on coax.
- Simultaneous downstream and upstream transmission also requires **vectoring to cancel near-end crosstalk**
- **Data rate increase & RTT latency decrease**

QoS

- **Multiple QoS** classes configured per individual line
- Per QoS class configuration of maximum latency
- **Ultra low-latency services (<1 ms)**
- Differentiation through flexible combining of requested and proactive retransmissions

DTFO

- **Discontinuous Time and Frequency Operation**
- Reduces complexity of large-scale vectoring systems
- Enables power savings – especially at the DPU
- Reserve part of time slots and higher frequencies for (unvectored) use by one line at a time, as required/implied by traffic needs of individual users
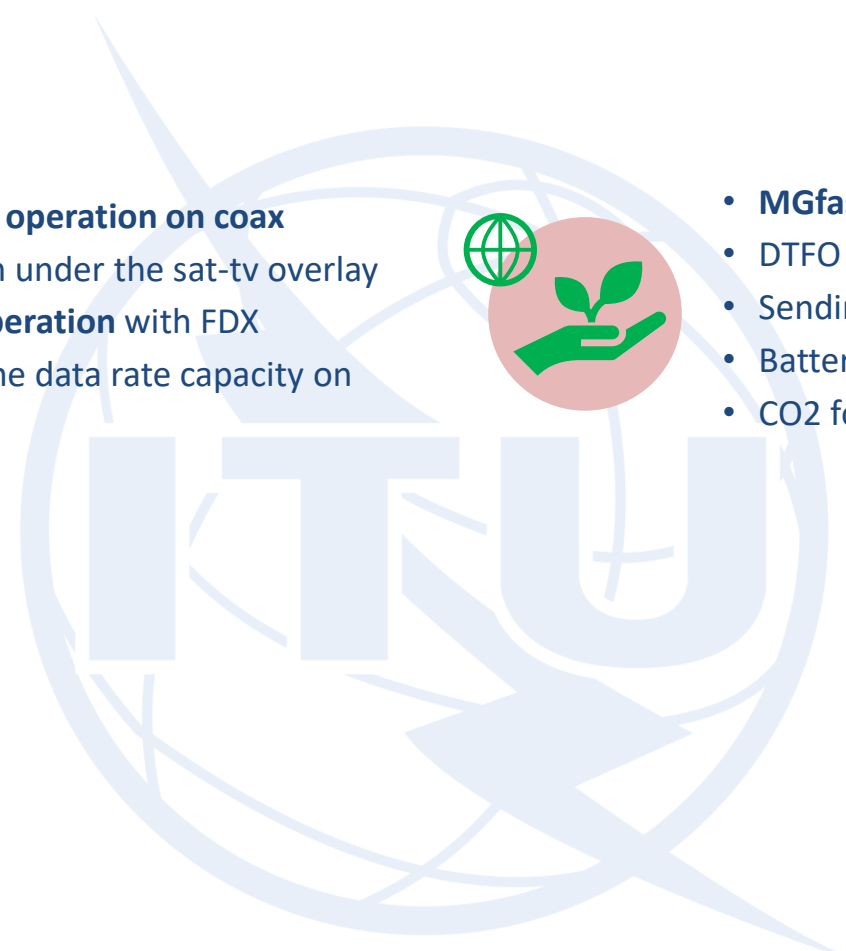
Future enhancements

848 MHz

- **MGfast 848 MHz operation on coax**
- Uses all spectrum under the sat-tv overlay
- **Up to 8 Gbit/s operation** with FDX
- Nearly doubles the data rate capacity on coax

- **MGfast low power operation**
- DTFO already enables power savings
- Sending signal only when sending data
- Battery operation
- CO_2 footprint reduction

Collaboration with Broadband Forum

Transforming the access network with gigabit capable broadband technologies

- **Technology requirements**: early liaison exchange about the what and why

- **FTTdp architecture** (TR-301): smaller nodes, reverse power feed (RPF)

- **Fiber Access Extension**: G.fast/MGfast and G.hn for affordable gigabit-class service to customers that can not be economically reached via fiber to the home (WT/MD-419)

- **YANG models** for G.fast, MGfast, bonding and RPF (TR-355), and DPU Ethernet/IP network functions (TR-383) facilitate introduction into the SoftwareDefined-WAN

- **Certification**: BBF-337 G.fast verifies functional interoperability and basic performance.

- **Performance**: setting the bar for G.fast operation over TP and coax with performance (TR-380) and RPF (TR-338) test plans.

- **Interoperability plugfests**: the engineers' sandbox at UNH

- **Marketing**: Promote/Showcase G.fast/MGfast technology for deployment (BASe)

ITU-T News : MGfast announcement

ITU-T Flyer MGfast