IF NOT FTTH, WHAT THEN ?

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One of the big limitations of Fiber to the Home (FTTH) is the cost involved in having the fiber all the way into the home. The big advantage is of course much higher speeds than what current DSL technologies can offer. As indicated by a recent Infonetics analysis, GPON and FTTH are maintaining strong growth rates, but the market split still highly favors Copper technologies.
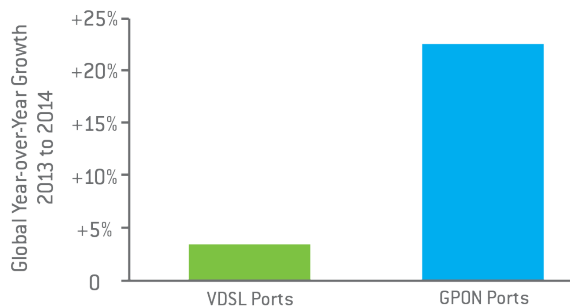

Figure 1. VDSL and GPON ports growth year-over-year.
Source: Infonetics Research/HIS Inc., PON, FTTH, and DSL Aggregation Equipment: Quarterly Market Share, Size, and Forecast, February 2015
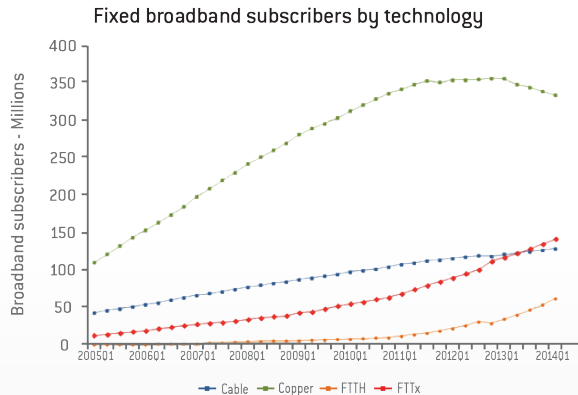

Figure 2. Fixed broadband subscribers by technology.
Source: Infonetics

In 2014, the ITU-T ratified a new DSL standard, G.9700 and G.9701, which in essence is a fast access to subscriber terminals (G.fast). A digital subscriber line (DSL) standard for local loops shorter than 250 m, G.fast targets performances between 150 Mbit/s and 1 Gbit/s, depending on loop length. It is a further technology development on VDSL2, however it is intended for operation on loops shorter than 250 m, while VDSL2 supports loops up to approximately 2500 m. The name G.fast is a recursive acronym for fast access to subscriber terminals.

G.Fast promises near fiber-like speed, up to 1 Gbit/s, without incurring the large costs of bringing fiber to the home. It avoids the need to install new infrastructure into and around the house, more specifically there is no need to install a new fiber cable between the distribution point (DP) and the home, drill a hole in an external wall to bring the fiber cable inside the house or install fiber between the entrance point and the optical network terminal (ONT). It allows self-install by customer, hence removing the need for a customer visit and the entailed costs in resources, logistics and time. G.Fast also brings down the time between receiving and being able to fulfil a customer order.

For G.Fast to be successfully deployed however, copper loops must have shorter lengths than what is currently the case in the field. For example,

› Fiber-to-the-node (FTTN): Interim step to FTTH. The optical fiber ends in an enclosed box which may be located a few miles from the customer premises. The cabling from the street cabinet to customer premises is usually copper.

› Fiber-to-the-curb (FTTC): Similar to FTTN, but differs in that the cable box or pole is closer to user premises; typically within 1000 m.

While these 2 topologies bring fiber close to homes, they do not bring it close enough to allow G.Fast to be successfully deployed.
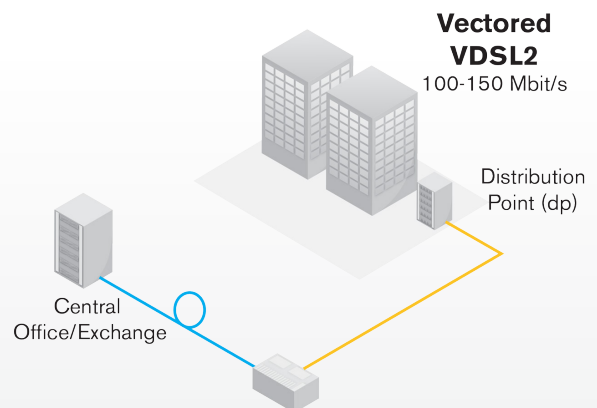

Figure 3. VDSL2 diagram.

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The Broadband Forum, building on the ITU-T G.Fast, is finalizing a recommendation for a new fiber topology and architecture: FTTdp, which is Fiber to the distribution point (WT-301). From an FTTN or FTTC architecture, an extra length of fiber will be deployed to a distribution point to serve only a handful of customers (small multiline distribution point units (DPU) will typically have 4-16 lines, while large ones will have 17-48 lines).
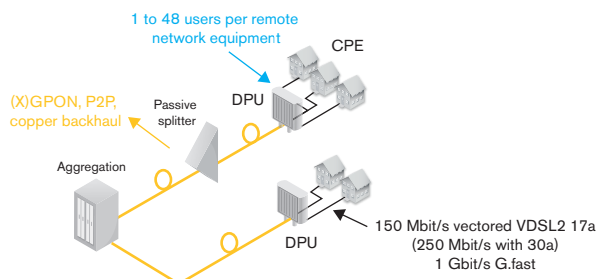

Figure 4. FTTdp architecture diagram.

In FTTdp deployments, a limited number of subscribers at a distance of up to 200-300 m are linked to one fiber node, which acts as DSL access multiplexer (DSLAM). As a benchmark for comparison, in ADSL2 deployments the DSLAM may be located in a central office (CO) at a distance of up to 5 km from the subscriber, while in some VDSL2 deployments the DSLAM is located in a street cabinet and serves hundreds of subscribers at distances up to 1 km.

A G.fast FTTdp fiber node is approximately the size of a large shoebox and can be set up outdoors (on a pole or underground) or indoors (in the basement or on the floor). In a fiber to the basement (FTTB) deployment, the fiber node is in the basement of a multi-dwelling unit (MDU) and G.fast is used on the in-building telephone cabling. In a fiber to the front yard scenario, each fiber node may serve a single home. The backhaul of the FTTdp fiber node, the Broadband Forum's FTTdp architecture provides GPON, XG-PON1, EPON or 10G-EPON as options, as well as point-to-point technologies (1 GigE/10 GigE).

THE OPTICAL DISTRIBUTION NETWORK

As FTTdp is deployed closer to the end-user than the cabinet, a very large number of active network nodes will need to be installed and provisioned. Testing of the extra length of fiber as well as testing of the backhaul infrastructure (GPON for example) will be required.

One of the most important factors in ensuring proper transmission over fiber is controlling power loss in the network against the link loss-budget specifications from the network design recommendation. It is vital to establish best testing practices at each deployment phase to achieve the expected data rate and reliability while minimizing costly and time-consuming troubleshooting efforts, such as locating dirty/damaged connectors, questionable splices and other faulty components.

Best practice N°1:

Perform testing at each and every deployment phase! For each deployment phase you want to make sure that the new optical component is correctly deployed and installed. These tests may range from a simple connector endface inspection, an optical power measurement to more advanced qualification such as OTDR testing. Having this test plan in place will help you protect your investments in deploying today's and tomorrow's technologies on this optical network.

Best practice N°2:

Establish test methods of procedure (MOP) that include all the steps or list all actions needed to deploy the fiber. This list should detail the tests to be conducted at every stage of the deployment. These methods of procedure will ensure that your field teams will be compliant and will successfully deploy at every selected location.

As previously stated, networks are generally deployed in a phase sequence. Once the system design has been completed, the lifecycle of the network can be generally summed up as follows:
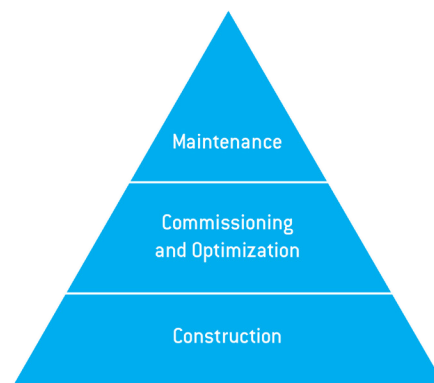

Figure 5. Network Lifecycle pyramid.

The bottom of the pyramid indicates the most critical phase, where MOPs will have the most impact on the success of following phases in deploying FTTdp. This stage encompasses most of the work required to connect the dwelling to the fiber expansion units. Installation of the optical physical layer during the construction stage is one the most important steps towards an easy-to-maintain system and consequently a higher return on investment. Adequate testing during construction will locate problematic splices, dirty or damaged connectors and other faulty components before they can cause any service disruption, thus minimizing costly and time-consuming troubleshooting efforts during the commission phase. It is therefore crucial to implement best optical-testing practices during this phase in order to ensure a successful and yet easy-to-maintain network in the future.

The table below details key testing considerations to consider at the construction phase.

Test Type	Why Test?	Test Parameters	Test Gear	Testing Considerations
› Out-of-service Test	› To qualify each optical element of the system (e.g., fiber, connector, splice) › To ensure the installation meets transmission system requirements › To avoid delays and costly repairs when turning up the system › To future-proof the network	› Connectors and ferrules cleanliness › Detect macro bends › Optical loss or insertion loss (IL) of each element › Total end-to-end loss compared to optical loss budget › Fiber mapping › Optical return loss (ORL) measurement	› OTDR or iOLM › Video inspection probe › Fiber optic cleaning tool	› Connector inspection › Testing at different wavelengths (1310 and 1490 nm) for IL and ORL › LinkView or OTDR trace documentation using 1310/1550 (Reporting) › Data storage › Testing total link or segments › Labor involved

To make sure that the network is less prone to problems, out of all the above testing considerations, two should stand out and be the core of a fiber testing method of procedure: connector care and end-to-end loss characterization.

Best practice N°3:

The amount of training and experience regardless, the human error factor remains a potential issue. Most of the time, automation and software intelligences will do jobs faster, cleaner, and more consistently throughout the network, since they are user-independent. Automation and intelligence can help to turn connector endface inspection into a one-step process via fiber inspection probes with features that enable autofocus, autocenter and auto-analysis. They can also be useful in link characterization which is usually performed using an Optical Time Domain Reflectometer (OTDR). Traditional OTDR testing requires several manual test set-ups and trace interpretation, however the advent of iOLM – the intelligent Optical Link Mapper, a fully automated OTDR-based software, now allows field technicians of any level to perform expert-level OTDR testing with more reliable and accurate results.

CONCLUSION

To wrap things up, G.Fast is an opportunity to meet the high demand for speed while avoiding costly FTTH installations. To deploy G.Fast and FTTdp effectively and maximize your return on investment, you need to establish test methods of procedures to ensure that the compliance and reliability of your field jobs. Proper testing practices at the construction phase are a key step:

› To qualify each fiber section of the system and document it for future reference

› To ensure it meets transmission-system requirements (standards)

› To avoid delays and costly repairs when the system is turned up

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