How to reach 10G systematically?

Problem statement

An operator would like to develop a **roadmap to reach 10G capacity on their access networks.** To make an informed decision he wants to understand the effect of multiple technology paths on total cost, investment profile, technology availability risk and ability to support his product roadmap.

High level assumptions

This use case is designed to understand the long-term evolution impact of various technology path options while keeping in mind the subscriber demand growth, the product roadmap and the technology availability requirements.

For this analysis we modeled a brownfield network with the following key assumptions:

- One facility with 50K HHP across 100 N+X nodes running DOCSIS 3.1
- Demand growth is assumed at 40% downstream and 30% upstream
- See Appendix-B for technology and product roadmap assumptions
- FDX is available only in N+0 configuration
- 12% discount rate for NPV calculations

Roadmap to get to 10G

10G
The Next Great Leap for Broadband

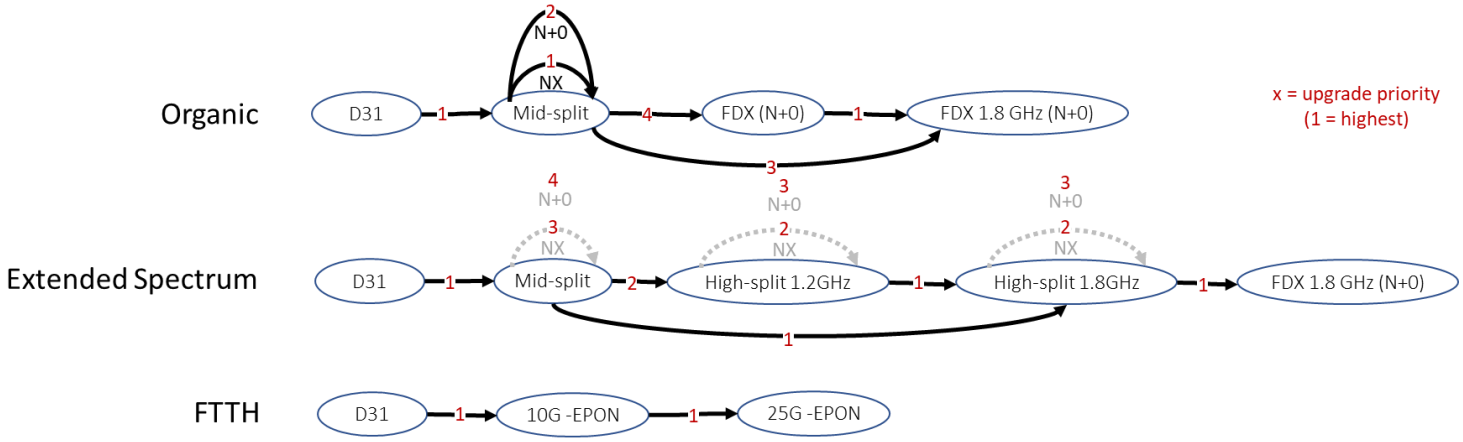
Evaluate the impact of the following technology path options:

- Organic Growth
- Extended Spectrum
- FTTH

Understand the impact of 1-year delay in technology availability.

Brief description and AP-Jibe approach

AP-Jibe is used to model and evaluate the above target network transformation along the following, as shown in the figure below, three technology path options.



For each of the upgrade paths, two sets of 10-year quarterly analyses are conducted using AP-Jibe. Initial analysis is conducted with the transformation triggered based on the demand growth and a later analysis triggered based on demand growth along with the need to offer the product roadmap as outlined in Appendix-B.

For the Extended Spectrum transformation path, we conducted an additional analysis to understand the impact of a 1-year technology availability delay.

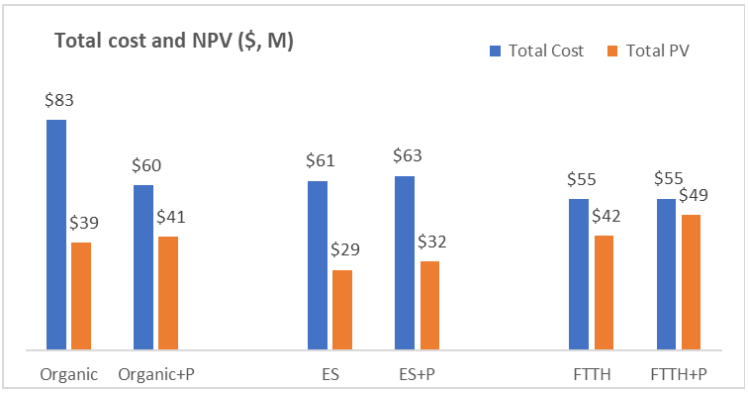
Results and conclusions

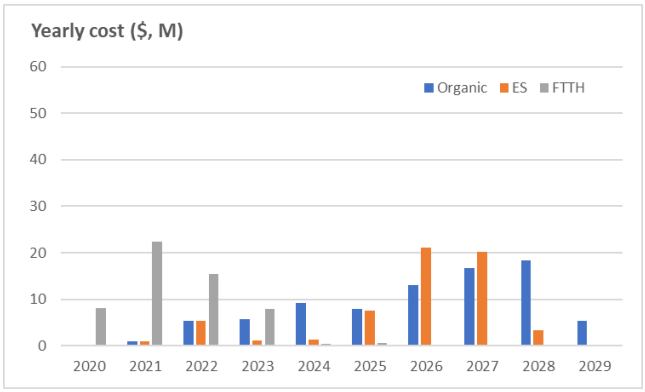
Caution: These results are based on our high-level assumptions for illustrative purposes only. Actual results may vary based on each operator's environment.

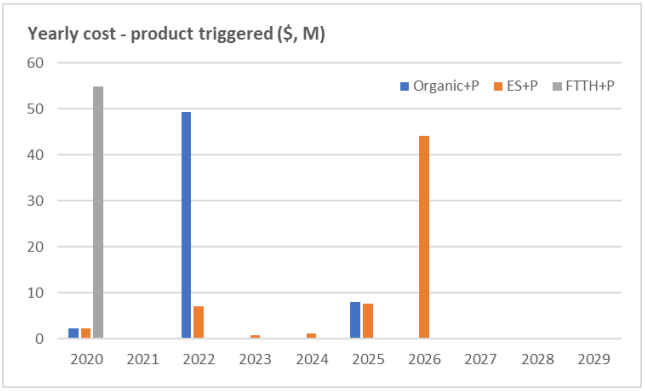
The AP-Jibe analysis provided a detailed view of cost, resource needs, activity, construction and much more for each of the above access transformation paths. We have highlighted a few interesting observations below:

How to reach 10G systematically?

- The analysis shows that all three upgrade path options can be used to sustain the demand growth as well as the product roadmap requirements.
- Major insights by comparing total 10-year costs and associated NPV values for the various technology paths, as shown in the charts on the right, include:
  - The **FTTH** option total cost is the lowest, however, since it requires most of the investment in the initial years, the NPV is the highest. On the other hand, it provides the earliest availability of 10G capacity.
  - The **Extended Spectrum** option total cost is slightly higher than FTTH as it requires a costly N+0 upgrade towards the end of the 10-year period. However, it has the lowest overall NPV since bulk of the cost is delayed. The downsides of this option are technology availability risk and slower path to 10G compared to FTTH.
  - The **Organic** growth option total cost is the highest mainly due to the regrettable investment in the intermediate node splits needed along the way. One benefit of this option is the smooth distribution of cost and activity over the 10-year period.
- The assumed aggressive product roadmap is outpacing the demand growth needs resulting in bulk upgrades. The impact of early upgrade is most visible in the **Organic** scenario where the forced early upgrade to N+0 significantly reduces the regrettable investment in intermediate node splits.
- In case of Extended Spectrum and FTTH scenarios, the product triggers do not change the total cost much, but only accelerate the timing and thereby increase the associated NPV.







In addition to the cost-based analysis, AP-Jibe provides a rich set of operational perspectives on the network evolution using each of the access transformation paths. Some of these include network technology footprint, node distribution, construction volume and associated resource requirements over the duration of the planning period.

We have summarized a few interesting perspectives in the charts below:

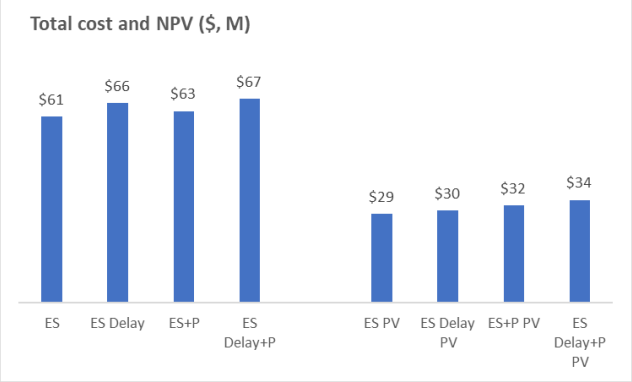
- An aggressive product roadmap can trigger bulk upgrades. The severity of the operational challenge depends on the transformation path the operator have chosen. Most of the complexity is determined by the timing of the final major construction to a fiber deep state.
- The **FTTH** scenario shows significantly lower number of nodes and node actions, thus potentially leading to an operational favorability over the 10-year period.
- The **Extended Spectrum** scenario shows the pushing out of construction activities, by absorbing the product roadmap requirements through spectrum enhancements.
- In the **FTTH** scenario the product requirement triggers a complete facility level construction as a first action.

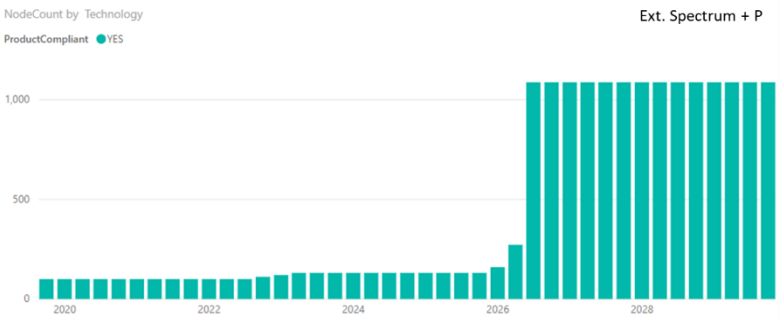
How to reach 10G systematically?

Appendix A: Analyzing impact of 1 year delay in highsplit 1.2 GHz and 1.8 GHz availabililty

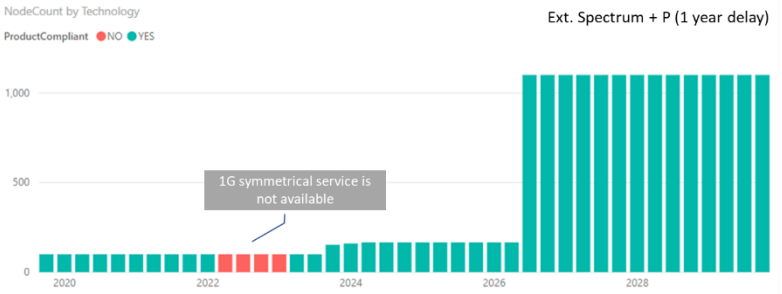
Another important factor in the upgrade path selection is the impact of technology risk. In this application note we took assumptions on when future technology options will become available. Especially for the extended spectrum case there is a lot of uncertainty as to the general availability of the equipment to meet the specs. As an example, we executed the extended spectrum scenarios (growth only and growth + product) with 1-year delay in availability for “High Split 1.2GHz”, “High Split 1.8GHz”, “FDX 1.8GHz”.

In the growth only case the delay did not impact the capability to sustain the demand as congestion could be resolved with additional node splits, causing incremental (regrettable) investments.





In the product case the overall impact is much more severe. The technology delay pushes availability of a 1G symmetrical service offering out by 1 year. In a competitive market this can result in significant subscriber and revenue loss.



Appendix B: Detailed scenario assumptions

The following table outlines some key assumptions relating to Extended Spectrum technology capabilities and availability for the analysis in this application note.

Capability	Availability	DS BW	US BW
Mid Split	Now	4.5 Gbps	450 Mbps
High-split 1.2GHz	2022	4.5 Gbps	1.3 Gbps
High-split 1.8GHz	2023	11 Gbps	1.3 Gbps
FDX (N+0)	2022	4.5 Gbps	3.5 Gbps
FDX 1.8 GHz (N+0)	2025	10 Gbps	7.5 Gbps
10G-EPON	Now	10 Gbps	10 Gbps
25G-EPON	2024	25 Gbps	25 Gbps

High-tier product roadmap assumptions

The following table outlines the assumption regarding the product roadmap with respect to the supported node data rates in the upstream (us) and downstream (ds) directions over a 6-year period.

2020	2022	2023	2025	2026
us: 100Mbps ds: 1Gbps	us:1Gbps ds:1Gbps	us: 1Gbps ds: 2Gbps	us: 1Gbps ds: 5Gbps	us: 5Gbps ds: 5Gbps

For more information on this application note contact us at contact@fpinno.com or +1-919-444-2270