Next Generation Optical Access

Fibre access & aggregation that truly decouples cost from capacity

Technology innovation and changing user behaviour are driving extraordinary growth in bandwidth consumption and even shorter technology cycles. To quench this seemingly unstoppable demand, a clever combination of innovative technology, planning, deployment & operation is necessary.

Bandwidth & cost dilemma

The truth is that current access & aggregation technologies (e.g. xDSL based & GPON) will not cater for the massive bandwidth that is forecast for the future. It is also true that these technologies do not ultimately scale for future expansion or increased bandwidth demand. Coupled with this is the ongoing issue of Total cost of Ownership (TCO), which rarely goes down. However, for the first time in telecommunications history, our Next Generation Optical Access (NGOA) vision plans to eradicate these 'headaches' forever.

Characteristics

NGOA is based on coherent Passive Optical Network (PON) technology and is characterised by the complete absence of any active equipment between subscribers and the Metro Point-of-Presence (POP) location, thereby representing a significant breakthrough in the architecture and philosophy of an 'all passive' fibre network. Furthermore, the burst mode characteristics found in Time Division Multiplexing (TDM) based PON solutions are replaced by an individual wavelength to each subscriber, up to 1Gbit/s and even 10Gbit/s for the future (using different modulation techniques).

The ability to reuse an existing fibre plant already deployed by an operator is of utmost importance considering typical investment cycles, with NGOA being able to integrate with existing PON architectures. Coexistence and migration scenarios are therefore possible to protect already existing network assets during their expected lifetime.

The technology

The NGOA working principle is based upon 'coherent' receiver technology, which is one of the principal contenders to become the upcoming standard for Next Generation PON2 (pure Wave Division Multiplexing (WDM)-PON being one other contender amongst others).

In our view, the principal advantage of a coherent PON, when compared to all other contenders, is that the achievable optical power budget for use in the outside fibre distribution plant is far superior. The coherent PON design not only allows for denser wavelength coexistence on the fibre, thereby enabling each user his "unshared" wavelength (without the use of Arrayed Waveguide Grating filters), but also vastly improves the overall splitting factor as well as the achievable range. Whilst current PON systems struggle to achieve the typically quoted 20-25km range at a splitting factor in excess of 1:32, NGOA can easily achieve ranges of up to 100km with splitting factors beyond the currently envisioned 1:64 – 1:128.

In a coherent system, the signal to noise receiver sensitivity is improved by at least +16dBm when compared to typically available PIN or Avalanche diode (broadband) receivers. Furthermore, a coherent system features vastly improved wavelength selectivity, enabling Ultra Dense Wavelength Division Multiplexing for wavelengths. Both factors are key to understanding the basic advantages of NGOA.

Consolidation

Before NGOA end-user deployment, we expect operators to initially focus on how to lower their TCO of their access & aggregation networks. The deployment of NGOA will advocate leaner network structures, cost optimised network assets and more efficient operational processes. Overall OPEX reduction can be achieved by consequently eliminating active outside plant components and associated reduced power consumption. Network operators can plan their central office consolidation by either reducing or eliminating the no longer required metro aggregation network elements, resulting in reduced floor space requirements in the remaining central offices. Power consumption, air conditioning units, shelves, racks, cabling, power supplies, batteries, optical distribution frame ports and other infrastructure components are all further factors which become part of this calculation.

Migration & coexistence

Deployment of NGOA (e.g. FTTx, Mobile Backhaul and Metro-Access) raises the question of coexistence with and the migration towards future technologies. It is of fundamental importance for operators to carefully investigate the various aspects of re-using available infrastructures and network assets. In particular, the re-use of the actual fibre infrastructure, which once built, typically lasts for decades. This is a key issue due to the following:

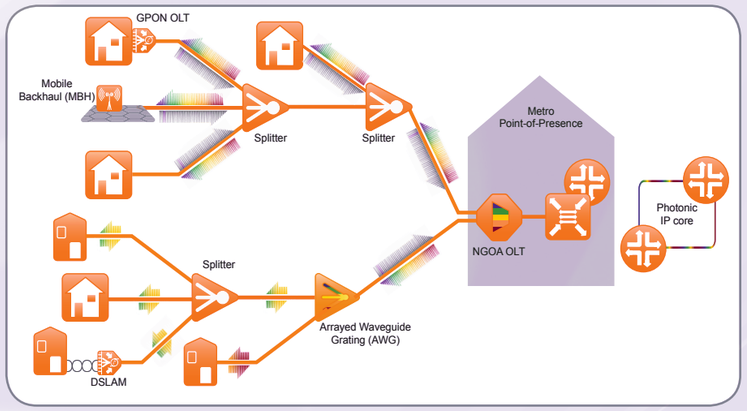
- Approximately 80% of overall investment cost relates to digging, trenching and ducting. Once built, the fibre plant should be largely untouched, whereas any necessary modification must be made with the lowest possible efforts, such as rearranging splitters.
- Future network equipment should be introduced in non-disruptive way. New technologies may be disruptive; however, the introduction and coexistence with legacy networking systems must be as non-disruptive as possible.

The potential of better fibre spectrum utilisation has long been recognized, with the Gigabit Passive Optical Network (GPON) standard G.984.5 describing the use of WDM blocking filters (wdm 1r), already anticipating that future technology will share the fibre plant with future systems delivering services over a multitude of different wavelengths. In general, there are two major scenarios that are closely related.

- Coexistence - future deployments can be fitted with the before mentioned filter components. The gradual introduction of NGOA will make use of exactly the same fibre plant without interfering with the legacy installed base. Therefore legacy access networks will be embedded in the NGOA network due to its versatile, flexible and transparent nature.
- Migration - due to the extended reach benefits of coherent technology, deployment of NGOA means that metro aggregation becomes unnecessary, therefore permitting consolidation to take place.

Towards a 'Gigabit' society

End-users are already expecting the kind of services that generate traffic volumes beyond the reach of today's communication networks. An operator's main concerns will be to keep CAPEX and OPEX under control as today's access & aggregation infrastructures migrate towards the next generation. At Nokia Siemens Networks & with our NGOA vision, our coherent PON technology will not only deliver increased bandwidth per subscriber but will also increase the reach of an operator's infrastructure, reducing the number of short distance offices to enable a huge reduction in the energy and other resources consumed by an operator's network, thus delivering substantial cost and environmental benefits. Future optical access & aggregation infrastructures require technology that connects numerous subscribers at high speeds over a simplified & flat architecture, aggregating their enormous traffic volumes at a central network node.



One crucial factor often ignored is that it's no longer just about increased bandwidth provision: it's about cost efficient bandwidth provision. Therefore our NGOA vision coexists with current technologies (e.g. xDSL, GPON), with our customers signaling their intent to deploy future technology alongside their current infrastructures, to maximise business & revenue benefits. NGOA predominantly fits all Fibre-to-the-Home (FTTH) applications but is equally well suited within other connectivity layers (e.g. aggregation, metro) and applications such as Mobile Backhaul and enterprise.

The future of access & aggregation

Optical access & aggregation infrastructures require technology that connects numerous subscribers at high speeds over a simplified & flat architecture, aggregating their enormous traffic volumes at a central network node. One crucial factor often ignored is that it's no longer just about increased bandwidth provision: it's about cost efficient bandwidth provision. Therefore our NGOA vision coexists with current technologies, with our customers signalling their intent to deploy future technology alongside their current infrastructures, to maximise business & revenue benefits.

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