

Master Planning PON Networks

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Abstract

This white paper introduces Passive Optical Networking (PON) technology as a means to implement efficient networks in real estate and infrastructure developments. It also presents the concept and the benefits of Information and Communications Technology (ICT) Master Planning. Two case studies show the practicability and effectiveness of the ICT Master Planning approach and the effectiveness of using PON.

PON Technology

The main characteristic of PON technology is the use of passive optical splitters connecting central office network equipment through a single fibre strand to up to 32 user nodes located in the field. PON uses multiple laser frequencies to provide upload and download connections over the same fibre concurrently. PON networks therefore require a much reduced cable infrastructure in comparison with any other type of networks.

PON uses standard IEEE 802.1Q compliant virtual local area network technology to segregate data streams. It also uses time-slot based communications, which gives it inherent control over the quality of service. These two features combined allow PON to be applied widely and allow concurrent use of the same physical infrastructure for real time and enterprise data. There is no risk of interference between the different types of data and no risk of delay.

Research shows that deployment of a PON network can lead to network related energy savings up to 70% when compared with a traditional multi-tier network.

Because PON networks can cover distances of 20 kilometres PON is an excellent technology for the implementation of in campus and property portfolio environments. PON enables very cost-effective open-access infrastructures and centralisation of ICT facilities without any requirement for intermediate data rooms or street furniture.

ICT Master Planning

ICT master planning is the process of analysing the use of a development from the end-user perspective and creating a detailed set of ICT related technical and operational specifications to be included in the architectural, engineering and systems design for that development. If done during the early stages of design, the ICT master plan can drive the minimisation of ICT complexity and foot print. It optimises the ICT related construction expenditure as well as on-going ICT operational expenditure. As technology life cycles are very short in comparison to the average development's design and construction life cycle, the ICT master plan also takes into account technology change.

The benefits of ICT master planning are particularly profound when combined with design and implementation of a PON-based Network Infrastructure Cloud (NIC) in a development. A PON-based NIC allows for a very elegant, highly configurable and cost-effective ICT infrastructure as shown in figure 1. In addition, if adopted early in the design life cycle, the ICT Master Planner can by utilising a PON-based NIC implement very significant simplifications in architectural and engineering design of the development and its ICT infrastructure. This will in turn lead to significant cost reductions, both from an initial capital expenditure perspective as well as from the on-going operational expenditure perspective.

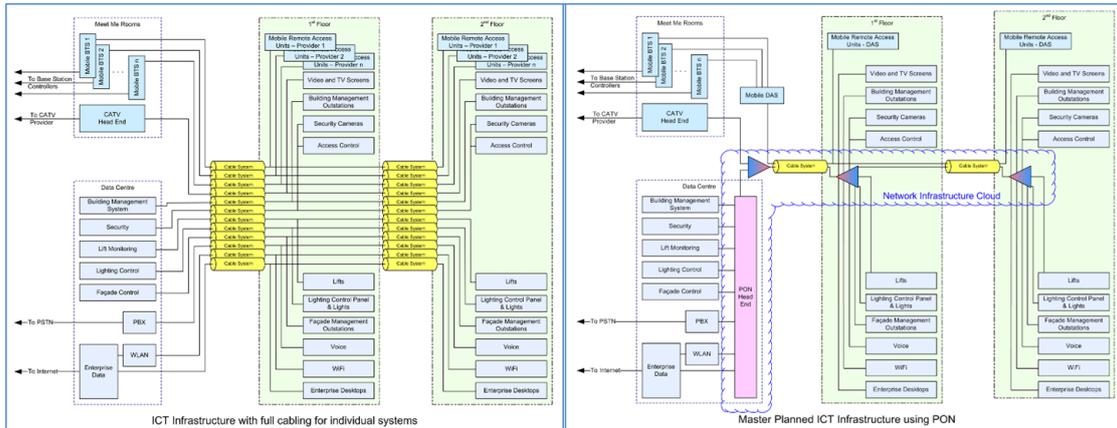


Figure 1: Comparison of fully cabled ICT network versus lean PON-based network

Case Studies

PON infrastructures are suitable for various environments, e.g. real estate developments (single and multi-tenant high rise buildings), campus developments, financial trade floors, industrial facilities and border security. The capability to cover large distances, combined with its economic space and power utilisation make it the technology of choice. The two case studies below show the practicability of a PON-based NIC in two very different applications.

Riffa Views International School

A PON-based enterprise network has been installed in the Riffa Views International School in Bahrain. ICT master planning at the very early stages of the design has allowed for the implementation of a single data centre and a PON infrastructure that concurrently supports over a single cabling system the class room's wireless network environment, the teacher's desktop and the telephone system. The same network also supports the school's offices and the school's public address system and bell system.



Riffa Views International School

The school's dimensions would normally require additional data risers to be built. Because of the use of the PON infrastructure with its passive components, designing and building the additional data risers has been avoided and the space has been returned to the primary function of the school. Classroom cabling and ducting has been simplified and is self-contained within a classroom which in turn has reduced classroom complexity. THE ICT Master Plan called for the deployment of thin client technology to avoid overloading the wireless network by the classroom's student laptops.

Arcapita Building

A PON-based NIC has been installed in the Arcapita Building in Bahrain. This landmark development on Bahrain Bay with its cantilever block construction, high entrance halls, and floor spaces of 150 metres length poses the challenge of large distances.



Arcapita Building on Bahrain Bay

The PON-based NIC solution carries concurrently all enterprise data, including all desktop, wireless and voice data, and all building and security data. Adoption of the PON NIC has meant, amongst others, being able to limit the number of data risers per floor, simplification of data riser design and removal of data riser screening provisions. It has allowed for the removal of specialised air-conditioning and separate cabling systems, and the minimisation of in ceiling and under floor tray systems. Under floor structured cabling to the workplace has been replaced by runs of fibre, which in turn enabled restricted raised floor heights without any risk of interference or service degradation. The PON NIC has also allowed the replacement of all vertical copper by a small number of fibre cables each having no more than 48 strands.

Implementation of the PON-based NIC has facilitated server and system centralisation into the building's data centre has simplified integration of all building systems into a single, workflow enabled facilities management system, giving the building the capability to optimise resource utilisation and adapt to changing use over the coming years.

PON as a bridging technology

Using RF over Glass (RFoG) technology the installations in the Riffa Views International School and in the Arcapita Building both have the capability to distribute satellite and cable TV signals. RFoG over PON provides a technology bridging capability that enables migration to a fibre infrastructure without losing the analogue capabilities of RF over coaxial cable.

Conclusions

PON-based NIC's and enterprise networking infrastructures, in combination with timely ICT master planning, have the potential to deliver huge benefits to the real estate industry in terms of development cost savings, as well as operational cost savings for the owner/operator of the development. The two case studies highlight the practicability of this combined approach and show that implementing elegant, footprint light and effective NIC's and enterprise network environments is entirely achievable.

About 2024Sight

2024Sight is a Vienna-based consultancy providing solutions to IT and IT-related problems that at first glance do not seem to have any obvious or elegant solution. 2024Sight has a specialisation in the creation of ICT Master Plans. It has designed and managed the implementation of the PON-based, converged building and enterprise access network for Arcapita Bank B.S.C. and the Riffa Views International School. Further it specified a high-density data centre using several innovative techniques, such as oxygen reduction to prevent fire and rack-based cooling. Subsequently, it managed and supervised the data centre's construction, testing and commissioning. 2024Sight staff has also created the ICT master plan for the Bahrain Bay development and worked on telecommunications regulation for open access infrastructures. In 2011 2024Sight managed the deployment of a long-haul telecommunications fibre network connecting the United Arab Emirates, Saudi Arabia and Bahrain.

About the Author

Anton Hofland has more than 20 years' experience in IT, IT infrastructure and enterprise networking, gained mostly in the financial industry. Before establishing 2024Sight he was the Head of IT for Arcapita Bank in Bahrain. Previously he has worked for several major financial institutions in the City of London. He has also worked in the area of telecommunications regulation and has experience in the telecommunications industry. Anton holds a M.Sc. in mathematics and computer science from Delft University, Netherlands.