

PON Technology Paves the Way for Cloud Networking



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As suggested by Moore's law, the rate of technology development since the mid-eighties has been exponential indeed and has led to ever faster enterprise desktops and Enterprise Access Networks (EAN). In today's IP-based EAN it is common to find gigabit networks connecting the enterprise desktops to the servers in the data center, using backbone cabling systems and enterprise-wide networking devices, which are powered up and cooled on a constant basis.

However, when analyzing the typical enterprise desktop from a usage perspective, one rarely finds a desktop that is heavily used. Typical usage generates CPU loads no higher than a few percent; i.e. the desktop is mostly idle. The same holds true for a network such as an EAN. The network load on an EAN is typically only a fraction of

of large files to and from servers or HD television streaming, a typical desktop will only sustain network transfer rates of 50Mb/s. For a gigabit EAN, that represents only 5% of the available bandwidth. Hence, the EAN too is mostly idle.

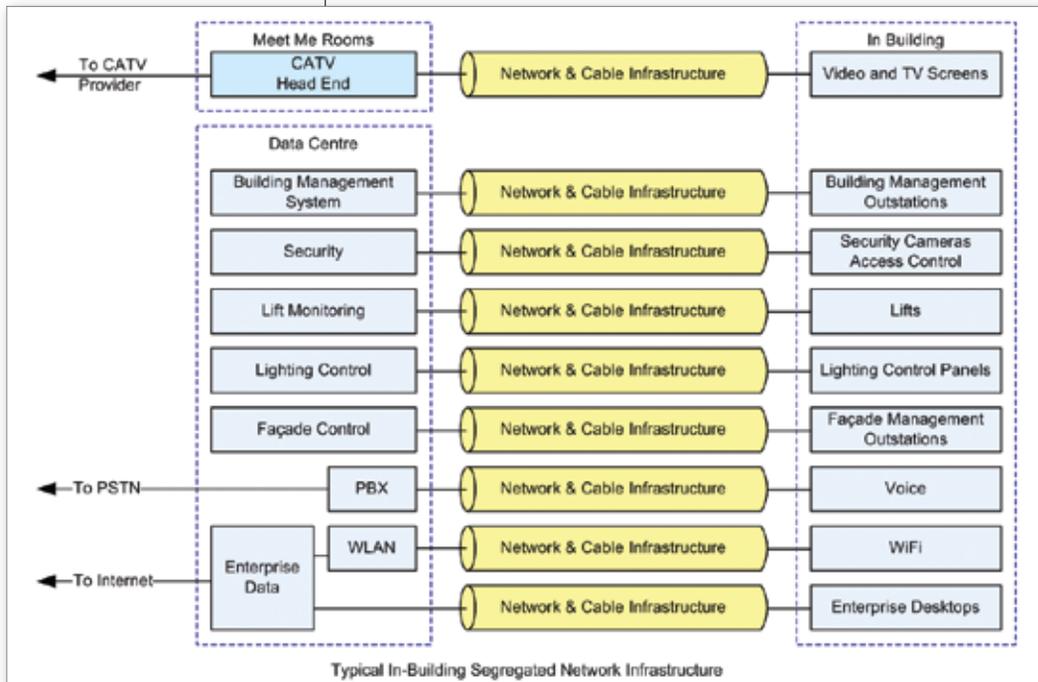
Two additional factors adversely impact EAN utilization. First, EANs are designed to accommodate growth. Normally, an EAN has significant numbers of unused but powered up network ports, spare backbone bandwidth and spare cable infrastructure, awaiting utilization that may never come. Secondly, the increasing adoption of cloud computing technology in the enterprise leads to more applications being run on the cloud server infrastructure in the data center. Applications running in the cloud have a lesser EAN bandwidth requirement than their desktop counterparts.

Many modern building management and security systems use also EAN-style, internal IP-based networks, which are segregated to ensure unimpeded quality of service for the delivery of small amounts of time-sensitive data. The design paradigms for these networks are no different from the ones for EANs. It stands to reason that a modern development system has an increasing number of segregated and under-utilized networks, which are being implemented and operated at a great cost.

Virtualization Counters Under-Utilization

In computing, the response to under-utilization has been

virtualization or 'cloud computing', where individual systems are consolidated on a single



what a modern EAN is designed for. Even under comparatively rare circumstances, e.g. copying

2024Sight is a worldwide ICT consultancy based in Bahrain that specializes in the creation of Information and Communications Technology (ICT) Master Plans for Network Infrastructure Clouds. In addition to the above developments, 2024Sight staff has created the ICT master plan for the Bahrain Bay city development and worked on open access telecommunications infrastructure regulation.

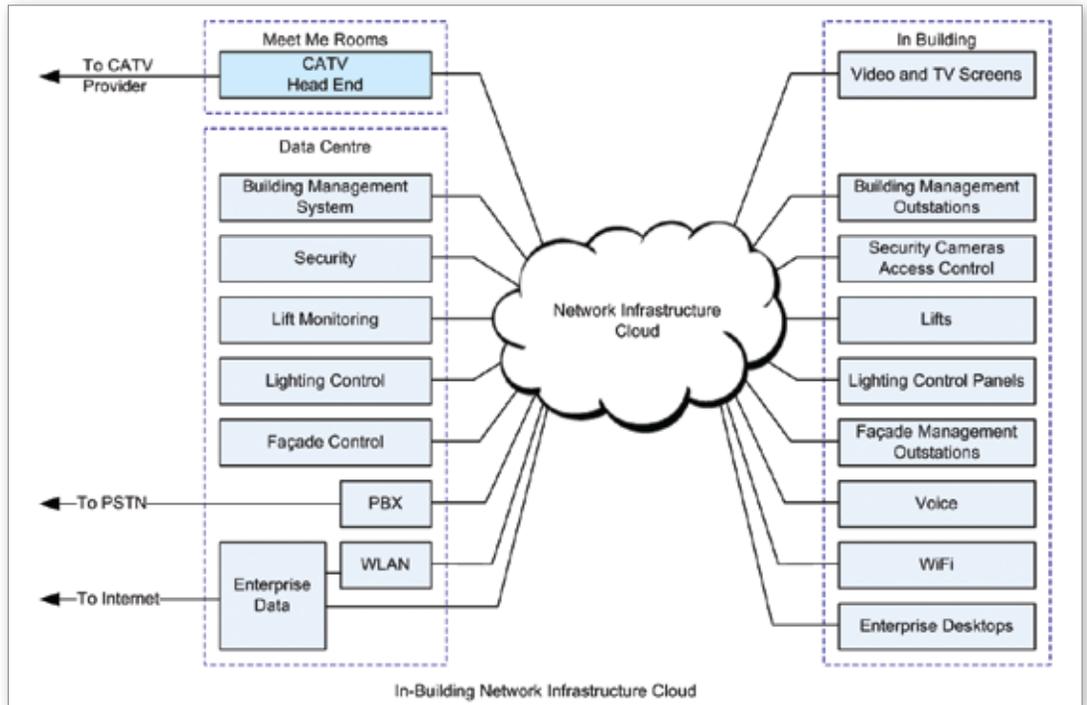
system, thereby significantly reducing power, cooling, cabling and space requirements, as well as reducing capital and operational expenditure.

The Network Infrastructure Cloud (NIC) enables the virtualization of the growing collection of enterprise access and building management networks. A single, well-designed NIC implements a simplified networking infrastructure without sacrificing functionality or performance, while realizing the same virtualization benefits as cloud computing technology. The NIC does away with the rag-tag collection of routers, switches and cabling infrastructures that would otherwise have been necessary. Instead, the NIC on-demand provides virtualized network ports at the appropriate speeds and guaranteed service levels to any device in the entire development, regardless of whether the device is an enterprise desktop, a security camera or an outstation of the building management system.

Prerequisites for the successful implementation of a NIC include the creation of a NIC design, which is based on a thorough analysis of the concept of operation of the development; supervision during design and implementation; and the availability of a suitable networking technology. The first two prerequisites can be met by engaging an ICT Master Planner during the very early design of the development and throughout implementation. The last prerequisite can be met by using the technology described below.

Utilizing Passive Optical Networking to Implement Network Infrastructure Clouds

Passive Optical Networking (PON) is a form of fiber optic technology that allows a large number of fiber optic end devices (up to 128 in some cases) to be connected concurrently to a single fiber strand over distances of up to 20 kilometers. Based on IEEE approved network virtualization standards, PON-based networks use virtualization techniques which enable the delivery of any virtual network to any connected device, regardless of whether it is an enterprise desktop, a security camera or a building management outstation. Furthermore, PON-based networks maintain network integrity and



security by enforcing strict virtual network segregation. To ensure appropriate bandwidth availability, PON-based networks use powerful Quality of Service (QoS) techniques to manage guaranteed delivery of the right amount of bandwidth to the right port at any time. Studies suggest that implementing a PON-based NIC would reduce the energy, cooling and space requirement by 70% to 80% when compared to a collection of traditional networks performing the same functions. PON technology is an excellent implementation candidate for a Network Infrastructure Cloud.

Network Infrastructure Clouds in Practice

Two buildings in Bahrain show that PON-based NICs are not just a theoretical possibility:

Riffa Views International School

A PON-based NIC has been installed in the Riffa Views International School. The NIC supports the classrooms' wireless network environment, the teachers' desktop and the telephone system and has enabled simplification of class room cabling and ducting design. Cloud-based thin client technology has been deployed for the students, thereby avoiding overloading the wireless network in the classrooms and improving the manageability of the school's systems. The NIC also supports the school's offices, public address

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system and bell system. If a traditional EAN architecture had been implemented, the design of the school would have necessitated construction of additional data risers to accommodate the network equipment. Because of the PON-based NIC, data risers were unnecessary and the space has been returned to the primary function of the school.

Arcapita Building

A PON-based NIC has been installed in the Arcapita Building, a landmark development on Bahrain Bay with a cantilever block construction, high entrance halls, and 150 meter long office floors.

The PON-based NIC carries concurrently all enterprise, wireless and voice data, and the data of the various building management and security systems. Adoption of the NIC has allowed minimal data risers per floor and simplification of data riser design, including the removal of screening provisions. The NIC has enabled the removal of specialized air-conditioning and separate cabling systems, achieving minimization of in-ceiling and under-floor tray systems. Under-floor structured cabling to the workplace has been replaced by fiber, thereby allowing for reduced raised floor heights without any risk of interference or service degradation. By replacing satellite television coaxial, the NIC is capable of concurrently distributing television signals without adversely impacting the available bandwidth. A very small number of fiber cables replaced all vertical copper in the building.

The NIC has encouraged servers and systems to be installed in



the building's data center, which in turn has simplified the integration of all building systems into a single Facilities Services and Management System (FSMS). Through its integrated workflow technology the FSMS automates facilities management and provides the building with the capability to optimize resource utilization and adapt to changing use over the coming years.

Summary

Sustainability and management of the environmental footprint are major issues for today's developments and enterprises. ICT Master Planned PON-based Network Infrastructure Clouds can improve sustainability of the installed technology through implementation of a single, adaptable, well-managed and well-utilized networking infrastructure, which is cost effective and energy-, cooling-, cable- and space-efficient without having to sacrifice any network functionality. •

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