How Fast is the NBN?

Dr Tony Eyers
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The April 2009 media conference which first announced the NBN called it a "new superfast network". A 100 Mbps peak speed was proposed, later upgraded to 1 Gbps, available to subscribers connected to the NBN "Fibre to the Premises" (FTTP) network. This report outlines how the NBN FTTP infrastructure delivers the proposed speeds.

Background

Starting from the 1980's, high speed fibre optic transmission systems have been used within "core" networks, e.g. data links between major cities. The last decade has seen greatly increased penetration of fibre transmission systems into "enterprise" networks, e.g. high speed data connections to corporate buildings.

The NBN takes fibre rollout a step further, with individual houses connected to fibre cables. Hence the term "Fibre to the Premises" or FTTP. FTTP uses a "Passive Optical Network", so named because network nodes merely redirect individual light signals, a simpler process than electronic switching used in other network types (e.g. core networks, Local Area Networks).

NBN GPON Architecture

The NBN FTTP infrastructure is based on the international "Gigabit Passive Optical Network" or GPON standard, otherwise known as G.984.

The GPON architecture is shown in fig 1. A single fibre connects the Optical Line Terminal (OLT) to the Fibre Distribution Hub, which then splits the signal amongst multiple subscribers (usually 32). Each subscriber has an Optical Line Terminal (OLT) which terminates the fibre cable. The OLT device will be the NBN equivalent of the current broadband modem. The Optical Line Terminal (OLT) is a large network infrastructure device, in the NBN a single OLT will serve up to 38400 subscribers. The NBN term for the Optical Line Terminal in Fibre Access Node or FAN.

The capacity of a GPON fibre link between the NBN Fibre Access Node and the Fibre Distribution Hub is shared between 32 subscribers, each receiving the same signal, due to the splitter. A GPON rollout involves many fibres, each NBN Fibre Access Node may connect to over 10000 fibre cables. GPON cables operate at full rate for distances of up to 20 km, roughly 10 times greater than the distance for full rate DSL networks. The NBN maximum fibre span is 15 km.

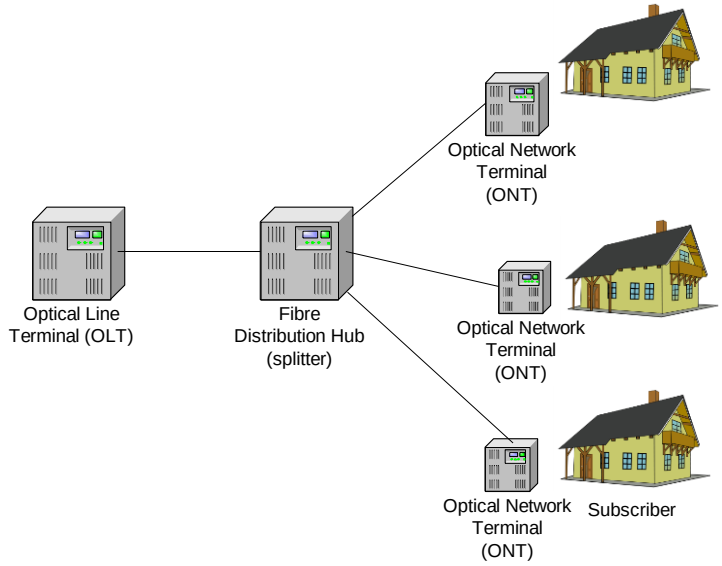

Fig 1: GPON Architecture

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GPON Speed

The NBN data rates are determined by the GPON infrastructure, which provides 2.488 Gbps downstream (from the network to the subscriber), 1.2 Gbps upstream. This GPON capacity is shared between 32 users.

If all 32 subscribers were active, and the GPON capacity was shared equally between them (both scenarios unlikely), then the per subscriber downstream data rate would be around 77 Mbps. In practice, the GPON capacity would be shared unequally. Given the 2.488 Gbps downlink capacity, individual subscriber peak rates of either 100 Mbps or 1 Gbps are therefore achievable.

Hence the GPON FTTP infrastructure meets the NBN 100 Mbps/1Gbps peak rate objectives.

A key GPON feature is the relatively high uplink capacity, 1.244 Gbps between 32 subscribers, as compared to the 1 Mbps uplink for current ADSL2+ services. This GPON uplink capacity is reflected in the higher speed plans offered by NBNCo, e.g. 100 Mbps downlink/40 Mbps uplink, 1 Gbps downlink/400 Mbps uplink.

XG-PON – the NBN upgrade

The next version of the GPON standard, known as XG-PON, provides 10 Gbps downstream, 2.5 Gbps upstream. This is a four fold increase in downstream capacity compared to GPON, and, like GPON, the capacity is shared between 32 subscribers.

The XG-PON standard was finalised in 2010, which also saw successful field trials by US operator Verizon. GPON and XG-PON can both be carried on the same fibre cable,

Hence XG-PON infrastructure can be introduced gradually to an existing GPON network. Given to 9.5 year NBN rollout timeframe, XG-PON infrastructure will likely comprise a significant portion of the final NBN, allowing multi gigabit peak rate services to individual subscribers.

Backhaul Bottleneck

Given the GPON rates (2.488 Gbps/1.244 Gbps) per 32 subscribers, the aggregate NBN data capacity is immense. However, there are other factors which will limit data rates seen by NBN subscribers.

A given Service Provider connects their backhaul to an NBN "Point of Interconnect" or POI, each POI covers a given "Connectivity Serving Area". The NBN will eventually comprise 121 POIs. Each Connectivity Serving Area requires backhaul (either 1 Gbps or 10 Gbps) to connect to the wider network. The actual data rates seen by NBN subscribers will be determined by this backhaul capacity, which, due to cost, will be only a small fraction of the total Connectivity Serving Area capacity.

Hence Service Provider backhaul capacity will have a key influence on the average or sustained data rates available to subscribers. Backhaul capacity is likely to be a major NBN bottleneck.

Also, Service Providers purchase capacity within the NBN, via a "Connectivity Virtual Circuit" or CVC, which serves the subscribers connected to a given NBN Point of Interconnect. CVC capacity cost is $20 per Mbps per month. CVC capacity (or lack thereof) will also constrain NBN subscriber data rates.

Summary

NBNCo proposes peak rates of up to 1 Gbps. The NBN Fibre to the Premises (FTTP) architecture is based on the GPON standard, which provides 2.488 Gbps shared amongst 32 users. This supports the 1 Gbps NBNCo peak rates (downstream and upstream). XG-PON, the next version of the GPON standard, will provide 10 Gbps downstream, shared among 32 subscribers, allowing multi Gbps subscriber services. However, actual NBN data rates will be constrained by backhaul and Connectivity Virtual Circuit capacity.