Next Gen NGN Framework

Next Gen NBN Industry Structure

Operational Separation to Ensure Open Access

Retail Service Providers (RSP)
Purchase bandwidth connectivity from OpCo and compete with each other in providing competitive and innovative services to end-users

High Level Industry Value Chain

Wholesale Operator (OpCo)
responsible for the design, build and operation of the Network active infrastructure

Structural Separation to Ensure Open Access

Passive Infrastructure Operator (NetCo)
responsible for the design, build and operation of the Network passive infrastructure

Retail Services

Services
(including Servers & CPEs)

Services Wholesale
(Layer 3 Open Access)

Bandwidth Wholesale
(Layer 2 Open Access)

Active Infrastructure
(including Switches & Transmission Equipment)

Wholesale Ducts & Wirelines
(Layer 1 Open Access)

Passive Infrastructure
(including Ducts & Wirelines)

Subject matter of NetCo RFP
NGNBN OpCo Network Requirement

- High Uplink, Downlink Access Speed
- Open Access, Reliable, Scalable, Secure and Upgradeable Network
- Support fair and equitable bandwidth allocation for multiple RSP and different types of applications
- Support 4 classes of service
- Network must be capable of efficiently handling increasing high bandwidth applications such as VOD and Peer to Peer traffic
- Network needs to be transparent to RSP IPv4/v6 addressing scheme for all services if a Layer 2 backhaul method is selected
- Network must provide flexibility to enable the growth of the end user bandwidth
Nucleus Connect was selected to Build and Operate the Active Network in Singapore’s Next Generation National Broadband Network (Next Gen NBN)

Nucleus Connect will deploy advanced technologies to enable a comprehensive range of ultra-high speed wholesale broadband services to RSPs

Nucleus Connect will launch commercial operations in Q1, 2010

Nucleus Connect will offer standard pricing to all Retail Service Providers (RSPs) through an Inter Connect Offering (ICO) that will be regulated by IDA.

Nucleus Connect will deploy a Fiber-to-the-Home (FTTH) architecture using GPON and Active Ethernet network elements to deliver broadband services with speeds up to 1Gbps
Nucleus Connect Central Office

OpCo Equipment Area

RSPs Equipment Area

Data Centre

NOC

IOT Lab
OpenNet and Nucleus Connect Overview

- Passive Network laid by OpenNet
  - Monitoring NTEs
  - Monitoring OLTs and Active Ethernet Switches
  - Monitoring RPE, P, and RSP routers
  - Monitoring Nucleus Connect NOC (i.e. Monitoring all Active Equipment)

- OpenNet CO

- Nucleus Connect CO

- Landed Property
- Multi Dwelling Units
- Non Residential
- Government Agencies

- ONT
Lighting up the Fibre

Non-Residential

Residential

NBAP
Wiring into the Home
1. Solution Overview
End to End Connectivity

Provider (P) Core Router

Aggregation Router

Active Ethernet

OpenNet CO1

OpenNet CO2

OpenNet CO3

OpenNet CO4

OpenNet CO5

OpenNet CO6

OpenNet CO7

OpenNet CO8

OpenNet CO9

RSP (Facing) PE Router

Provider (P) Core Router

RSP (Facing) PE Router

Inter CO Connectivity

End to End Connectivity
2. Connection Services
Residential Services

Connections Services
- 100 Mbps Ethernet
- 1 Gbps Ethernet
- **Subscribe to different class of services**
  - Best Efforts
  - Real Time
  - Near Real Time
  - Mission Critical

Potential RSP Offerings
- VoIP
- IPTV and Video on Demand (SD and HD)
- High Speed Internet
- Online Gaming
- Video conferencing (e-learning)
- Online storage
- Telemedicine
Non-Residential Services

Connections Services
- 100 Mbps Ethernet
- 1 Gbps Ethernet
- Symmetrical bandwidth
- **Subscribe to different class of services**
  - Best Efforts
  - Real Time
  - Near Real Time
  - Mission Critical

Potential RSP Offerings
- Voice over IP
- High Speed Internet
- Corporate data usage (VPN, Intranet)
- Video conference, Tele-Presence
- Lease line (DLC, ELL equivalence)
- Software as a Service (SaaS)
- Telemedicine
Non-Building Address Point (NBAP) Services

Connections Services
- 100 Mbps Ethernet
- 1 Gbps Ethernet
- Symmetrical bandwidth
- **Subscribe to different class of services**
  - Best Efforts
  - Real Time
  - Near Real Time
  - Mission Critical

Potential RSP Offerings
- Traffic Monitoring
- Security Surveillance
- Mobile stations backhaul
- Broadcast service (advertisement, notice, etc…)

[Diagram showing network connectivity and services]
This service allows RSPs to deliver IP multicast content over the NGNBN using Nucleus Connect’s IP multicast technology.

The IP Multicast technology is used to efficiently deliver bandwidth-intensive video broadcasting services such as:
- IPTV
- Web seminar
- E-learning, and
- a host of other business applications.

Using Multicast technology, an RSP offering IPTV can multicast its broadcast channels to the Nucleus PE Routers. With all the Broadcast channels replicated across the MPLS PE Routers, the RSP does not need to scale its core capacity requirements as its actual subscriber numbers grow.
3. Managed Services
Each branch has pseudo-wire L2 Point-to-Point connection terminated at the PE serving the Data Center. Traffic from each branch is identified and separated by VLAN.
All traffic from branch use PE as default router. PE router performs all routing functions.

Layer 3 VPN based on IETF RFC 4364
L2 VPN Ethernet LAN (ELAN)

Emulating LAN over MPLS network
Co-Location Service

- Rack space within Nucleus Connect CO to facilitate the co-location of QPs’ active network equipment for the purpose of connecting to the Nucleus Connects Active Network.

- Dimension of co-lo space:
  - 600mm by 900mm by 42U racks
  - 600mm by 1,000mm by 42U racks
2. Network Resiliency and Redundancy
Resiliency and Redundancy

- The proposed network is designed with 99.95% monthly network availability to meet the stringent QoS targets offered in the ICO.

- All Core, Aggregation and Access Equipment are configured with redundant configuration, including:
  - Controller cards;
  - Switching fabric cards;
  - Power supply modules; and
  - Fan modules.

- Failure on any active components will automatically trigger a switchover to the backup cards/modules without service disruption.
4. Quality of Service
Quality of Service

- RSPs will be able to offer different QoS levels to their customers at both L2 & L3. They can control this by:
  - Class of Service for each service
  - Amount of CIR and PIR on the uplink and downlink
  - Dimensioning of the core and upstream capacity

- Network Design plays a key role
  
  - Network Dimensioning
    - Coping with bursty nature of IP flows
    - IP classification and differentiation of different service types
    - Video, VoIP, High Speed Internet (HSI)
  
  - Service and Network Availability
    - Network resiliency
    - High Service Availability in the Network Equipment

- Nucleus Connect will provide RSPs QoS information on a segment basis (End user, core network, and Network access)
5. Service Ports and Service Transparency
Nucleus Connect will provide Service Ports to RSP at the following locations:

1) at the PE router facing RSP at Nucleus Connect’s CO - for RSP to achieve nation-wide coverage easily; **1GE** and **10GE** ports, single-mode fiber;

2) at the Aggregation Edge router at OpenNet’s CO – for example: for RSPs providing IPTV and services requiring low-latency; **1GE** and **10GE** ports, **single-mode fiber**; and

3) at the NTE at End-User Premises – for the RSP’s End-User to consume services. Ports are **100/1000 Mbps**, **electrical RJ-45**, cat 5/5e UTP cable, based on GPON or Active Ethernet.
The proposed Nucleus Connect network (GPON or Active Ethernet) will be transparent to the delivery of the following RSP services:-

- IPv4 and IPv6 Protocol;
- IPv4 and IPv6 Layer 3 VPN;
- IPv4/IPv6 – Unicast, Multicast and Broadcast traffic co-existence on the similar platform;
- Traffic segregation and prioritization;
- Support various packet sizes varying from 64 to 9000 bytes;
- Transparently proxy/relay or transparently pass through the authentication protocol to RSPs;
- Support private circuit security tunneling protocol like IPSec and QinQ
6. Open Access Systems (Platform, End-User Portals)
The proposed OSS-BSS solution is designed to provide an **Open Access** Platform to enable End-Users, RSP, QP and OpenNet to interact with the Nucleus Connect for ease of delivery of service.

Being at the heart of the NGNBN eco-system, the proposed OSS-BSS solution is designed with the following business needs:

- **Deliver Ease of Doing Business**
- **Empower End Users and Partners**
- **Efficient end-to-end Services Delivery**
Self Care services that will be available to RSPs include:

- Nucleus Connect’s Product and Services information
- Enquiries on Nucleus Connect’s and OpenNet’s Network Coverage and Rollout status
- Ordering, Modification and Termination of orders
- Status of services subscribed
- Creation, updating and status query of trouble tickets;
- Manage and Maintain their services
- View bills and make billing enquiries

RSPs are provided with option to establish a connection to the Nucleus Connect platform using either a Public Internet secured VPN or a dedicated point-to-point secured link or both
Information on RSP Services

Order placed on by End-User directly on RSP portals

HTTP RE-DIRECTION

Information provided by RSP as part of Registration Process