Next Generation National Broadband Network in Singapore

Submitted by: Singapore
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Presented at APEC Tel 39 Regulatory Roundtable
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15 April 2009

Agenda

1. The Need for Next Generation Infrastructure

2. Possible government intervention models

3. Key Specifications of Next Gen NBN

4. Next Gen NBN Status Update
The Need for Next Generation Infrastructure

Broadband is the Highway of the Knowledge Based Economy

> For Singapore to compete in the global Knowledge Based Economy, broadband is a critical enabler.

> As a source of competitive advantage, broadband is an infrastructure and not a luxury

> Singapore has continually invested in infrastructure to prevent economic growth from being constrained by infrastructure bottlenecks.
Infrastructure leadership has been critical to Singapore’s competitiveness

1. Left on its own, the private sector will continue to milk from existing assets & not invest (in infrastructure) sufficiently in time.

2. Incremental improvements are possible over time, but DSL & Cable technologies are approaching their limits

Bandwidth Drivers

**Downstream increase drivers**
- SDTV: 2 Mbps/channel
- HDTV: 6 Mbps/channel
- Basic HSI: 5 Mbps average
- Gaming: 2 Mbps/session
- Multimedia surfing: 8 Mbps average
- Video Conf., learning: 3 Mbps/session
- Home working: 4 Mbps average

**Upstream increase drivers**
- SDTV: 0.2 Mbps/channel
- Basic HSI: 2 Mbps average
- HDTV: 0.5 Mbps/channel
- Personal content upload: 3 Mbps/channel
- Gaming: 2 Mbps/session
- Multimedia surfing: 2 Mbps/session
- Video Conf., learning: 3 Mbps/session
- Remote home monitoring: 0.5 Mbps/call

Drivers: HDTV, MPEG4, latency needs & peak usage

- Continuous increase of bandwidth needed in future
- Latency reduction for interactive applications
- Bandwidth competition

Source: Alcatel
Explosive Growth of P2P & Internet Video to PC


Explosive Growth of P2P
Driver for both upstream & downstream traffic

On consumer broadband networks:
• 50-65% of downstream traffic is P2P
• 75-90% of upstream traffic is P2P

Source: CacheLogic
Video as Main P2P Driver

- Average P2P file sizes are constantly growing – driven largely by video
  - Majority of P2P traffic volume is generated by objects with an average size >1GB
  - In Asia, this figure is 2.5GB


Size & Impact of P2P in Consumer Broadband

50-65% of downstream traffic is P2P

75-90% of upstream traffic is P2P

- Because of P2P’s symmetry & the network’s asymmetry, all upstream capacity has been consumed

- Upstream capacity is challenging for xDSL & DOCSIS families

Source: CacheLogic
High-speed symmetric broadband at affordable rates enable new teaching and learning paradigms
- Learning and sharing across borders
- Immersive Learning

New capabilities and services through interactive IPTV
- Multi-play
- On-demand TV
- Audience Voting
- Multiple camera views
- New advertising models

Next Gen NBN Enhances Productivity for Enterprises

Examples
- Multiplay services - combining Voice, Video and Data
- High bandwidth enhances Cloud Computing capabilities
- Enables collaboration through high quality video conferencing (2D and 3D)
- Opens Doors to SMEs adopting ICT
  - Cost of connectivity will fall as a result of NGNBN
  - Software-as-a-Service (SaaS) lowers barriers of adoption

Source: Gartner
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Intervention Options for the Government to Develop the Next Gen NBN Project

(since End-2007)
Significant FTTx Developments Worldwide

**Canada**
- Mid 2006: Alberta SuperNet Project covers 429 communities serving a population of 3 million

**USA**
- End 2006: 3.8m Subs
- Aug 2008: 13m Homes Passed
- End 2006: 6m Homes Passed
- Verizon on track with US$18B FTTH deployment in US

**China**
- Jun 2008: 17.8m FTTx Subs
- Feb 2009: 5.9m FTTH/B Subs
- 2011: 36m Homes Passed

**France**
- End 2008: 60,000 Subs
- Mar 2007: >13 municipalities/cities
- End 2006: 1m Homes Passed (France Telecom)
- 2012: 4m Homes Passed (Iliad)

**Denmark**
- Jun 2008: 38,000 Subs
- Jan 2008: 70,000 Homes Passed
- 2010: Rollout complete

**Netherlands**
- Jun 2008: 183,500 Subs

**Sweden**
- Jun 2008: 546,000 Subs
- Mid 2007: 300,000 Subs

**UK**
- 2008: BT announces $1.5b initiative to connect 10m homes by 2010

**Italy**
- Jun 2008: 293,000 Subs; speeds up to 1Gbps
- 2010: 2.05m Homes Passed
- 2017: FTTC available to 65% population

**Japan**
- Feb 2009: 13.2m Subs
- End 2006: 5.5m Subs
- 2010: 80% homes have 100Mbps

**South Korea**
- Jun 2008: 1.3m FTTx Subs
- Feb 2009: 7.1m FTTx Subs
- 2010: Nation-wide by 2010

**Hong Kong**
- Feb 2009: 652,000 Subs
- PCCW & HKBN have launched 1Gbps FTTH services
- 2012: 95% (or 2m) Homes Passed (HKBN)

**Chinese Taipei**
- Feb 2009: 848,000 Subs
- 2013: 3.27m FTTx subs
- Planned 2007 – 1m FTTH subs

**Malaysia**
- Awards RM15.2Bn High Speed Broadband Plan to TM to deploy Fibre Optics to 2.2m urban homes by 2019
- Feb 2009: 40,000 FTTH/B subs

**Australia**
- Nationwide high-speed internet estimated to cost A$4.7b
- Feb 2009: 17,000 FTTH/B subs

Other EU countries like Slovenia, Greece and Norway have also rolled out FTTH.
Areas of Government Intervention in Recent NGN Deployment Worldwide

**EMEA**

**Greece**
Sep 08: govt announced its plans regarding a 7yr programme to construct a national fibre-optic network (project cost $4.12 billion – PPP)

**Finland**
Incumbent carrier: TeliaSonera
Sep 08: govt unveiled its initiative to fund one-third of the NGN project cost (~S$190.73m)

**UK**
Incumbent carrier: BT
Jul 08: BT unveiled plans for a S$3.12b fibre rollout across Britain

**UK-Northern Ireland**
Apr 08: Govt initiated Next Gen residential broadband at a total cost of ~$131.192

**ASIA PACIFIC**

**Australia**
Incumbent carrier: Telstra
Sep 05: govt announced the proposed separation of Telstra into "arm's length" wholesale & retail units
Apr 08: Govt released RFP to roll-out & operate the NGN (committed S$14.16b)

**Japan**
Incumbent carrier: NTT
Gone through two stages of separation in 1992 & 1999
regulatory body continued to monitor NTT's market dominance
After 2010: Further restructuring decisions may be made

**Malaysia**
Incumbent carrier: TM
Oct 07: govt willing to fund 30% of urban FTTH rollout
Sep 08: govt agreed to fund ~S$6b high speed broadband rollout

**New Zealand**
Incumbent carrier: Telecom NZ
Apr 07: govt proposed TNZ separate into 3 businesses
Mar 08: structural separations plan approved
May 08: govt announced a S$458.12m investment to boost fibre over the next 5 years

**Government Ownership in FTTH Deployments**

1 **Stokab**
Stockholm, Sweden

2 **Axia / Supernet (with Bell Canada)**
Alberta (rural areas), Canada

3 **Fastweb (with Metroweb)**
Milan, Italy

4 **Glasvezel (Citynet)**
Amsterdam, Holland

5 **Verizon**
USA

6 **BT / Openreach**

- **End Users**
  - RSP
  - RSP
  - RSP
  - RSP
  - RSP

- **Government Ownership**
  - 0%
  - 0%
  - 100%
  - 0%
  - 0%

- **Opco**
  - Telkomsel
  - Telkomsel
  - Telkomsel
  - Telkomsel
  - Telkomsel

- **Netco (Stokab)**
  - 100%

- **RSP/Opco level**: Open Access
  - Opco/Netco level**: Open Access

- **Opco (BBned)**
  - 0%
  - 0%
  - 33%

- **Netco (GNA)**
  - 0%

- **RSP/Opco level**: Open Access
  - Opco/Netco level**: Monopsony

- **RSP (Fastweb)**
  - 0%

- **Opco (Fastweb)**
  - 16%
  - 0%

- **Netco (Metroweb)**
  - 34%
  - 10%

- **RSP/Opco level**: Closed Access
  - Opco/Netco level**: Monopsony

- **RSP (Verizon)**
  - 0%

- **Opco (Verizon)**
  - 0%

- **Netco (Verizon)**
  - 0%

- **RSP/Opco level**: Closed Access
  - Opco/Netco level**: Closed Access

- **RSP (BT)**
  - 0%

- **Opco (BT)**
  - 0%

- **Netco (Openreach)**
  - 0%

- **RSP/Opco level**: Open Access
  - Opco/Netco level**: Open Access
Sweden’s Open Access Spurs Vibrancy in RSP Market & Innovative Services

Users can subscribe or change broadband services plans via TV screens at home or via internet. E.g. 100Mbps broadband services as shown in screenshot

Competition from Open Access results in lower prices and shorter contract terms.

Characteristics of Each Layer & Need for Separation to Achieve Open Access

**Retail Service Providers (RSPs)**
- Broadband Services (Internet access, IPTV, Video Conferencing, Surveillance etc)
- Competitive Market (> 50 providers)
  - Low capital investment (~$50-100 Million), Economic lifespan of 5 - 7 years
  - Service provider business with expected returns of equity of > 20%
  - Main business to provide broadband services to end consumers

**Operating Companies (OpCos)**
- Active Equipment (switches, routers, access equipment etc)
- Limited Competition (~2-4 large providers)
  - Medium level of capital investment (~$400M - $700 Million), Economic lifespan of 5 - 7 years
  - Traditional Telco-like business with expected return of equity of 16% – 19%
  - Main business to provide broadband access to RSPs

**Network Company (NetCo)**
- Passive Infrastructure (ducts, dark fibre etc)
- Natural Monopoly (~1 national provider)
  - Capital intensive (~$2 Billion), Economic lifespan of 25-30 years for fibre and 40-50 years for ducts
  - Utility-like business with expected return of equity of 9% - 11%
  - Main business is to deploy and provide dark fibre connection to OpCos

Separation to Ensure Open Access & Minimise Discriminatory Conduct
Layered Approach to Ensure Open Access

Tender Process Options

Option 1: Single Tender for NetCo+OpCo (Baseline Consideration)

Option 2: Separate Tender for NetCo & OpCo held at the same time

Option 3: Tender for NetCo followed by OpCo later

OpCo

NetCo

OpCo

NetCo
Intervention Options for Government

Increasing Level of Government Participation for NGNBN

**Free Market**
- Characteristics:
  1. Large capital investment & Rights of Way issues
  2. Lack of interest by new market entrants
  3. Lack of incentive to invest by incumbents

**Regulatory Relief**
- Characteristics:
  1. Granting regulatory relief from Open Access obligations
  2. Effectively granting NGNBN Operator “monopoly” rights
  3. Turning the clock back on market liberalisation efforts

**Government Grants**
- Enforcement of Open Access, Coverage & Business Continuity Obligations

- Characteristics:
  1. Timely rollout of NGNBN
  2. Regulatory & contractual controls
  3. Unique opportunity to put in place Open Access Industry Structure

**Government Build, Own & Operate**

Financial Support Objectives

> Financial Support aligned to two key objectives

**Objective 1**
Enable the NetCo and OpCo to create a viable and sustainable business case by improving the project’s bankability

Max. of S$750M for NetCo

**Objective 2**
Support the achievement of IDA’s desired outcomes for the NGNBN

Max. of S$250M For OpCo
Key Specifications of Next Gen NBN

Exciting Benefits End-Users Can Look Forward To with Next Gen NBN

- **Competitive Prices**: For both wholesale and retail broadband services.
- **Innovative Services**: Supports R&D efforts in and delivery of innovative services such as high-definition video, gaming, healthcare, education and security.
- **Ultra-High Access Speeds**: Minimum access speeds of 50Mbps uplink and 100Mbps downlink per end-user connection; scalable up to 1Gbps and more.
- **Pervasive Nationwide Coverage**: Ensure that all segments in Singapore benefit.
### Next Gen NBN Bandwidth Requirements

<table>
<thead>
<tr>
<th>Bandwidth Type</th>
<th>By Commercial Operations Date</th>
<th>Beyond Commercial Operations Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Downstream Bandwidth per Residential Connection</td>
<td>100 Mbps</td>
<td>Shall be scalable to enable future downlink bandwidths in excess of 1Gbps per End-User Connection</td>
</tr>
<tr>
<td>Peak Upstream Bandwidth per Residential Connection</td>
<td>50 Mbps</td>
<td>Shall keep pace with or even exceed the downlink bandwidth as it is increased</td>
</tr>
<tr>
<td>Committed Downstream Bandwidth per Residential Connection</td>
<td>25 Mbps</td>
<td>Shall increase over time (required to support next generation services e.g. high definition video streams)</td>
</tr>
</tbody>
</table>

### Categories of Premise

- **Residential**
  - public housing
  - private apartments
  - private landed housing

- **Non-Residential**
  - commercial blocks
  - industrial blocks
  - institutional properties
  - government offices
  - schools
  - hospitals
  - libraries

- **Non-Building Address Points**
  - lamp-posts
  - bus stops
  - traffic junctions
  - lift monitoring rooms
  - lift lobbies
  - wireless access points
  - street-side display signs
  - other address points in Singapore and connected islands

**ICO Mandatory**
Inter-Connection Offer

> Regulated prices, offered to all qualified customers, on a transparent basis

- ICO lists the prices, terms & conditions by which the Next Gen NBN Operators must offer Mandated Services to qualifying customers;

- Contains all necessary services to provide end-to-end connectivity.

- Available in electronic format on NetCo’s and OpCo’s Platforms.

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Next Gen NBN Status Update
OpenNet Selected as Next Gen NBN NetCo

> OpenNet selected as Next Gen NBN NetCo
> Awarded on 26 September 2008

OpenNet

<table>
<thead>
<tr>
<th>Company</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Axia</td>
<td>30%</td>
</tr>
<tr>
<td>SingTel</td>
<td>30%</td>
</tr>
<tr>
<td>SPH</td>
<td>25%</td>
</tr>
<tr>
<td>SPT</td>
<td>15%</td>
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</tbody>
</table>

Highlights of OpenNet’s Proposal

> New, all-fibre network to the homes and businesses
> Future-proof, capable of supporting more than 1 Gbps
> Leverage existing underlying passive infrastructure assets, such as ducts, manholes and exchanges
  - Coverage that is nationwide, with minimal disruption during roll-out
Overview of Next Gen NBN Wholesale Prices

OpCo Wholesale Price to RSPs:
- NetCo Wholesale Price to OpCo:
  - S$15/month (Residential)
  - S$50/month (Non-Residential)

OpCo Proposals Received
- 4 proposals received on 5 December 2008
- Nucleus Connect selected as Next Gen NBN NetCo
- Awarded on 3 April 2009
OpCo Services over OpenNet’s Fibre Network

OpCo RFP awarded to StarHub OpCo – Nucleus Connect on 3 April 09

> NetCo RFP awarded to OpenNet on 26 Sept 08
> 95% Nationwide all-new Optical Fibre Network by 2012
> USO by 2013

Overview of Next Gen NBN Wholesale Prices

OpCo Wholesale Price to RSPs:
- From $21*/month (Residential)
- From $75*/month (Non-Residential)

*Includes NetCo Wholesale Price

NetCo Wholesale Price to OpCo:
- $15/month (Residential)
- $50/month (Non-Residential)

Innovative Services and Competitive Retail Prices

End-Users

RSP
Technology to be Deployed by OpCo

- **Core**
- **Residential**
- **Non-Residential**
- **Non-Building Address Points**

Central Offices

- Optical Ethernet Switch
- GPON Optical Splitter

Wholesale Service Offerings

**Residential**:
- Bandwidth Service
- Uplink: 1Gbps, 500Mbps, 100Mbps
- Downlink: 50Mbps, 500Mbps

**Non-Residential**:
- Bandwidth Service
- Uplink: 1Gbps, 100Mbps
- Downlink: 100Mbps, 50Mbps

**Modular**
- Unbundled services
- Able to add-on bandwidth increments and different classes of service

**Flexible**
- OpCo provides online platform for self-provisioning by RSPs

**Comprehensive**
- 1 Gbps available
- Facilitates RSPs having fast and easy market entry
Wholesale Service Offerings

- **Class A** Real Time
  - Examples of Services: Video Conferencing, Premium VoIP Gaming

- **Class B** Near Real Time
  - Examples of Services: IPTV Video Streaming, Gaming, Video Conferencing

- **Class C** Mission Critical
  - Examples of Services: IPTV Video Streaming, Gaming, Video Conferencing

- **Class D** Best Effort
  - Examples of Services: Internet surfing, VoIP

> Flexibility of service offerings allowing RSPs to meet the needs of diverse range of applications and services

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Next Gen NBN Timeline Moving Forward

<table>
<thead>
<tr>
<th>OpenNet</th>
<th>60% Year 2010</th>
<th>95% Year 2012</th>
<th>USO 1 Jan 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Residential</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nucleus Connect</td>
<td>Joint Rollout</td>
<td></td>
<td>USO 1 Jan 2013</td>
</tr>
</tbody>
</table>

> Nucleus Connect’s services made available within 7 working days after OpenNet has declared coverage of a building;

> Universal Service Obligation (USO) from 1 Jan 2013.