FTTH IN APAC – OPTIMUM AREAS FOR GROWTH

June 2016
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FTTH in APAC: Optimum Areas for Growth

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- Rollout & Deployment Strategies  11
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Case Studies included:
Countries – Japan, Hong Kong, Myanmar
Companies – NTT, So-net, HK Broadband (HKBN), HKT-PCCW, MyRepublic, Telekom Malaysia (TM), Planet Fiber, Jasmine International, Myanmar Posts and Telecommunications (MPT), Yatanarpon Teleport (YTP), Myanmar Information Highway Limited (MIH)

Acronyms:
IRU = Indefeasible Right of Use
MIC = The Ministry of Internal Affairs & Communications
PON = Passive Optical Network
PPP = Public Private Partnership
RSP = Retail Service Provider
FTTH in APAC: Elements of a Successful Business Case for Fibre Investments
1. Supportive Government Policies
2. Sufficient Demand Prior to Rollout & Deployment
3. Keeping Tabs on Cost to Supply
Supportive Government Policies
A clear regulatory approach to FTTH has resulted in advanced FTTH rollout & deployments

“Subsidy” Model
- 2nd most common funding method after PPP. Used in Singapore, Malaysia, South Korea & Japan
- Subsidies given by governments can be in the form of tax incentives or direct subsidies either to network operators or to local state governments to deploy Fiber Optic networks
- To create neutral, open access networks, some governments have mandated degrees of separation within the incumbent network operator e.g. in Australia & New Zealand

<table>
<thead>
<tr>
<th>Pros</th>
<th>FTTH rollout &amp; deployments increase in number and are brought forward</th>
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<tbody>
<tr>
<td>Cons</td>
<td>Subsidies without FTTH rollout &amp; deployment commitments imposed on incumbent network operators e.g. ceiling price &amp; QoS/SLA, create inefficiency as these do not achieve the objective of deploying affordable infrastructure to benefit FTTH subscribers. However, competition from LTE will eventually bring FTTH pricing down</td>
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Right of Way & Access Permission
- Use of existing Rights of Way (RoW) e.g. within water & sewer networks, gas pipe systems, canals, waterways and other transport tunnels, within towns & cities can expedite and reduce cost of FTTH rollout & deployment

Case Study – Japan
“The Guidelines on the Use of Poles, Conduits and etc owned by Public Utilities” had been specified as early as Apr-01 to promote FTTH rollout & deployment by network operators
Supportive Government Policies
A clear regulatory approach to FTTH has resulted in advanced FTTH rollout & deployments

Case Study – Japan

Following on from previous initiatives, the government launched the “New Broadband Super Highway Plan” or “Hikari no Michi” in May-10 targeting to cover Japan with an over 100 Mbps network by 2015.

Measures undertaken within the FTTH market segment to achieve the target included:
- MIC mandated functional separation of NTT East & West facility department and the sales department, which collectively had approximately 75% of 20 mil FTTH subscribers in Japan.
- The government provided financial support for local state governments constructing broadband networks via a subsidy that funded 1/3 of the total construction costs. The constructed broadband networks were then made available to the private sector by means of the IRU scheme.

Outcome – Increased FTTH penetration & take up and lower FTTH pricing
- Fiber was justified even for rural areas as a result of the government subsidy under the IRU scheme.
- NTT subs market share was still at 64% at eot 2015 due to pricing reductions & new services.

Previous Government Initiatives
- 2001 -> e-Japan I
- 2003 -> e-Japan II
- 2004 -> u-Japan
- 2006 -> IT New Reform

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<tbody>
<tr>
<td>20 mil FTTH Subs</td>
<td>Dec-12 - NTT East &amp; West cuts its retail prices by 34% to counter LTE competition, ARPU has been declining ever since…</td>
<td>2015 - NTT “Hikari” Collaboration Model (B2C to B2B2C)</td>
<td>30.3 mil FTTH Subs</td>
<td>100% Homes passed</td>
<td>8.7% CAGR (2010-2015)</td>
<td></td>
</tr>
<tr>
<td>May-10 – “New Broadband Super Highway Plan” launched</td>
<td>Apr-13 – So-net launched Nuro internet service with 2Gbps download &amp; 1Gbps upload speed but with limited coverage</td>
<td>2015 – So-net launched Nuro internet service with 10Gbps download &amp; 2.5Gbps upload speed but with limited coverage</td>
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Sufficient Demand Prior to Rollout & Deployment
Private models ensure economic viability by securing sufficient ROI upfront

Demand Driven Rollout & Deployment Strategies
• Full coverage in densely populated areas, especially in high GDP countries – Strategy to cover areas with lower rollout & deployment costs and/or higher margins
  o Japan, South Korea, Singapore, Hong Kong, Taiwan exhibit high FTTH penetration & take up rates within APAC. These countries also appear towards the top of population density and GDP per capita listings

<table>
<thead>
<tr>
<th>Country</th>
<th>Population Density or # people per sq km</th>
<th>GDP per Capita in USD in 2014</th>
<th>FTTH Penetration or % of homes passed in 2015</th>
<th>FTTH Take Up as at Dec-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singapore</td>
<td>7,987.52</td>
<td>55,910</td>
<td>96%</td>
<td>77.5%</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>6,442.65</td>
<td>40,252</td>
<td>91%</td>
<td>68.9%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>649.25</td>
<td>22,669</td>
<td>88%</td>
<td>48.7%</td>
</tr>
<tr>
<td>South Korea</td>
<td>491.78</td>
<td>28,166</td>
<td>94%</td>
<td>81.6%</td>
</tr>
<tr>
<td>Japan</td>
<td>336.33</td>
<td>36,298</td>
<td>100%</td>
<td>59.3%</td>
</tr>
</tbody>
</table>

Source: F&S Analysis, CIA World Factbook, UNCTAD & APAC FTTH Council

  o GDP per capita can be used as an indicator of FTTH take up but more importantly is a strategy to encourage take up e.g. NTT in Japan matched the price of DSL to ensure migration to FTTH
  o High population density has the effect of lowering rollout & deployment costs and duration
    1. Japan has low rollout & deployment costs due to its dense multi-dwelling units (MDU) and connection method of to the basement instead of to the unit. NTT further lowers the cost by using aerial rollout & deployment e.g. along poles/facades
    2. HKT-PCCW in Hong Kong took 5 years to go from 53% to 84% of households whereas TM in Malaysia (with 91 people per sq km) has only reached 31% of households after 7 years. Population density can be used as an indicator of relative rollout & deployment speeds
Sufficient Demand Prior to Rollout & Deployment
Private models ensure economic viability by securing sufficient ROI upfront

Case Study – Hong Kong

➢ Background
  o In Hong Kong, there is no government strategy or financing in place for FTTH. All FTTH networks in Hong Kong are entirely privately funded

➢ FTTH Rollout & Deployment Approach
  o FTTH was first rolled out in Hong Kong by HKT as pilots for premium customers in the early 2000. Following the maturity of cost effective PON technology, HKT commenced a massive FTTH rollout in 2009 and achieved 84% of households after 7 years
  o Being a densely populated city, the rollout of the Fiber Optic network was achieved relatively cheaply and quickly with rollout & deployment cost per household at approximately USD 220, for fibre infrastructure, which is only a portion of the cost charged in the US and Europe
  o Owing to the high upfront capex investment and entry barriers such as technical operation teams, work practices support systems and logistics, incumbent operators had clear advantage over new entrants and capitalized on it
  o To increase initial ROI, there was some prioritizing of high demand areas, easy access areas as well as households near Fiber backhaul

➢ Current Status of FTTH in Hong Kong
  o FTTH Council in APAC shared that Hong Kong had 1.6 mil subscribers and 91% FTTH/B Homes Passed in total Households as at end of 2015
  o FTTH has had a positive impact on home-based businesses needing high bandwidth accessible from home, especially with the introduction of cloud-based services
  o HKBN’s FTTH service delivers fast and stable access to both local and overseas content at a costs of USD 61 /month for 1 Gbps whereas HKT-PCCW offers 1 Gbps & 10 Gbps at USD 90 & 372 /month
**Sufficient Demand Prior to Rollout & Deployment**
Private models ensure economic viability by securing sufficient ROI upfront

**Demand Driven Rollout & Deployment Strategies**
- Limited coverage – Strategy to focus on selected areas only

**Selected Cities or Towns**
1. So-net in Japan only offers its 2 or 10 Gbps service in in the Kanto region which holds 1/3 of the total population of Japan and has 1,300 people per sq km (Japan’s average population density is 336 people per sq km)
   a. Kanto region also has a high concentration of youth (target users of high speed internet)

**Selected Types of Buildings**
1. Planet Fiber in Thailand focuses on high rise buildings for implementation of its 1Gbps Fiber to the room (FTTR) technology (Thailand’s average internet speed is 20 Mbps)
   a. To achieve further growth, they plan to target tourist islands as well e.g. Phuket with population density of 1,042 people per sq km

**Rural, Remote & Underserved Areas**
1. Within areas that are poorly served by existing broadband, such as rural towns or villages, there may be considerable pent-up demand. Some operators are experiencing better take-up rates in these areas than in cities
   a. Jasmine International in Thailand only offers its services in the Bangkok Metropolitan area (BMA) as well as provincial Thailand. Market share increased to 29.5% in Q115 by reaching provincial customers. Approximately 75% of its subscribers are from the provinces
2. To reach some remote areas, apart from utilizing government subsidies, it is also possible that the initial rollout & deployment cost can be taken up directly by subscribers

- Provide backhaul bandwidth and connectivity to Mobile network operators venturing into LTE
Keeping Tabs on Cost to Supply
Affordable FTTH infrastructure rollout & deployment through low CAPEX & OPEX solutions

Proven Solutions to Keep FTTH Rollout & Deployment Costs Low:

- Use public infrastructure e.g. ducts, poles and co-location space
- Negotiate Rights of Way
- Opt for aerial rollout & deployment wherever possible
- Start with FTTB if demand is not there yet or investment is too high or risky
- Aim for minimal deployment disruption in order to gain acceptance and continue to grow
- Keep future upgrades in mind e.g.to the newer technology e.g. NG-PON2 or XGS-PON, to higher bandwidth capacity requirements as well as if evolving from FTTB to FTTH

New Solutions e.g. Fiber As a Service (FaaS) → Suitable for Greenfield Networks

<table>
<thead>
<tr>
<th>CloudCo</th>
<th>Virtualized Services</th>
<th>NFV, IaaS, SaaS, NETFLIX, IFLIX, KLIX</th>
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</thead>
<tbody>
<tr>
<td>OpCo Layer 2+3</td>
<td>Active Equipment</td>
<td>Deploying active network elements &amp; providing wholesale broadband service to RSP</td>
</tr>
<tr>
<td>NetCo Layer 0+1</td>
<td>Ducts &amp; Cables</td>
<td>Designing, building &amp; operating the passive infrastructure</td>
</tr>
</tbody>
</table>

Source: “Fiber as a Service Whitepaper”, FTTH Council Asia Pacific, April 2016
Keeping Tabs on Cost to Supply
Affordable FTTH infrastructure rollout & deployment through low CAPEX & OPEX solutions

### Case Study - NTT West

<table>
<thead>
<tr>
<th>Outcome</th>
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<tr>
<td>Cost per line and average installation lead time have successfully been reduced by 80% and 40% respectively in the last 10 years</td>
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<table>
<thead>
<tr>
<th>How They Achieved It</th>
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<tbody>
<tr>
<td>Costs reduction is achieved through use of an integrated wiring method, effective design based on demand forecast and self-installation of drop cable by the customer from facility DB to the customer’s premises followed by remote activation by NTT West, among other things</td>
</tr>
<tr>
<td>Installation lead time is reduced through quick decision making on activation date using the “Sokketsu” System that is based on maintaining pole information in a DB and automating facility assignment based on simplified planning, among other things</td>
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### Case Study - MyRepublic

<table>
<thead>
<tr>
<th>Outcome</th>
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<tr>
<td>Market disruption possible through use of a lean telco model that has resulted in seven-fold increase in operational efficiency and increased customer satisfaction</td>
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<tr>
<th>How They Achieved It</th>
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<tr>
<td>Operational efficiency is achieved through use of cost efficient, agile software technology that leverages on zero-touch orchestration in their operations &amp; management (ZOOM) as well as business &amp; operational support system (BSS/OSS) platform</td>
</tr>
<tr>
<td>Increased customer satisfaction is achieved through increase speed of delivery and high process reliability as a result of a four-step customer-centric framework which includes a seamless, omni-channel customer purchase experience and a fully automated order-to-cash process.</td>
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</table>
FTTH in APAC: Rollout & Deployment Strategies

1. Integrating FTTH into Industry
2. Company Profiles – HKT-PCCW & MyRepublic
3. Country Profile – Myanmar
Integrating FTTH into Industry

Fiber can offer future proof connectivity solutions to a host of Industry use cases.

*FTTH Applications → Multiple Industry Use Cases*

- Home Automation
- M2M (e.g. Automobiles, Health & Utilities)
- IoT (e.g. Industrial)
- Big Data

- Enabler for SME to leverage on Cloud Services e.g. Google @Work, DC & cloud storage and Salesforce.com
- TCO reduction e.g. with MySDN Cloud VPN

*FTTH Unique Selling Point → Future Proof Connectivity*

1. No bandwidth limitation
2. 1x passive infrastructure rollout & future terminal equipment upgrade deployments

- National Broadband Networks (NBN)
- Smart City Initiatives
- Digital Economy Strategies e.g. e-Government, e-Education & e-Health

- Mobile Backhaul & Access Network (3G, LTE, 5G)
- Wimax Backhaul & Access Network
- xDSL Replacement
- Triple or Quad Play

- HD TV Content
- Ultra HD 4k & 8K TV Content
Integrating FTTH into Industry
Fiber can offer future proof connectivity solutions to a host of Industry use cases

• Sample Industry Implementation

Solution to overcome G-PON Bandwidth Limitation

When introducing Ultimate 4KTV (100 Mbps) or 8KTV (200 Mbps), the present G-PON network can no longer support both 1G Internet service and the video service.

Solution: Use 10G GPON to serve Ultimate 4KTV or 8KTV Customers
Approach: Ride on same ODN to support both G-PON and 10G G-PON

• Share the same fiber infrastructure for G-PON & 10G G-PON
• Simple installation by changing the ONU & STB at customer premises
• Incremental cost for 10G G-PON Upgrade

Source: HKT-PCCW, June 2016
Company Profile – HKT-PCCW

Invested in FTTH as response to shift in Industry dynamics from market share gain to value creation and ARPU growth

• What they have achieved
  o HKT-PCCW has recently launched Hong Kong's first 10G broadband service to support 8k TV and has made FTTH available to more than 84% of households in Hong Kong
  o Fiber is positioned as a faster and more reliable service with customers migrating from ADSL typically being over 50%, by using the above business model

• How they achieved it
  o Sales Strategy - Provide total solution to stimulate demand, then develop marketing offerings and special offers to further stimulate demand through call center or direct sales

Stimulate Demand: Utilize existing data base of customers to target those customers and stimulate demand in the building or estates e.g. call center calling, offers & flyers
Collect Potential: Gauge interest in building by making use of sales force to contact customers and collect preregistration forms, including understanding in more detail households and demographics
Influence Owners, especially Owner Committees: Gather the pre-registration forms to demonstrate interest in service to obtain permission (if required), and to also obtain their support to actively market
Provide an Attractive KPI: FTTH-ready means FTTH service can be available within 4 days of receiving a service order

• Going Forward
  o HKT-PCCW plans to focus more on premier areas & remaining low-rise buildings agreed with financial justifications & manage ADSL pull out plan
Company Profile – MyRepublic
A market disruptor bringing high speed internet to the masses

• What they have achieved
  o MyRepublic managed to leverage the potential of Fiber to the maximum by having 100 Mbps and 1 Gbps internet access customer offers out there at reasonable mass market prices
  o It was the first to launch 1 Gbps at SGD 49.99 /month in Singapore and 100 Mbps at IDR 299,000 (approx SGD 30) in Indonesia and have seen tremendous positive response from both markets

• How they achieved it
  o In Singapore, MyRepublic leveraged on scale and density as well as lean telco model that has resulted in seven-fold increase in operational efficiency and increased customer satisfaction. Its spend on IT was a mere SGD 100,000 - 1mil as opposed to an estimated SGD 100 mil by a local incumbent telco
  o In Indonesia, as part of nationwide rollout, they strived to work with other market participants to accelerate coverage rollout & deployment and avoid too much replication via network element sharing, especially of the passive components
  o To make a success of FTTH, MyRepublic believes in knowing where to rollout, understanding costs as well as operating and servicing the QoS. It has also optimised their network for video streaming and gaming essentially following and driving usage changes in the market

• Going Forward
  o My Republic is driving the Indonesian model in the markets where they operate and are in active discussions to extend the business model beyond Indonesia
Country Profile – Myanmar
Huge opportunity to transform Myanmar using FTTH & some innovation

• Background
  o For Myanmar, there seems consensus that FTTH is the way forward. It is an exception from other countries in the sense that it has ready, pent up FTTH demand and it is only a matter of “when” rather than “why” or “how much”
  o The reason is because other basic needs have not yet been met. Electricity outages are still common day experiences and with it comes FTTH outages since the electronics require electricity
  o In Myanmar, current internet connections suffer from insufficient budget to expand and/or upgrade. The internet connection is still “not good enough” with speeds on average only up to 4 Mbps and daily outages on State-owned Myanmar Posts and Telecommunications (MPT)
  o Despite low average speeds, MPT charges businesses USD1,265/month for 20 Mbps Fiber broadband and YTP, another ISP, charges approximately USD63/month for a 1 Mbps DSL line

• Measures undertaken to improve the situation included:
  o The government introduced a new ISP i.e. Myanmar Information Highway Limited (MIH) so that the internet traffic can be offloaded from MPT and subscribers there can be served with SLA. However, the government will not be mandating the SLA as part of ISP’s license obligation

• Outcome Expected
  o MIH will initially rollout in Yangon before expanding to other major economic cities
  o With MIH facilitating connectivity at speeds of up to 20 Mbps, Myanmar will be on par with other developing countries and even some advanced countries when it comes to internet speeds
  o Competitive pricing and innovative business strategies/models will be needed to increase take up & monetize FTTH in a country where GDP per capita is still only USD 1,244 (in 2014) and 25.6% of the population still live below the national poverty line
FTTH in APAC: Wrap Up
Key Takeaways

1. In justifying a Business Case for FTTH,
   1. Seek out countries where there is a clear regulatory approach to FTTH
   2. Ensure economic viability by securing sufficient ROI upfront
   3. Keep tabs on costs to achieve an affordable FTTH infrastructure rollout & deployment

2. In rolling out & deploying a FTTH network,
   1. Understand that there is tremendous opportunity for FTTH, just look at Myanmar. What’s needed is a carefully planned out strategy
   2. Industry dynamics keeping changing. Either you respond to it or you change it yourself. PCCW responded with FTTH, MyRepublic used FTTH to change it
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