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Introduction

Around the world, telecom service providers are introducing 1 gigabit broadband access service offerings – and a small, but increasing, number of residential subscribers are signing up for this service. Why would service providers offer such high capacity connections to residences? And why would residential subscribers purchase broadband access at speeds of 1,000 megabits per second?

This whitepaper discusses the results of research conducted jointly by Joe Savage of Telecom ThinkTank and Michael Render of RVA Market Research from November, 2011 to February, 2012.

We gathered information on gigabit service offerings from Telecom service providers around the world, surveyed gigabit subscribers to determine their motivation and utilization of the ultra-high speed broadband access, and reviewed relevant documentation on ultra-high-speed broadband access.

Some analysts have the opinion that gigabit service is overkill and that today's computers cannot even operate at that speed. The counter-argument we've heard from gigabit subscribers is that multiple devices and multiple simultaneous applications serve to make efficient use of their 1,000 megabits per second pipe.

Gigabit Service Offerings
Gigabit Ethernet Connections have become the standard for Enterprise broadband connectivity. Gig-E circuits provide the bandwidth needed for server farm connection, mandated data backup and recovery, and the myriad of file transfers, application connectivity and machine-to-machine communication needed by the 21st century information-intensive company.

Gig-E circuits are now also used as the “backhaul connection” for most Fiber-to-the-Building networks. Many large apartment buildings and other multi-dwelling units have local area networks within the building and share the Gig-E connection from the building to the ISP. This FTTB arrangement which uses gigabit service and is shared among multiple users to connect apartment renters to their broadband providers is not the focus of this paper.

Individual subscribers connected at gigabit speeds constitute a relatively new phenomenon. First introduced by Hong Kong Broadband in 2010, the number of service providers offering residential gigabit services is growing, with more than two dozen companies identified in
2011/2012. Chart 1 below provides a representative sample of gigabit service providers. (Listings in red are planned but not yet in service.) It is interesting to note that offers of residential gigabit service are present in every region of the world.

Among these residential gigabit service providers, most are small-footprint operators serving densely populated areas (i.e. Hypersonic, Paxio). A few are rural Telco’s who are using their fiber infrastructure to attract new business and to bring their rural populations into the information age (i.e. Jersey Telecom, Sonic.net).

Chart 2 shows the operators who offer residential gigabit service and pass more than 100,000 homes.
The global list consists of 14 operators, most of whom have offered gigabit service for less than one year. So, gigabit coverage is small but growing. Our March, 2012 estimate is that global residential gigabit subscribers number in the hundreds. In 2012, it is anticipated that South Korea, Singapore and Google (Kansas City, USA) will deploy large FTTH networks and offer gigabit services.

Almost all FTTH operators could offer residential gigabit service, but they are weighing a number of concerns:

- Cannibalization of Enterprise Gig-E business
- Current level of local competition
- Associated craft training and customer service issues

We anticipate that in addition to those providers mentioned above, other service providers will join the residential gigabit club in 2012. In fact there is already evidence of this trend. The 2012 RVA survey of North American providers, currently in progress, indicates another 20 or more small providers are currently rolling out gigabit residential service options. Many of these are municipal or competitive systems, but some are Tier 3 ILECs.

**Pricing for Global Gigabit Service**

Table 1 below provides examples of pricing and other information on residential gigabit service offerings. Prices for residential gigabit service range from a low of US$26 per month for Hong Kong Broadband’s service to a high of $560 per month at network operator Turkcell. Prices roughly correlate to the CapEx required to pass a subscriber in the serving area: $200 per home passed in Hong Kong versus $1,000 to $4,000 per home passed in Europe and North America.
These early gigabit prices do not seem to correlate to competitor’s service offerings: Comcast Xfinity Extreme 105 Mbps service in California is $199 per month while Sonic.net is $70 per month; Verizon’s top tier is 150 megabits at $195 per month; and AT&T’s tops out at only 25 megabits. And, while Comcast and others have monthly data caps, most of the offerings from current gigabit service providers do not cap subscriber usage. (What’s the use of having gigabit speeds if you have to watch your use?)

One interesting outlier is Sonic.net of Sebastopol, California, USA. This community broadband ISP set a new low per Mbps of bandwidth in the US, at $70 per month for gigabit service, but it also includes two phone lines and in-country long distance. (Sonic.net is operating Google’s gigabit trial service to faculty members at Stanford University and is negotiating with the City of San Francisco to operate their proposed city-wide FTTH network.)

Most of the 2012 gigabit service offerings are symmetrical – 1 Gig down and 1 Gig up. The uplink speed and the price per megabit make current gigabit offerings highly competitive to traditional network operator service offerings. Large competitors limit the uplink to 150/35. Therefore, service providers to whom we’ve spoken have indicated they no issue attracting gigabit subscribers who want the best possible service.

**Gigabit Services Network Issues**

Gigabit network operators have a variety of network issues in order to overcome to successfully offer residential gigabit service. Access links to subscribers are either gigabit Ethernet ports off the service provider’s router, or gigabit Ethernet ports off the service provider’s GPON ONT.
The next tier in the service provider’s network is in their metro area. Metro area networks are engineered to overall capacity utilization, and Gig subscribers get no special preference in the main network. This will require some traffic engineer’s attention as the number of gigabit subscribers increases.

However, among gigabit service providers, network-to-network connections, or backhaul to their Internet Exchange Point, vary considerably. Rural operators, who have to rent backhaul capacity, sometimes find themselves priced out of the market to offer gigabit service. Some operators have access to next-gen Internet networks like Lambda-rail or Internet2, and are able to handle additional traffic from gigabit subscribers. Others are in regions where connection prices are regulated or mandated to support offering higher access speeds.

**Network Issues Affecting Operators Offering Residential Gigabit Service**

In addition to the cost issue of network-network connections and backhaul, gigabit service providers must train craft in new testing and measurement equipment, and provide Customer Service/Technical Support with the tools to help subscribers to get a gigabit all the way to their devices.

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**Gigabit Services – Network Issues**

- Access Link – 1 Gbps
- Metro Network – 10G Typical (Traffic monitored independent of Gig Subscribers)
- Network to Network Interconnection – Varies significantly (Traffic monitored independent of Gig Subscribers)

**Issues Affecting Gigabit Performance – Operators**
- Backhaul costs
- Testing limitations
- Network-network connections

**Issues Affecting Gigabit Performance - Subscribers**
- Web Site Capacity Rationing
- Testing limitations
- Home Networking issues

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**Network Issues Affecting Gigabit Subscribers**

Subscribers who sign on for gigabit Service find that they must upgrade their home network and they have computer issues with the superfast speed. Most speed-testing web sites cannot measure gigabit speeds, so subscribers are at the mercy of their providers. (At present, most providers are measuring access speeds within their networks and are making sure to provide...
the full Gig-E capability to their customers.) Home networking and computers are bottlenecks that require upgrading for the home to operate at gigabit speeds: computers require parameters to be reset and fine-tuned; only the latest in-home routers and Wi-Fi systems can support a gigabit of throughput; and many websites will limit the bandwidth of the connection and not provide gigabit access.

**Gigabit Operator and Subscriber Motivations**

Table 3 below highlights the reasons given by service providers for offering gigabit services and the reasons given by gigabit subscribers for purchasing gigabit services.

<table>
<thead>
<tr>
<th>Service Providers</th>
<th>Subscribers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leverage FTTH Network</td>
<td>• Work-at-Home Productivity</td>
</tr>
<tr>
<td>• Competitors can’t match speed</td>
<td>• Cloud Connectivity</td>
</tr>
<tr>
<td>• Service Differentiation</td>
<td>• Multi-player Games (Latency)</td>
</tr>
<tr>
<td>• Target Distributed Business Customers</td>
<td>• MDU Resale (resale of Internet Access to residents through internal routed network)</td>
</tr>
<tr>
<td>• Revenue</td>
<td></td>
</tr>
<tr>
<td>• Application Development</td>
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</tbody>
</table>

Network operators who have invested in fiber access networks have performance advantages over their broadband competitors. And most have priced gigabit service to deliver a positive return for the service. With much weasel-wording, non-FTTH competition could claim to offer 100 megabits per second. By offering residential gigabit service, FTTH operators could not be matched by competitor’s marketing claims. Gigabits provide a clear service differentiation -- extremely low latency and speedy file transfers provide efficiency improvements for work-at-home professionals.

Some operators have identified distributed enterprises as a target for residential gigabit service. Companies such as call centers and customer service agencies require superfast, reliable connections for their work-from-home staff.
One operator, Chattanooga Electric Power Board, has opened an application-incubation facility to develop future services that will utilize the horsepower of residential gigabit access. EPB’s Gig Tank, “A program that is part accelerator, part think tank, where the best gigabit ideas and businesses will not only have access to Chattanooga’s network for development and testing…”

**Gigabit Service Provider Marketing**
Marketing of gigabit services to residential subscribers emphasizes three points of value. As illustrated in the examples in Figure 1 below:

1. Fastest Speed appeals to the technophile and the home user requiring ultra-low latency, such as the “super-gamer”
2. Bundle Value appeals to the user who integrates his home network and requires a large pipe to support multiple devices and services
3. Home Productivity appeals to the Work-from-Home professional who benefits from low latency and rapid file transfers.

**Gigabit Subscriber Characteristics**
Residential gigabit subscribers can be described as the “earliest of the early adopters”. Figure 2 below lists the gigabit subscriber attributes which surfaced from interviews with a few early North American gigabit subscribers.

*Gigabit subscribers report that they are online an average of 8 hours per day. Compare this with the US Internet user average of 2.5 hours per day.*

In addition to the gigabit access link, most high-speed users have relatively complex home networks with five or more network devices. (Note: in 2010, 12% of Internet users had more
than 10 fixed- and mobile-connected devices.) They tend to be technology aware and are adopters of other new things, such as LTE Smartphones, the latest tablets, Internet-connected televisions and the latest gaming consoles.

**Gigabit Subscriber Attributes**

- **Gigabit Subscribers** –
  - Technology Savvy
  - Early Adopters of other “new things”
  - Heavy Internet Users
    - multiple uses – social networking, entertainment, gaming and work-from-home
  - Content Creators – HKBN cites 3 times upload traffic to download

These gigabit subscribers have multiple applications in play at all times. They are near-continuous users of social networking (Twitter, Linked-In, Facebook, etc.). They view HD video downloads and streaming media via Hulu and other sources. They participate in a number of Multi-player games and own the latest game consoles. And, for many, the distinction between home and office has faded with network performance and efficiency better at home than at work.

Gigabit subscribers tend to be content creators as much or more than content consumers. Hong Kong Broadband provides an extreme example. The Telecommunications Authority of Hong Kong reported that “65% of internet users consider upload as important or very important”. And, HKBN network traffic measurements show that upload traffic is three times more than download traffic for their high speed subscribers. As examples, upload speed is key for: distributing HD photos and videos; sending large files to work, efficiently communicating with “The Cloud”, and virtual presence video conferencing,

*Given the amount of time spent online and the breadth of applications and interests, the Killer Application for gigabit subscribers is “Living on Line”.*

Based on interviews with early gigabit subscribers, they are highly interested in futuristic applications such as:

- Virtual presence for education, business, healthcare, and family connection
• Full motion HD, 3D websites
• Very large, extremely high definition display screens
• Remote control of “avatar-like” robots

Direct quotes from some of the gigabit subscribers highlight the desires of some to be on the leading edge of technology:

“When I was a child, Popular Science magazine ran an article about fiber optics. For forty years I waited. Forty years is long enough.”

“Early adopters, like us, allow new technologies to become mainstream.”

Gigabit Subscriber Project - Conclusions
The number of connected devices per subscriber is growing. The size of files and bandwidth per application is growing. The average time on line for Internet users continues to grow. With increased dependence on Cloud Computing, interaction through the residential broadband pipe is growing. Each time a subscriber upgrades the speed of their broadband access link; rarely do they see their old link’s performance as any longer satisfactory. Gigabit residential service will be a common service offering by 2015, and new applications anticipating the availability of higher bandwidth will be emerging. This is good news for both FTTH service providers and their customers.

In 2012, residential gigabit subscribers are the leading edge of the leading edge of technophiles and Net-citizens. They praise the rapid-fire, low latency of their circuit and enjoy the seemingly instantaneous operation. Issues concerning testing and home networking are being resolved today. Their pioneering experience will pave the way for a smoother transition to a gigabit world and will accelerate the availability of applications and services which will depend on that service.

Joe Savage – Telecom ThinkTank, Inc. with Research Assistance from Michael Render – RVA Market Research LLC

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