

Global FTTH Risks and Rewards

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Agenda

- Global FTTH statistics
- FTTH Market Models
- Technology choices and evolution
- Specific country and regional FTTH activity
 - Europe
 - Asia/Asia Pacific/Australia
 - Latin America
 - North America
- Trends and Barriers to FTTH
 - Business case
 - IPTV
 - Politics
- Summary

Global broadband statistics

Approximately 180 million subscribers thru Q2 2005

North America

45.3 M subscribers

Cable modem leads but DSL matching new adds

350 k FTTH subs

Europe

44.4 M subscribers

Strong DSL growth due to unbundling; municipal FTTH base

600 k FTTH subs

Asia*/Australia

72 M subscribers

Significant DSL growth coupled with deep fiber penetration; FTTB+LAN

3,600 k FTTH subs

* Excludes Russia and Middle East

CALA

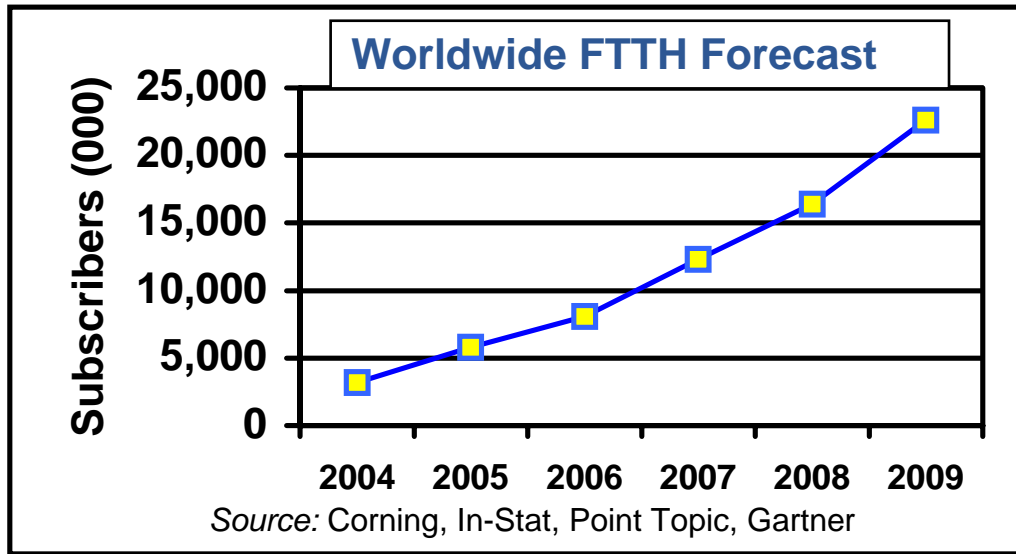
5.1 M subscribers

DSL is primary technology

FTTH trials emerging

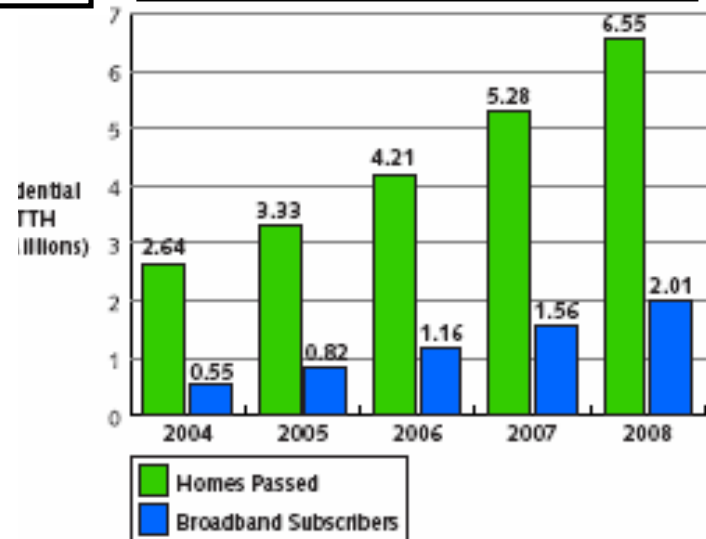
Worldwide FTTH Forecast

Global subscribers and regional homes passed



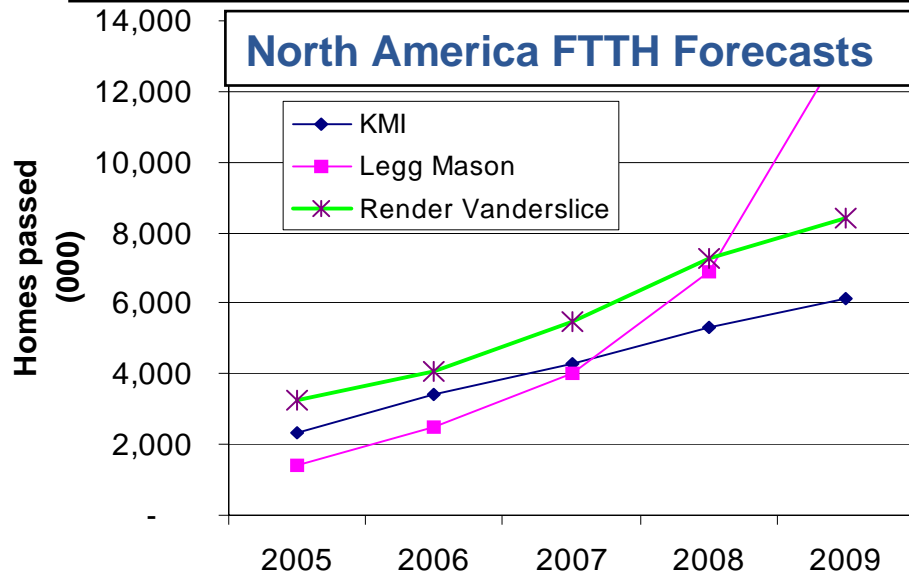
- Still in the early stages of growth
- Only handful of major telecom carriers have adopted FTTH
- Asia will continue to lead in the near term
- Greenfield deployments defaulting to FTTH

European FTTH Forecast



Source: Yankee Group Dec 2004

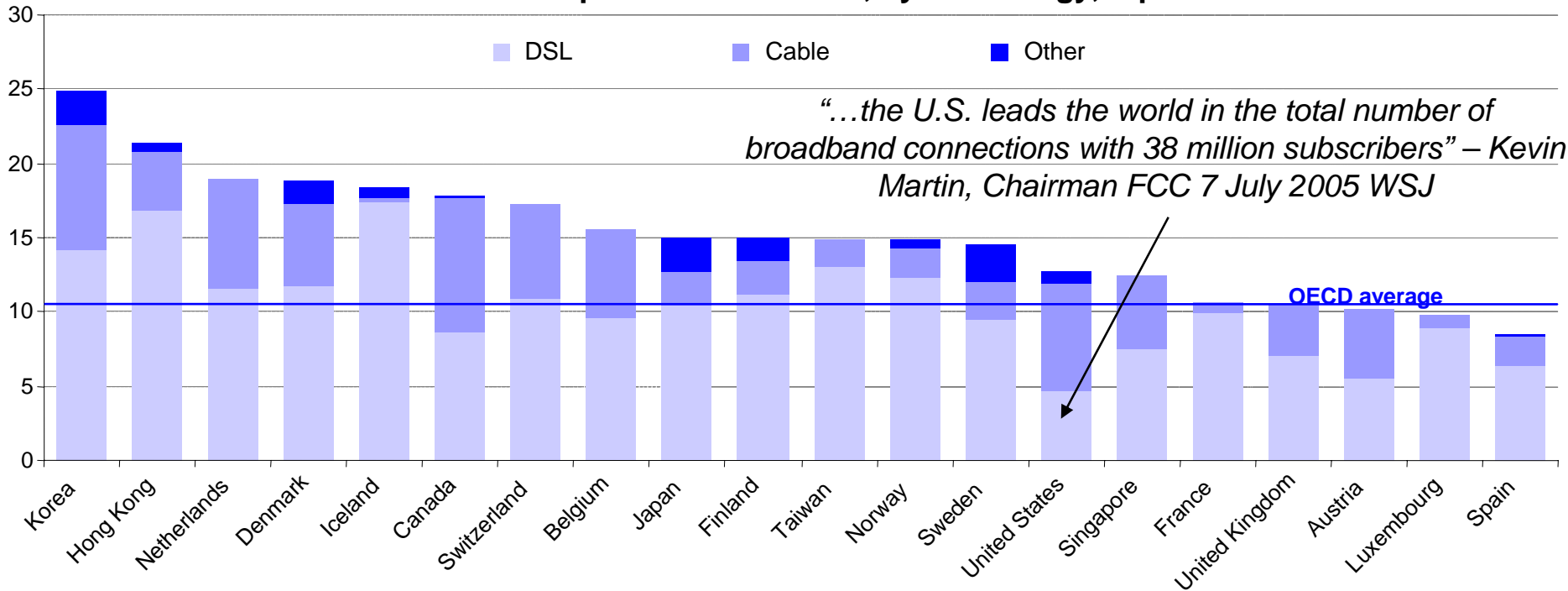
North America FTTH Forecasts



Broadband Subscribers

The importance of a national broadband policy

Broadband subscribers per 100 inhabitants, by technology, top 20 countries



Countries that have developed, articulated and deployed broadband development programs have seized an earlier lead in broadband penetration foster domestic education, quality of life, productivity and new industries

Source: OECD
DEC 2004,
Corning Analysis

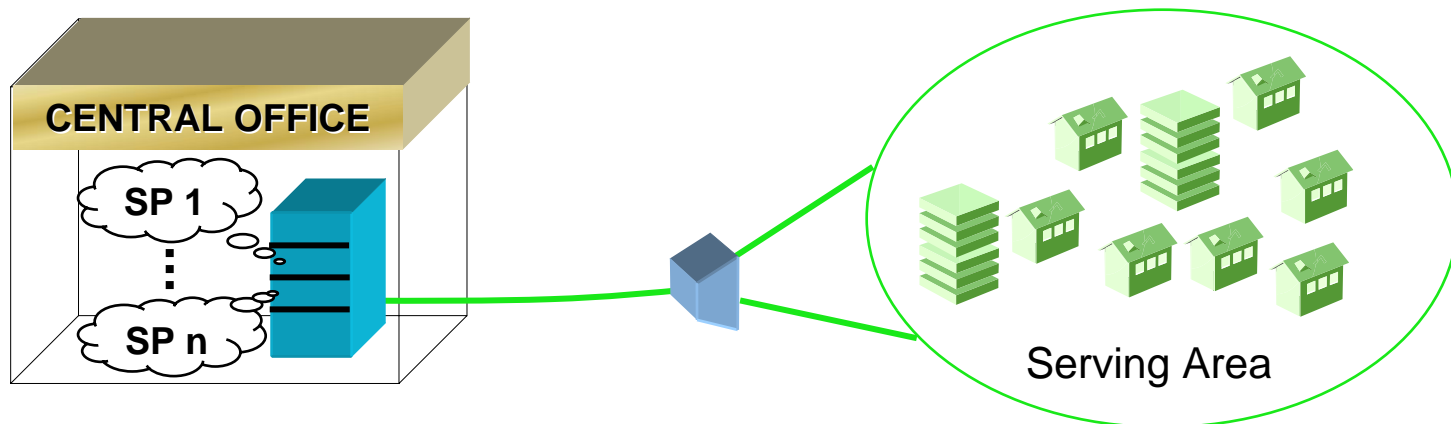
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Market Models for FTTH

Open access

- **Open access networks provide wholesale access on equal terms for Service Providers (SPs)—telcos, ISPs, video providers etc...**
 - **Most infrastructure builds are result of municipal action**
 - **Economic development and consumer choice**
 - **Owner of physical infrastructure does not compete against SPs**
 - **Network infrastructure considered a utility similar to power, water, roads**
 - **Different depreciation cycles and financial models for passive and active infrastructure**
 - **Fiber infrastructure allows advanced services as well as bandwidth for future services and applications**



Open Access Networks

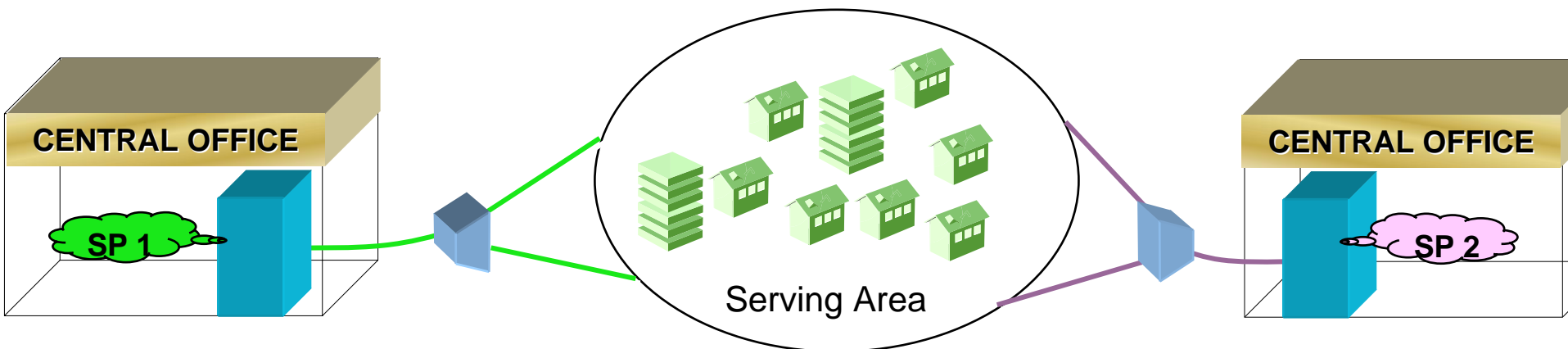
Examples

- The Swedish Urban Network Association (SSNf)
 - Non-profit group of 300 municipalities, telecom operators, energy companies and others whose mission is to:
 - Give cities an open infrastructure for everyone
 - Stimulate the market by offering new operator capacity at below self cost
 - Reduce digging in the streets
 - Create and own a network for the city
- Numerous open access municipal builds in Western Europe and Scandinavia
 - Stokab- Stockholm, first of it's kind, profitable since 1996
 - Västerbotten a rural area in Northern Sweden, twice the size of Holland (pop-260,000)
 - 15 Municipalities working together on a fiber optical network
 - There are 289 municipalities in Sweden over 200 have their own network
 - CityNet, Amsterdam – 450,000 homes to be complete by 2010
 - Municipalities throughout Denmark
- New laws allowing or requiring open infrastructure
 - France and England generating discussion throughout Europe
- Municipalities in the US
 - Utopia- 11 communities in Utah

Market Models for FTTH

Competitive infrastructure

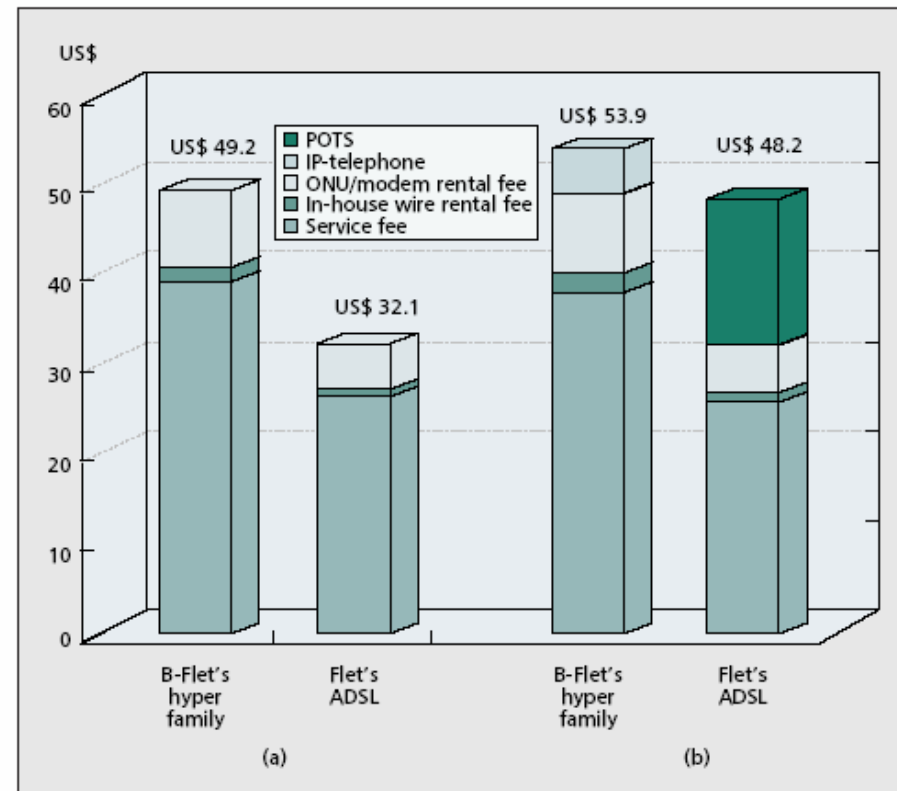
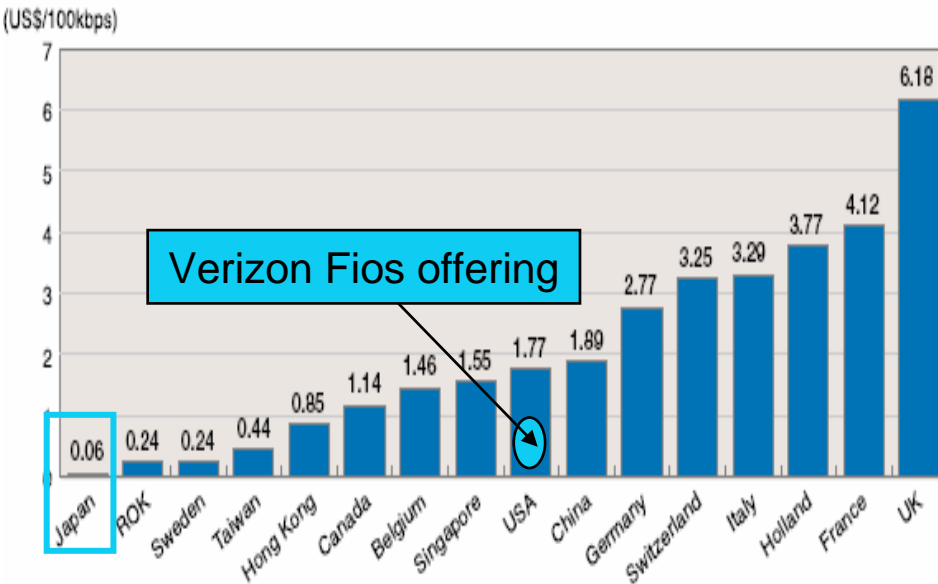
- **Competitive markets- Carriers fight for subscribers using own infrastructure**
 - Two most obvious examples are US and Japan
 - US telcos and MSOs in fierce battle for customers
 - Nine Japanese carriers building FTTH with some redundant infrastructure
 - **Fiber offers competitive advantage**
 - Converged services, lower churn, higher ARPU, higher data rates, lower operating costs, marketing cache
 - **Examples of duplicate FTTH networks are evident outside Japan**
 - Amersfoort, Vathorst new development near Amsterdam will have redundant FTTH by the developer and by CATV operator Casema



Market Models for FTTH

Competitive infrastructure examples

- Japanese competition first led to lower prices (lowest per bit cost)
- Data speed is now primary competitive attribute
- Service based competition on the horizon
- NTT current service offering and switch to IP based voice
- Soon to offer broadcast video



Source: Ministry of Public Management-Information and Communications in Japan

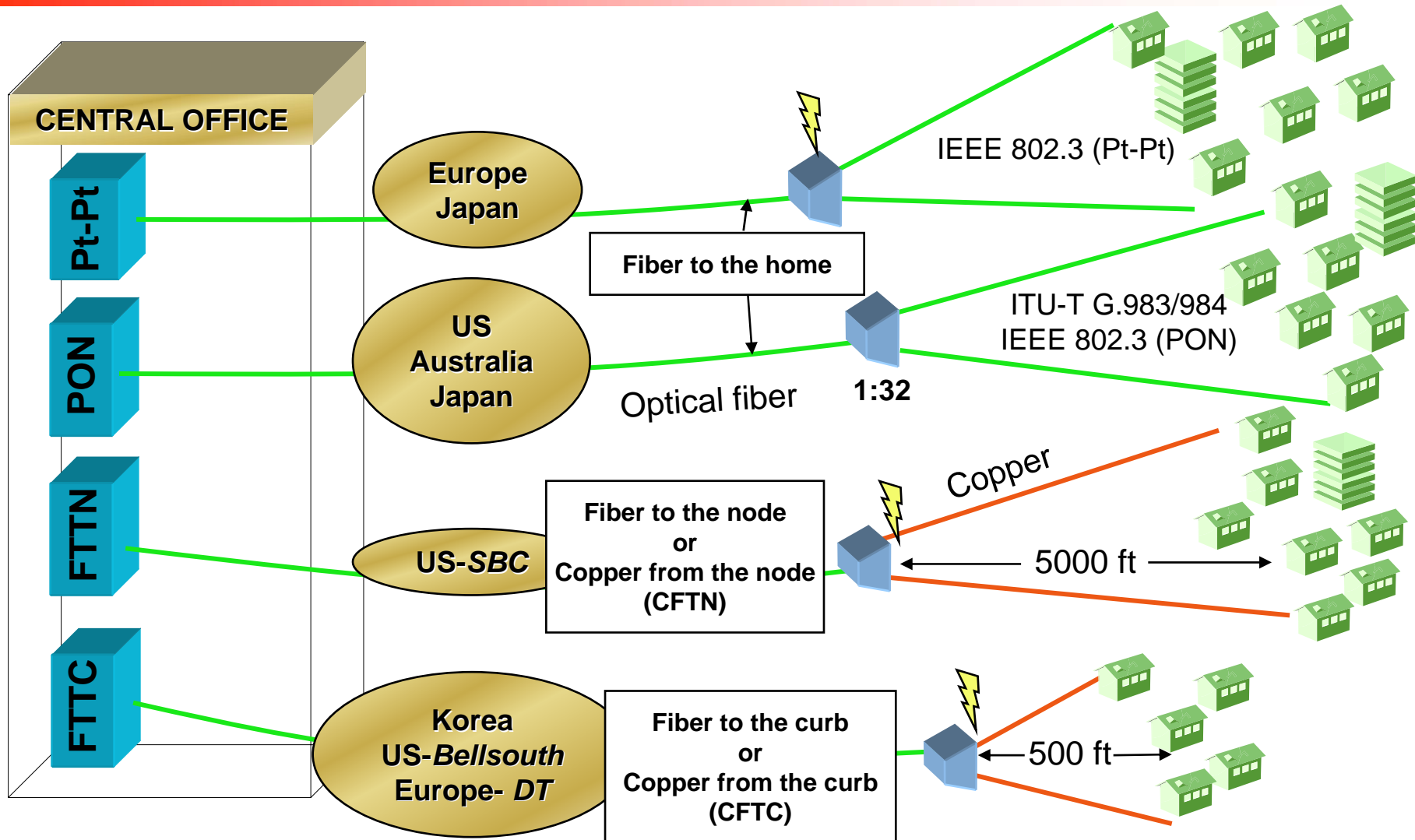
Source: NTT

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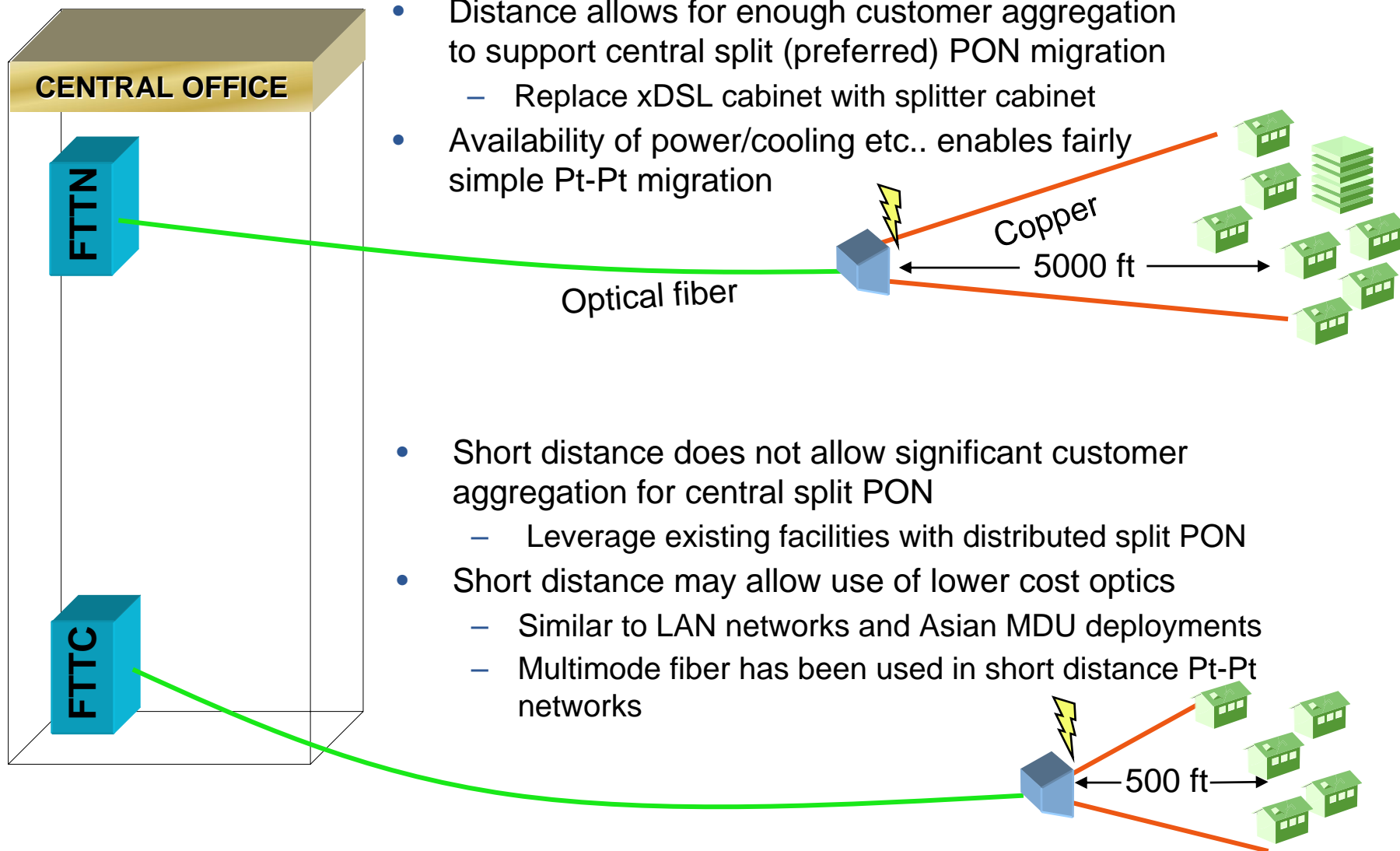
Broadband architectures

Eventual migration to FTTH



Broadband architectures

Eventual migration to FTTH



- Distance allows for enough customer aggregation to support central split (preferred) PON migration
 - Replace xDSL cabinet with splitter cabinet
- Availability of power/cooling etc.. enables fairly simple Pt-Pt migration

- Short distance does not allow significant customer aggregation for central split PON
 - Leverage existing facilities with distributed split PON
- Short distance may allow use of lower cost optics
 - Similar to LAN networks and Asian MDU deployments
 - Multimode fiber has been used in short distance Pt-Pt networks

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Europe

Overall climate



- European Commission provided a vision for the next five years called “i2010: European Information Society 2010”
 - Foster economic and job growth
 - Modernizing European policy to develop the digital economy
 - Promote secure high-speed broadband offering rich and diverse content
- Numerous examples of national broadband policies
- Why FTTH is not adopted by incumbent carriers?
 - PTTs have little competitive pressure
 - Short loop lengths enable relatively high data rates for xDSL
 - In Scandinavia incumbents lease fiber access from municipalities at lower cost than to build themselves
 - Video is not as important/prevalent as in the US
- Why is FTTH happening at the municipal level?
 - Local governments sponsoring broadband programs
 - Regions are using broadband as an economic development tool
 - Carriers are more open to shared network facilities

Europe

Scandinavia and other open access FTTH (Pt-Pt)

- Sweden, Norway, Denmark and the Netherlands make up ~90% of European FTTH deployments
 - Primarily open access municipal networks
- Finland FTTH
 - Network Co-operative Kuuskaista consists of 6 municipalities: Kuortane, Alavus, Töysä, Ähtäri, Lehtimäki, Soini about 10,000 homes and 2,000 businesses
- Netherlands
 - Numerous municipal projects- Amsterdam (CityNet), Rotterdam
 - 40,000 households to be built in the Zeeburg district (Amsterdam)
 - Kenniswijk Project-an initiative of the Dutch General Directorate of Telecommunication and Post (DGTP)
 - Individual households join a cooperative society - "Ons Net" (Our Network) - which pays for and owns the network
 - Nuenen- largest live FTTH project to date 7,500 homes, > 90% take rate!
 - Ons Net has led to the development of innovative local broadband services, from video consultations by doctors to church services and sports broadcasts
 - The project in total has approximately 16,000 FTTH subscribers

Hear more about the Kenniswijk project later this afternoon in Session 3B

Europe

Western Europe

- **Spain-** Huge broadband project (\$500 M)
 - Planned by the Government of Catalonia and Localret, a consortium of 782 municipalities
 - Build will start in 2006 and complete in four years
 - Sell wholesale services only- expect incumbents and other large European telcos as network users
- **France-** Excellent progress in broadband deployment, improving relative penetration
 - New article of French law gives public entities the following rights :
 1. build, subsidize and develop “passive” telecom infrastructure and provide/transfer them to carriers or independent local users.
 2. build open networks on a given territory and provide/transfer them to a territorial carrier.
 3. operate open telecommunications networks in respect of regulations.
 4. provide telecommunications services to end users
 - French startup citeFibre to offer high speed internet access at speeds of up to 100 mbps (symmetrical) using fiber through the sewers of Paris.
 - FT issued GPON RFI in June

Europe

Western Europe PON deployments

- **UK**

- British Telecom to set up separate “Access Services” division announcing “openreach” to operate and maintain the “first mile” infrastructure
 - Ofcom accepts commitments made by British Telecom to consolidate all access assets including all civil infrastructure assets, fiber, copper cables as well as local exchanges into a new division
 - The new division will have a different brand name and will be headquartered separately from the rest of the BT group and provide equal open access
 - The regulator will hold off from ordering the divestiture of BT’s access assets despite their belief these assets present features of a natural monopoly.
- BT’s 21st Century Network plans continue with FTTH trials underway
 - Expect both Fibre to the Cabinet (Street MSAN) and FTTH PON (ECI) to be deployed concurrently

- **Estonia**

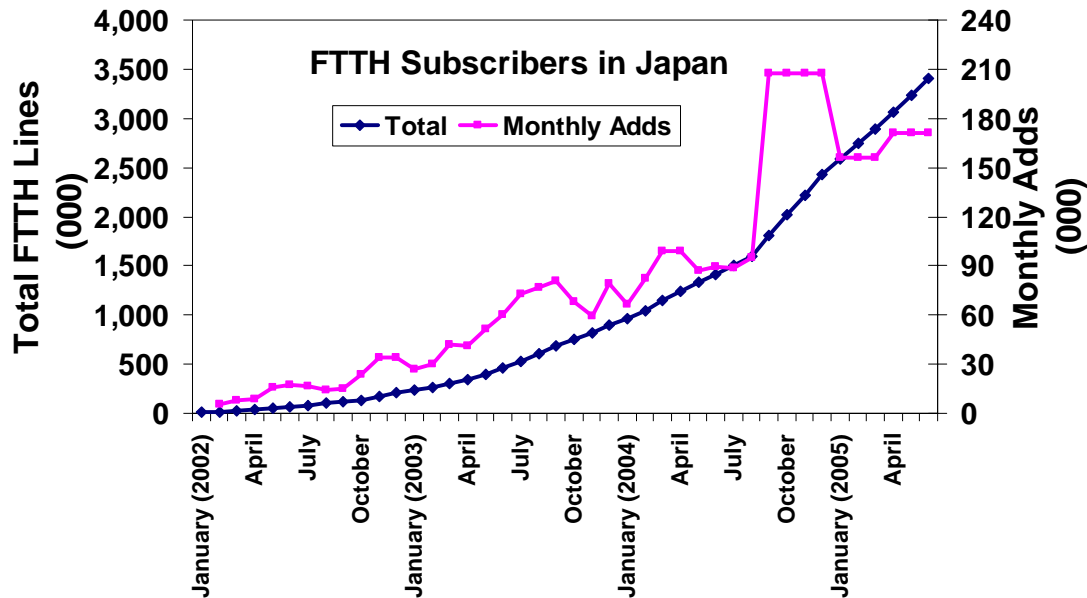
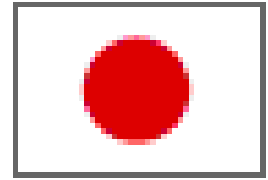
- Elion Enterprises Ltd., the incumbent in Estonia providing triple play FTTH over PON commits to additional deployments following a successful FTTU trial

- **Austria**

- Telecom Austria deploying FTTH in Arnoldstein and will deliver triple-play services over fiber to 1500 homes

FTTH Asia

Japan worldwide FTTH leader



- u-Japan –extension of e-Japan
- NTT FTTH Leader
 - Investing ¥5T (\$47B) through 2010 to upgrade 30 M homes/businesses with fiber
 - New regulations allowing re-broadcast TV over FTTH
- KDDI/TEPCO merger competitive threat
- USEN (12% of FTTH market) growing via former ADSL subs

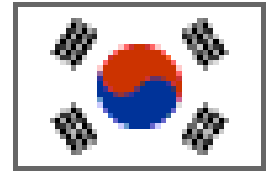
- Total FTTH subscribers (3.4 M) now exceed cable modem subscribers (3.1 M) -June 2005
- Q1 '05 new FTTH subscribers (~420k) exceed new ADSL subscribers (~350k) for the first time
- Q2 '05 new FTTH subscribers (~500k) exceed new ADSL subscribers (~400k)



Source: Ministry of Public Management--
Information and Communications in Japan
*Monthly estimate based on quarterly reports (2005)

FTTH Asia

Korea leader in broadband penetration



- Korea entering its 2nd broadband wave; ADSL and cable modem have hit saturation points; only country to have DSL subs falling
- Multiple ongoing programs to promote high speed broadband usage
 - Certification Program for Cyber Apartments
 - Gwangju FTTH Field Trial (>20k subs)
 - Broadband convergence Network (BcN)
 - Leader in Online Gaming
 - Promoting carrier competition
 - KT promoting innovative network ideas (WDM PON)
- Selling on speed and price
 - Powercomm rolling out optical LAN
 - “Xpeed” 100 Mb/s service
 - Priced lower than KT 4 Mb/s service
 - Goal 500K subs this year
 - KT has ~650K optical LAN subs
 - ~6 M broadband subs (50% market)
 - Hanaro has ~350K optical LAN subs

Cable to the Home	Fiber	Fiber+Cat5e	Cat5e	Cat3
Maximum Speed	1Gbps~	100Mbps~	10~100Mbps	10Mbps
Emblem				

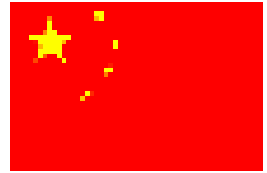
	Speed	Monthly Fees
KT optical LAN	100Mbps	33,660 won
Hanaro Telecom optical LAN	100Mbps	32,670 won
Powercomm optical LAN	100Mbps	30,800 won
KT Megapass Light (ADSL)	4Mbps	31,350 won
Hanaro Hanafos Light (ADSL)	4Mbps	31,020 won

The prices will be offered when subscribers agree with a three-year mandatory contract.
The prices include value-added taxes and the usage fees of modems.

Source: telecom companies

FTTH Asia

China- Largest Broadband Community in Asia



- 30.8 M BB subscribers (Q2 2005)
 - 100 M Internet subscribers
 - Added 5M broadband lines in Q2 2005 (largest growth worldwide)
 - ~4 million FTTB+LAN (optical LAN) subscribers
- Population and dominance of MDUs drive broadband economics
- FTTH still in trial stages ~15 trials underway
 - Mixture of large carriers, developers and municipalities
 - China Netcom (EPON), Shanghai Telecom (BPON), Beijing Netcom (BPON), TaiLong (Pt-Pt)
 - Barriers to FTTH adoption
 - Low disposable income of general population
 - Already low cost of service~ \$30/ month for triple play services
- Investment in broadband still very active
 - PCCW to pay \$39 MM (US) for 50% interest in China Netcom's broadband subsidiary, CNCBB will invest ~\$600MM (US) in mainland China
 - PCCW and partners will restructure the company to provide broadband TV services in China, modeled after PCCW- NOW TV services in Hong Kong
- Taiwan- will spend >\$300MM (US) on public ducts and lease to operators
 - 2.8 million FTTH users by 2008

Australia/Tasmania/New Zealand

FTTH projects



Broadcast Engineering Services- FTTH deployments in the new developments of Somerly, Brighton and Vale in the suburbs of Perth, Australia. Connections of up to 100 Mbps are promised.



Aurora Project- Sponsored by the Victorian government offers the opportunity to test out a model for FTTH rollout in new developments. Aurora is the first project that brings together State and local governments and a developer to try to test a model



TasCOLT, Tasmania is a government sponsored project designed to explore ways to accelerate the development of high capacity communication infrastructure in Tasmania. Trials will be located throughout Tasmania using EPON technology. First trial will be 1200 homes in Hobart



CityLink, New Zealand is privately owned infrastructure by seven NZ companies, with the active participation of the Wellington city authority. The network is open access designed to allow users, access to numerous service and application providers

Latin America

FTTH projects starting to emerge



FTTx study underway, contemplating Triple Play service for residential and corporate business, planned trial for 2006, preferred technology will be GPON.



FTTP project in the state of Santa Catarina/Brazil. Optical network being installed to interconnect 48 cities to offer broadband services. Project being financed by BNDES (Brazilian monetary and development fund)



FTTH study/trial underway, 130,000 homes in the major cities of Brazil (10,000 in 2005), EPON technology



CLEC in the southern region of Brazil recently granted the right to provide telecommunications services to a region FTTH PON trial underway.



Mexico - Municipality of San Pedro Garza, Monterrey, phase one 1,200 homes, phase two 30,000 homes, 100 Mb/s data, voice, CATV, VOD

North America

US FTTH carrier Segments

- Rural LECs, Municipalities and Developers were early leaders
- Competition, lower OPEX and new revenue generation driving RBOCs

RBOCs

- Facing MSO bundled service competition
- Regulatory certainty increasing
- Significantly improved financials
- Ample capital availability to fund programs
- Deploying FTTH in greenfields (SBC, VZ)
- VZ will pass cumulative 3 million homes

Rural LECs

- Deployment leader; only 8% of access lines
- Building for bundled services and revenue generation
- Financially sound; can afford long payback periods
- Rural Utilities Service (RUS) loans targeted for rural broadband deployment

Municipalities

- Local governments want BB for their citizens
- Face lack of BB options and need for economic development
- BB seen as a “utility” like roads, power, water
- Legislative/regulation support varies across nation

Home Developers

- Provides differential advantage to attract home buyers; ~1.5M homes built each year
- New construction removes barriers such as:
 - Network construction costs
 - ROW issues
 - Financing of the network

North America

Canadian Gov

“We foresee a Canada where the benefits of 21st century economy are being reaped from coast to coast to coast – on our farms, in our fishing, forest and mining industries and in our rural communities where modern communications are helping to surmount the barriers of distance.”

Speech from the Throne 2004

- Despite low population density Canada remains one of the global leaders in broadband penetration
 - Hundreds of local broadband initiatives
 - Government programs such as The Broadband for Rural and Northern Development Pilot Program (BRAND) was started in 2002 and has since funded 58 rural broadband projects for 884 communities with approximately \$105 M (Canadian)
 - Bell Canada moving forward with Greenfield FTTH and select rehabilitation sites
 - Higher bandwidth needs to provide triple play services
 - Need to lower operating costs
 - The plan calls for steady FTTH deployment through 2010 at which point they will start complete replacement of the copper

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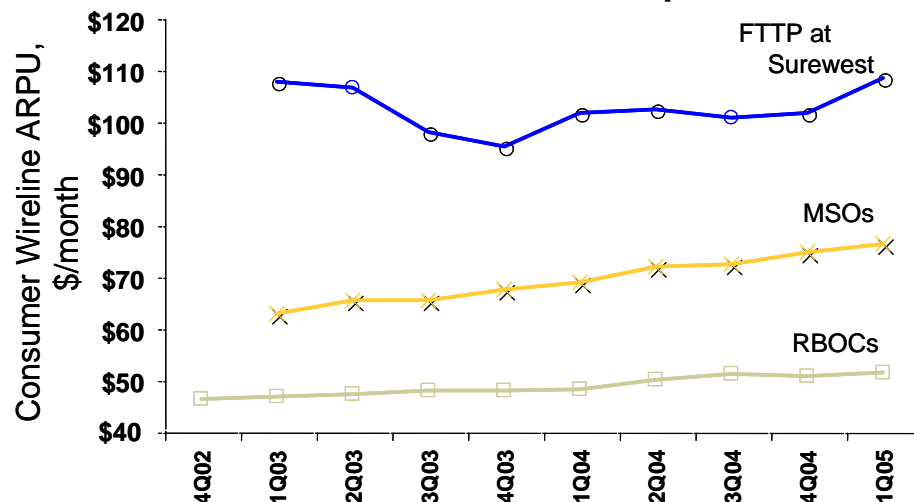
Trends and barriers

Business case for FTTH

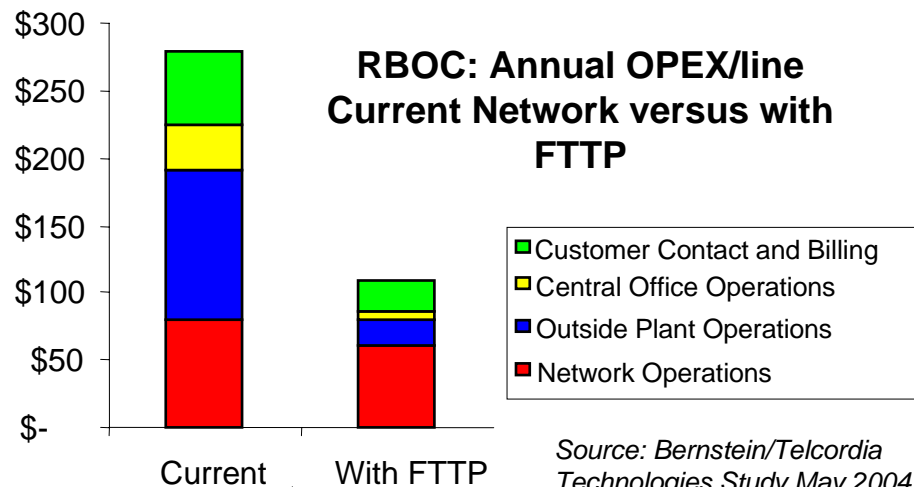
• Competition driving the need for converged services

- **Lower churn-** CATV operators report 50% reduction in churn for triple play
- **Higher ARPU-** Based on recent numbers, the monthly average revenue per user (ARPU) for video is ~\$59, voice is ~\$40, and data is ~\$40
- **Large addressable market for video-** While broadband penetration is only 32% of US households, paid television subscribers account for 81% of households.
- **DSL will be challenged-** Loop lengths will limit bandwidth to provide competitive video package with HDTV
- **Lower OPEX-** VZ claims up to 50% reduction in OPEX compared to copper network. Corning modeling indicates ~\$100/line annual savings
- **Lowering first installed costs-** FTTH installed costs have been reduced from ~\$4000 per subscriber in 2001 to <\$1500 per subscriber in 2005

Carrier ARPU Comparison



RBOC: Annual OPEX/line Current Network versus with FTTP



Source: Bernstein/Telcordia Technologies Study May 2004

Trends and barriers

Regulatory climate

- Governments role in broadband needs to compliment market dynamics
- Latest developments
 - China
 - MII to allow telecom operators to enter radio and TV broadcast business
 - The new Telecom Law will cover emerging issues such as the convergence of telecom, broadcasting, and internet networks
 - Japan
 - Streamline procedures for leasing utility poles owned by NTT. These poles are a crucial part of the infrastructure required to install fiber-optic lines into households
 - Telcos and utilities to be permitted to offer broadcast video
 - US
 - Flurry of activity on video franchise streamlining
 - Texas allowing state wide franchising
 - How should IPTV be treated? Is it a basic video service or is it new “interactive”
 - Municipalities building/operating their own networks
 - Multiple bills both for and against
 - UK
 - Ofcom requiring BT to set up a new ‘access services’
 - ‘Equivalence’- BT’s wholesale product must be the same product BT uses, except for price
 - Major reduction in the price of full local loop unbundling—should allow lifting of other restrictions

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Summary

- FTTH has secured a strong foothold as an economically viable and technologically advanced broadband architecture
- FTTH flourishes in competitive markets or when local governments set broadband as a priority (open access)
- Observe speed races and price declines in Korea, Japan, France as a predictor in other regions
- FTTH trials and projects are occurring everywhere
- Telecom operators need to improve their networks and lower their operating costs to compete
- Governments must match regulatory approach with market dynamics