NEC’s Submarine Cable System

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NEC Corporation
Broadband Network Operations Unit
Executive General Manager
Masamichi Imai
1. Outline of Submarine Cable Systems
1-1. The History of Submarine Cables

1850: First Telegraph cable at Dover Strait
1858: First Trans-Atlantic Telegraph Cable
   (1876: Graham Bell invents the Telephone)
1906: Submarine Cable Tokyo-Guam
1956: First Trans-Atlantic Coaxial Cable
   (1963: Satellite Communications between Japan and US begins)
1964: First Trans-Pacific Coaxial Cable
1988: First Trans-Oceanic Optical Cable (1 Gb/s)
1999: Trans-Oceanic Optical Cable (640 Gb/s)
2001: Trans-Oceanic Optical Cable (1.28~Tb/s)
1-2. Summary of Submarine Cable Systems

Max. Transmission Distance 12,000~13,000km

Station A

- Avg 1m-3m burial (Max. 15m)
- Burial up to sea depth of 1500m

Station B

- Max. Sea Depth 8,000m
  (at 8000m below sea level, water pressure is equivalent to holding a car on one's thumb.)

Cables are laid in deep trenches

Repeater
Placed at 40Km~100km intervals

Japan to US West Coast is approx. 8,000km
At least 80~100 repeaters are required.
1-3. Components of a Submarine Cable System

**Dry Side**
- Line Terminal Equipment
- Supervisory System
  - Overall System Monitoring
  - Repeater Performance Monitoring

**Wet Side**
- Submarine Cables (incl. fiber.)
- Submarine Repeater
- Power Feeding Equipment
- Network Protection Equipment (SDH system)
- Installation Cableship
1-4. Technical Trends

Coaxial

Fiber Optics

Optical Amplifier System

Optical Regenerator System 1.3 / 1.55 μm

Coaxial Repeater System


40G DWDM
10G DWDM
2.5G DWDM
5G Single
1-5. Transmission Capability

- **Coaxial Repeaters**
- **Optical Regenerator**
- **Optical Amplifier**

**40Gb/s WDM System Based**
- 40G x 96
- 10G x 128
- 10G x 64
- 10G x 32
- 10G x 16

**10Gb/s WDM System Based**
- 10G x 96
- 10G x 64
- 10G x 32
- 10G x 16

**2.5Gb/s WDM System Based**
- 2.5G x 16
- 2.5G x 8
- 2.5G x 4

**1.55μm**
- 1.55μm

**1.3μm**
- 1.3μm

**5th Generation WDM**
- 5G
- 10G x 128
- 10G x 64
- 10G x 32
- 10G x 16

**3rd Generation Single Wavelength**
- 10G x 192
- 10G x 96
- 10G x 64
- 10G x 32
- 10G x 16

**2nd Generation**
- 2.5G x 8
- 2.5G x 4

**1st Generation**
- 1.44G
- 560M / 622M
- 420M
- 140M/280M (TPC3)
1-6. Latest Transmission Capacity

The Maximum Transmission Capacity for the latest Submarine Cable System, using the latest Optical Transmission technologies, is 10.24 Terabits/sec.

◆ So, how fast is 10.24 Tbps?

1 Cable can carry **Approx. 160Mil. Telephone Circuits** simultaneously
or
1 Cable can send **Approx. 272 DVD Disks** between continents within 1 second.

\[
\begin{align*}
10.24 \text{ Tbps} &= 10 \text{Gbps} \times 128 \text{WDM} \times 8 \text{fiber pairs} \\
\text{a) 10Gbps:} & \quad 1 \text{ wavelength (color) can carry 10Gbps worth of data} \\
\text{b) 128WDM:} & \quad 1 \text{ fiber can carry wavelengths (colors) up to 128 colors} \\
\text{c) 8fiber pairs:} & \quad 1 \text{ Submarine Cable can accommodate up to 8 fiber pairs.}
\end{align*}
\]
1-7. Comparison between Submarine Cable and Satellite Communications

1. Enables Highly Reliable and Affordable Broadband Communications
   1) Suitable for Communications
   2) Adaptable to various Applications
      - HD Digital Television
      - High Speed Internet Connection
      - High Speed Mobile Communications
      - High Speed Data Transmission, etc.

2. Easily Upgradable plus Long Lifespan
   1) Upgrade only when necessary
      - Upgradable with minimum investment
   2) 25 year Design Life

Satellite Communications
- Latency: 250ms
- Design Life: 10~15 years
- Capacity: 48,000ch

Optical Subsea Communication
- Latency: 50ms
- Design Life: 25 years
- Capacity: 80,000,000ch
  (10Gbits, 128WDM, 4fp)

Now and Then
In 1995:
  Subsea 50:50 Satellite
Today (2008):
  Subsea 97:3 Satellite
2. Features of Submarine Cable Systems
2-1. Submarine Cable Projects

**Features**

- Infrastructure for Int’l Traffic
  (Construction Period 10~18 Months)
- Large Capacity Transmission
- System Design Life  25 years

**Project Formation**

- **NEC**
  - System Design
  - Subsea Repeaters
  - Line Terminals
  - Power Feed
  - Integration
  - Project Management

- **Cable**
  - OCC
  - NTT・WEM
  - KCS
  - KTS
  - ACPL
  - others

- **Marine**
2-2. Flow of a Typical Project

- RFP Release
- Create Proposal
- Submit Proposal
- Select Vendor
- PJ Commence
- Down Payment
- Contract Sign
- Provisional Acceptance (Commercial)
- End of Warranty

- Project Duration: 6~8 years
  (from RFP to System Completion: 1~3 years)

- 2wks~4wks
- 1Mo~6Mo
- 2wks~4wks
- 1yr-2yr
- 2yr~5yrs
2-3. Construction of New Cable vs. Upgrade

Construction of a New Cable ≒ Like building a 10 lane expressway (but use only 1 lane)

Capacity Upgrade ≒ Like opening one lane at a time. No New Construction.

- Constructing a New Cable is like constructing a 10 lane expressway but using only 1 lane at the beginning. If traffic increases, more lanes will be opened.
- A 10 lane expressway costs more to build than a 1 lane expressway, but is less than building ten 1 lane expressways. Initial investment works out to be high, but are being build to cope with future demands.
3. Submarine Cable Systems Market
3-1. Global Trends

Demands were high during 1999-2001, but a 20 year trend seems stable at US$2,100M～2,500M.

2007 saw demands coming back to mid 90’s level. Expect moderate growth for coming years.

CAGR of Upgrades is approx. 100.2%.

Expect high demands in Asia-Pacific, Indian Ocean, Middle East and Africa.
4. NEC’s Strategy towards Submarine Cable Systems
4-1. NEC’s Strategy for Submarine Cable Systems

1. Focus on the Asia-Pacific region (Maintain regional strength)
   • Produce High Quality products from Ohtsuki plant (25 year warranty)
   • Focus marketing resources to Asia-Pacific

2. Maintain Stable Growth
   • Total Supply from Terminal Equipments to Repeaters & Cable
     Stable Supply made possible with acquisition of OCC
   • Maintaining Profitability while Minimizing Risk
   • Avoid High-risk / High-return projects, and maintain stable growth

3. Spin-Off ~ Ocean Bottom Seismograph Systems
   • Sole supplier of Ocean Bottom Seismograph Systems in Japan
   • Detect “P-wave” from earthquakes for the Meteorological Agency’s “Earthquake Early Warning System”
4-2. Status of the Submarine Industry (Top 3 suppliers)

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- Top 2 Suppliers can manufacture, integrate and implement, and provide Maintenance Services with own resources within.
- By acquiring OCC, NEC is now able to provide services nearly equal to the top 2 suppliers.
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NEC Corporation and Sumitomo Electric Industries acquired OCC Holdings from the Longreach Group.

4-3. Structure of OCC Acquisition

Acquired interest of OCC Holdings

(Before)

Longreac Group

(100%)

OCC Holdings

(100%)

OCC

(After July 15, 2008)

NEC

Sumitomo Electric Industries

Approx. 75%

Approx. 25%

OCC Holdings

(100%)

OCC

NEC Corporation and Sumitomo Electric Industries acquired OCC Holdings from the Longreac Group.
4-4. Company Overview for OCC

| Operations          | Subsea Cable: Design, Manufacture and Sales of Communication purpose Submarine Cable and Surveillance cables.  
|                    | Terrestrial Cable: Manufacture and Sales of Communication purpose Terrestrial Cables. |
| Offices            | Head Office: Yokohama, Japan  
|                    | Plants: Submarine Cable (City of Kita-Kyushu)  
|                    | Terrestrial Cable (Kaminokawa Township) |
| Founded            | June 1935 |
| Capital            | 2.255 Billion Yen (as of March 2008) |
| Sales              | 17.46 Billion Yen (for year ending March 2008) |
| Director           | Yoshihisa Okada, President and CEO |
| Employees          | Approx. 221 pax. (not including directors and temp.staff) |
| Shareholders       | OCC Holdings (100%) |
4-5. Ocean Bottom Seismograph System

- Constantly transmits data gathered from the Seismograph through Optical Fiber Cable to the Terrestrial Station.
- Technology base: NEC’s Submarine Cable System and Subsea Equipment (Features)
  - Enables real-time monitoring of seismic activities 24/7
  - Enables Tsunami readings off the coast before reaching the shores.
  - Enables Reliable and Stable Monitoring
4-6. Seismograph System of Omaezaki

Features
- Installed as part of strengthening the observation system of Tokai area
- NEC was selected as supplier for this project on the followed account:
  1. In 1976, NEC supplied the first Ocean Bottom Seismograph System to JMA
  2. NEC is the only supplier of Ocean Bottom Seismograph System and has a supply record of 7 systems around Japan

Future outlook
- Upgrade project of Hiratsuka, and New projects in Sanriku and Kii Peninsula

Project Outline
- Customer: JMA
- Installation completed for the first 2 year phase (Project Duration: total 4 years)
- Scope of work: Supplying Ocean Bottom Seismograph/Tsunami gauge

Seismograph System around Japan

Note:
- Optical Fiber
- Coaxial

JMA: Japan Meteorological Agency
ERI: Earthquake Research Institute, University of Tokyo
NIED: National Research Institute for Earth science and Disaster Prevention
JAMSTEC: Japan Agency for Marine-Earth Science and Technology
Empowered by Innovation

NEC