Standardization for Cable Television
(JCTEA Standard)

Jan. 24th 2011

Japan Cable Television Engineering Association (JCTEA)
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• An Overview of Japanese Cable Television
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• Standardization for CATV
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An Overview of Japanese Cable Television

A History of Japanese CATV
Cable Television Subscribers
Internet Development
IP Multi-cast Broadcasting
A Brief History of Japanese CATV: Upgrades and Full Service

1953—◆ TV broadcast service starts in Japan
1955—◆ First CATV starts in “Ikaho Spa.” (TV retransmission service starts)
1962—◆ The Building Standard Law is revised. High-rise buildings appear and largely introduce CATV to deal with TV radio wave shadow.
1963—◆ “Gujou–hachiman CATV” first begins to broadcast locally produced programs.
1972—◆ The “Cable Television Broadcast Law” is established.
1984—◆ Satellite broadcasts start. (Broadcasting Satellite)
1987—◆ “Tama Cable Network” first opens an urban-type large-scale CATV station.
1989—◆ The private communication satellite JC-SAT is launched.
1996—◆ CS digital broadcasting services start. (Communication satellite)
1997—◆ “Titus Communications” & “Suginami Cable Television” start a CATV telephone service. (Not IP telephone) (Telephone service starts)
2000—◆ The BS digital broadcasting service starts (Broadcasting Satellite).
2001—◆ The “Law Concerning Broadcast on Telecommunications Service” is established. (Full-scale digital multi-channel service is introduced)
2003—◆ Terrestrial digital broadcasts start. (Digital channels further increase)
2005—◆ FTTH regulations are added to the Cable Television Law.
2006—◆ The “:COM” group begins the first mobile telephone service in CATV.
2007—◆ “I–CAST” begins the first IP retransmission service for terrestrial digital broadcast programs. (TV broadcasting programs are transmitted by IP technology)
2008—◆ Gap-filler systems are introduced as a measure for dealing with bad digital TV reception
◆ WiMAX wireless services are introduced by cable operators.

From MIC data
Cable Television Subscribers

Subscriptions: 24.71 million households at the end of March 2010; subscription rate: 46.7%

- Unit: 10,000 subscribers

<table>
<thead>
<tr>
<th>Year</th>
<th>Subscription</th>
<th>Rate of Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>'98</td>
<td>789</td>
<td>18.1%</td>
</tr>
<tr>
<td>'99</td>
<td>943</td>
<td>19.5%</td>
</tr>
<tr>
<td>'00</td>
<td>1,044</td>
<td>10.7%</td>
</tr>
<tr>
<td>'01</td>
<td>1,300</td>
<td>24.5%</td>
</tr>
<tr>
<td>'02</td>
<td>1,514</td>
<td>16.5%</td>
</tr>
<tr>
<td>'03</td>
<td>1,654</td>
<td>9.2%</td>
</tr>
<tr>
<td>'04</td>
<td>1,788</td>
<td>8.1%</td>
</tr>
<tr>
<td>'05</td>
<td>1,913</td>
<td>7.1%</td>
</tr>
<tr>
<td>'06</td>
<td>2,061</td>
<td>7.7%</td>
</tr>
<tr>
<td>'07</td>
<td>2,194</td>
<td>6.5%</td>
</tr>
<tr>
<td>'08</td>
<td>2,301</td>
<td>4.8%</td>
</tr>
<tr>
<td>'09</td>
<td>2,471</td>
<td>7.3%</td>
</tr>
</tbody>
</table>

*1 Rate of increase  *2 Subscription rate is based on Basic Resident Registers  *3 From data of MIC (Ministry of Internal Affairs and Communications) From MIC data
At the end of March, broadband subscribers had reached 32.04 million; the number of cable internet subscribers reached 4.35 million (13.6% of all broadband subscribers).

Cable internet service drove the market early on, followed by DSL. Today, FTTH service leads the way.

The number of cable internet subscribers is still increasing, but that of DSL subscribers began to decrease in the 1st quarter of 2006 (fiscal year).
DOCSIS 3.0 Ultra High-Speed CATV Internet

Thirty-one CATV operators introduced or are introducing DOCSIS wideband cable modem system (ultra high speed), complied with or based on DOCSIS 3.0, among 379 CATV internet operators. (Jun 2010) More operators will introduce it soon (2011).

1. DOCSIS 3.0 features
   The DOCSIS 3.0 system provides ultra high-speed internet service.
   - Some channels having 30 to 40 Mbps (per 6 MHz) are bonded up to 120M to 1.2G bps over the HFC system with channel-bonding technology.
   - It has as same speed as GE-PON over FTTH.

2. DOCSIS 3.0 advantages
   - Separate channels can be bonded; effective use of spare channels is available.
   - Conventional DOCSIS modems can be used together in the network.
   - Change of CATV network infrastructure is not necessary (for example: to FTTH).
   - Service speed can be made higher by increasing the number of bonding channels according to the customer’s requirements.
Penetration reached 749,000 subscribers in 2010 (calendar year; excludes subscribers of VOD only)

* Summations of subscriber data of five TV broadcast operators using IP multi-casting systems among TV broadcast operators providing telecommunications service.

From MIC data
# IPTV in Other Countries

<table>
<thead>
<tr>
<th>Region</th>
<th>No. of subscribers (million)</th>
<th>Background</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td></td>
<td>• The multi-ch video market remains immature</td>
<td>• CATV is not well developed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• CATV is not popular in some countries</td>
<td>• IPTV service entry of a German telecom</td>
</tr>
<tr>
<td></td>
<td>France: 9.4</td>
<td></td>
<td>• Government subsidization (Italy, France)</td>
</tr>
<tr>
<td></td>
<td>Germany: 1.6</td>
<td></td>
<td>• Time-shifted TV (Italy, UK, France)</td>
</tr>
<tr>
<td></td>
<td>Belgium: 0.9</td>
<td></td>
<td>• IPTV is supplemented with BB</td>
</tr>
<tr>
<td></td>
<td>Spain: 0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Italy: 0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td>• CATV has superiority in multi-ch video services</td>
<td>• Telecom carriers fight hard against CATV</td>
</tr>
<tr>
<td></td>
<td>6.5</td>
<td>• Multi-ch video services are saturated</td>
<td>• Same service level as CATV in price, HD video, digital only.</td>
</tr>
<tr>
<td></td>
<td>(Verizon: 3.2</td>
<td>• RF video on FTTH</td>
<td>(Triple-play service)</td>
</tr>
<tr>
<td></td>
<td>AT&amp;T: 2.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASIA</td>
<td>China: 6.8</td>
<td>• China: Increase of four operators</td>
<td>• China: Subscriber increase of BesTV of SGM origin</td>
</tr>
<tr>
<td></td>
<td>South Korea: 2.9</td>
<td>• Hong Kong &amp; South Korea: CATV has spread broadly and multi-ch video</td>
<td>• Hong Kong: Service strategy gets the backing of subscribers</td>
</tr>
<tr>
<td></td>
<td>Hong Kong: 1.2</td>
<td>requirements are high</td>
<td>• South Korea: Telecom carriers are aggressive in securing subscribers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• CATV &amp; telecom carriers are fierce competitors</td>
<td></td>
</tr>
<tr>
<td>JAPAN</td>
<td>2.0</td>
<td>• FTTH has spread rapidly (Internet)</td>
<td>Future factors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Multi-ch subscriber penetration of CATV is about 31%</td>
<td>• IP retransmission of terrestrial broadcast programs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Giving advantage of IP service in No. of VOD program titles and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>service rate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Increase of HD content</td>
</tr>
</tbody>
</table>

Research by JCTEA, June 2010
Progress of Broadcasting and CATV
Cable Television Development in Japan

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>MW (1925)</td>
</tr>
<tr>
<td>1952</td>
<td>SW (1952)</td>
</tr>
<tr>
<td>1969</td>
<td>FM (1969)</td>
</tr>
<tr>
<td>1953</td>
<td>Television (1953)</td>
</tr>
<tr>
<td>1960</td>
<td>Color TV (1960)</td>
</tr>
<tr>
<td>1982</td>
<td>Sound multiplex (1982)</td>
</tr>
<tr>
<td>1985</td>
<td>Teletext multiplex (1985)</td>
</tr>
<tr>
<td>1996</td>
<td>Data broadcasts (1996)</td>
</tr>
<tr>
<td>2000</td>
<td>Digital Trial from 2002</td>
</tr>
</tbody>
</table>

- **Terrestrial Broadcasting**
  - 1955: First plant in Ikaho Spa
  - 1972: CATV Law
  - 1975: JCTEA
  - 1980: JCTA
  - 1989: Internet start
  - 1996: Digital (SDTV)
  - 2000: Cable Lab
  - 2001: CATV on Telecom Service

- **Satellite (BS)**
  - 1989: SDTV (Analog)

- **Satellite (CS)**
  - 1990: SDTV (Analog)
  - Dec 2000: Digital (SDTV+HDTV)

- **Cable Television**
  - 2000: Digital

- **Sound multiplex**
  - 1982

- **Digital**
  - 2000

- **Television (Analog)**
  - 1990

- **Data broadcasts**
  - 1996

- **Sound**
  - 1950

- **1970**
  - 1975 JCTEA
  - 1980 JCTA

- **1990**
  - 1996 Digital (SDTV)
  - 2000 Digital

- **2000**
  - 2000 Digital

- **CATV on Telecom Service**
  - 2001
Digital TV retransmission Services of CATV

Cable Television Station

- Terrestrial
- Terrestrial TM
- Broadcasting Satellite TM
- 110° CS TM
- JC-HITS TM
- i-HITS TM
- CMTS
- SMS
- Modem

RF Return

- STB100
  - B-CAS Card
  - C-CAS Card
- STB200
  - B-CAS Card
  - C-CAS Card
- STB300
  - B-CAS Card
  - C-CAS Card
- STB400
  - B-CAS Card
  - C-CAS Card

Terrestrial R&D HDTV Monitor
(Built-in CATV Terrestrial Pass-through)

SDTV Monitor

HDTV Monitor

HDTV Monitor

Terrestrial

B-CAS Center

CAS Information

SKY PerfecTV!

JCHITS

Suppliers

i-HITS

Private Producer

Internet

CAS Center

RF Return

Information Data

110° CS

124° CS

124°/128° CS

144° CS
Single TS & Multiple TS Multiplexer

- **TS**: Transport Stream
- **PSI**: Program Specific Information
- **SI**: Service Information
- **PID**: Packet Identifier
- **EPG**: Electronic Program Guide

**Fig. 1 Conceptual illustration of single TS multiplexer**

*PSI/Si and EPG are restructured in order to select channel.
*PID must be changed to have a different PID between each program.

**Fig. 2 Conceptual illustration of multiple TS multiplexer**

*(For terrestrial digital TV signal and digital BS signal retransmission)*
CATV Services
# Cable TV Services In Japan

## 1. TV video service

1) Resending TV broadcast programs
   - Terrestrial TV broadcast programs (analog and digital)
   - BS broadcast TV programs (analog and digital)

2) Resending CS-distributed TV programs
   - Many specialized programs (news, movies, sports, anime, etc.)

3) Locally produced programs
   - Local pick-up news, local government news, local emergency information (disasters, accidents), etc.

4) Other video services
   - Special program VOD, ITV video transmission

## 2. Internet service providing

## 3. Telephone services *(Triple-play)*

- Fixed telephone

## 4. Mobile telephone *(Quad-play)*

## 5. Others

- Emergency earthquake notices, karaoke, local information
CATV Service Signals

Many RF Signals go through the Cable Transmission Line

Television Broadcasting Services

1) 90 - 770 MHz
   - NTSC-VSB-AM, 64 QAM (256 QAM), OFDM

2) 1035.05 MHz - 1484.95 MHz
   - BS-IF (Analog & Digital)

3) 1595.75 MHz ~ 2070.25 MHz
   - Broadband CS-IF (digital)

Other Telecommunications

1) Telecommunication
   - Cable internet
   - IP telephone
   - Mobile telephone
   - Video on demand
   - WiMAX etc.

2) Others
   - Emergency earthquake notices
   - Karaoke
   - Public announcements
   - Locally produced TV uplinks
   - Surveillance ITV
   - Other control systems etc.
Frequency Allocation of CATV Signals (Example)

1) FTTH CATV downstream
   (Analog multi-chs + dig. multi-chs + BS-IF + broadband CS-IF)

   ![Diagram of frequency allocation]

2) HFC CATV signals (analog multi-ch + digital multi-ch + others)

   - VSB-AM
   - 64 QAM

   Selected content from the satellite channels are carried on CATV signals of the 770 MHz band.
# Transmission Signals of FTTH or HFC

<table>
<thead>
<tr>
<th>Television Signal</th>
<th>Modulation</th>
<th>Freq. Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Television Broadcasting</td>
<td>NTSC-VSB-AM</td>
<td>90-770 MHz</td>
</tr>
<tr>
<td>(Analog Television)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Std. Digital Television Broadcasting</td>
<td>OFDM</td>
<td></td>
</tr>
<tr>
<td>(Terrestrial Digital Television)</td>
<td></td>
<td>90-770 MHz</td>
</tr>
<tr>
<td>Digital Cable Television Broadcasting</td>
<td>64 QAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>256 QAM</td>
<td></td>
</tr>
<tr>
<td>Std. Satellite Broadcasting Television</td>
<td>FM</td>
<td>BS-IF (1035-1332-1484MHz)</td>
</tr>
<tr>
<td>(BS Analog Television)</td>
<td></td>
<td>BS1 - BS15 - BS23</td>
</tr>
<tr>
<td>Std. Satellite Broadcasting Digital</td>
<td>TC8PSK</td>
<td>Broadband CS-IF</td>
</tr>
<tr>
<td>Television (BS Digital Television)</td>
<td></td>
<td>(1595-2071MHz)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* (2126-2602MHz)</td>
</tr>
<tr>
<td>Broadband Transmission Digital Television</td>
<td>QPSK</td>
<td></td>
</tr>
<tr>
<td>(CS Broadband Digital TV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A Typical CATV Network in Japan
HFC (Hybrid Fiber and Coaxial) System

CATV Center
Optical Fiber
Optical Node
Additional Opt Node
Coaxial Amp
Optical Fiber Cable
Additional Optical Fiber Cable
Coaxial Cable

Renewal Optical Fiber
Coaxial Cable

Downsized Cell
(500 Households)

Original Cell
(1,500 Households)

Higher Performance CATV by Cell-Size Reduction
Intensity Modulation Transmission Over FTTH

- Transmitter input:
  - AM & QAM carrier (70 M - 2.6 GHz)
- Optical transmission:
  - AM & QAM carrier (70 M - 2.6 GHz)
- V-ONU output:
  - AM & QAM carrier (70 M - 2.6 GHz)

TV signal 1 → TV signal 2 → TV signal 3 → TV signal 4 → FDM → Direct or external modulator & opt amplifier → Dispersion compensation fiber → Optical fiber → O/E

Features:
- Optical modulator is easier and cheaper
- Weak against noise for wave dispersion, opt-reflection, amplifier noise
- Low sensitivity of opt-receiver

Mainly using CATV operators
FM Conversion Transmission Over FTTH

Transmitter input
- AM & QAM carrier (70 - 2600 MHz)
- 2.6 GHz

Optical transmission
- FM signal (to 6 GHz)

V-ONU output
- AM & QAM carrier (70 - 2600 MHz)
- 2.6 GHz

Features
- Circuits of transmitter and receiver are more complicated, more expensive.
- Strong against noise for wave dispersion, opt-reflection, amplifier noise
- Higher sensitivity of opt-receiver

Mainly using NTT
Digital Conversion Of CATV
- Gap filler for digital conversion
- Introduction of provisional conversion from digital signal broadcasts to analog signal broadcasts for analog televisions
The number of CATV subscribers has been increasing every year; at the end of September 2010, there were 25.33 million subscribers.

Based on the number of subscribers, the terrestrial digital compatibility rate with CATV is 98.6%.
Retransmission over the cable-television system for terrestrial broadcast

- A digital TV receiver provides a terrestrial OFDM tuner, BS tuner, and CS tuner
- An STB provides a terrestrial OFDM tuner, QAM tuner, and hard disk memory
Function Blocks For Multiplexing TS

Fig. Configuration of trans-modulation for terrestrial broadcast signal
Gap Fillers for Digital Conversion

Locational image of small power broadcasting repeaters (gap fillers) to recover blind areas (gaps) in digital TV reception

- Planned broadcasting area
- Area covered by TV tower
- Blind areas of TV reception (SPR applicable)
- Common antenna system
- Private recovering SPR (licensed)
- Behind buildings
- Behind hills
- Behind bridges
- Behind mountains
- Underground areas
- SPR of broadcast company

SPR: Small Power Repeater (gap filler of less than 50 mW/ch)
Gap-Filler System

Configuration of the gap-filler system

- Frequency deviation: ±20kHz
- Delay time: 120μs ≥
- Antenna power: 50 mW ≥
- Spectrum mask:

Conceptual image of covering TV reception in blind reception areas behind mountains with gap-fillers (small power transmitters)
Digital-to-Analog Conversion

Introduction of digital-to-analog conversion equipment

- CATV operator
- Digital headend
- Digital-to-analog conversion equipment
- Shared audio and video reception for housing complexes
- Remote area audio and video reception

Digital waves
Converted digital to-analog waves (analog)
Digital-to-Analog Conversion for Remaining Analog TVs (Provisional)

Terrestrial digital TV broadcasting is converted to analog format at the headend for CATV and resent.

- Requests by viewers to continue using usable analog receivers even after terrestrial analog broadcasting ends
- Equalization of the burden of viewers that need to replace analog receivers, including second and third receivers
- Equalization of disposal/recycling of analog receivers

Thus, digital-to-analog conversion will be promoted as a provisional measure until the end of March 2015.

After the end of terrestrial analog broadcasting

Since only digital broadcasts are resent to subscribers via cable, digital broadcasting cannot be viewed on analog TVs other than those that are connected to an STB

Provisional introduction of digital-to-analog conversion

Having cable TV operators convert terrestrial digital broadcasting to analog broadcasting as a provisional measure will make it possible to view terrestrial digital broadcasting even on analog TVs for a certain period of time

(Provisional)

<table>
<thead>
<tr>
<th>CATV company</th>
<th>Digital broadcasting</th>
<th>Digital TV</th>
<th>STB</th>
<th>Other analog TVs*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Digital antenna</td>
<td>Digital</td>
<td>STB</td>
<td>Not viewable</td>
</tr>
<tr>
<td></td>
<td>conversion equipment</td>
<td>broadcasting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Many channels</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>with HD image quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SD image quality</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Digital-to-Analog Conversion for Remaining Analog TVs**

- Total number of subscriber household
  - Approx. 24.71 million households (end of March 2010)

**Provisional introduction of digital-to-analog conversion**

- Digital-to-analog conversion service comes with the following kinds of limitations.
  1. Images are letterbox size and of SD image quality.
  2. Data broadcasts cannot be received.
  3. EPG (electronic program guide) cannot be used.
  4. The number of times that broadcasts can be recorded is "copy once."

**Viewable**

**Not viewable**

By the end of March 2015
Standardization for CATV

Government Regulations and Voluntary Consensus Standards
CATV Standardization Process in Japan

MIC
Study group
Telecom. Technology Sub-council
Rule making
Cable Television Regulatory Council

JCTEA
Standardization committee
Working group
Standard Assembly
Voluntary JCTEA standard

JLabs
Technical committee
Working group
Voluntary lab specification

Note: MIC = Ministry of Internal Affairs and Communications
<table>
<thead>
<tr>
<th>Nature</th>
<th>Government Regulations</th>
<th>JCTEA Standards</th>
</tr>
</thead>
</table>
| Purpose           | ❖ To promote efficient use of frequencies  
                     ❖ To avoid interference  
                     ❖ To protect consumers (minimum quality) | ❖ To ensure common interface  
                     ❖ To ensure suitable quality (higher quality) |
| Technical items   | ❖ Frequency band  
                     ❖ Carrier-to-noise ratio  
                     ❖ Bit error rate | ❖ Carrier-to-noise ratio  
                     ❖ Communication protocol  
                     ❖ Sensitivity  
                     ❖ Measurement methods |
JCTEA Standard Committee

• Establishment: 1996
  Members: 65 (as of Dec. 2010)
  – Open to any company, organization, or person
  – No limitation on nationality
  – Independent from JCTEA membership

• Organization:

  Publication and maintenance of JCTEA standards

  Standard Assembly
  Chairman
  Members

  8 working groups + 2 committees

• Standardization activities
  • Discussion and drawing of standards for technology and measurement
  • Publication of standards books
  • Certification of standards conformity
JCTEA Standards concerning Networks, Equipment, STB & Measuring Methods for Digital, FTTH, & Internet

- STD-001 Conditional Access for Digital Cable Television
- STD-002 Multiplexing for Digital Cable Television
- STD-003 Service Information for Digital Cable Television
- STD-005 Data Transmission Equipment for Cable Television Network
- STD-006 Symbol Marks for Design of Cable Television
- STD-007 Receiver for Digital Cable Television
- STD-008 BS Digital Broadcasting Pass-Through System for Cable Television
- STD-009 Method of Measurement for Cable Modem
- STD-010-OFDM Method of Measurement for OFDM Signal
- STD-010-PSK Method of Measurement for PSK Signal
- STD-010-QAM Method of Measurement for QAM Signal
- STD-011 Terrestrial Digital Retransmission System for Cable Television
- STD-012 Retransmission System of Terrestrial Digital Broadcasting for Cable
- STD-013 Transmission System of MDU Inside
- STD-014 Optical Network and using Equipment for FTTH Cable Television System
- STD-015 Method of Measurement for FTTH Cable Television System
- STD-016 Method of Interference Measurement for Cable Television Signal Transmission System
- STD-017 Examination Facilities Equaled with Actual Cable Television Network for Cable Television Signal Transmission System
- STD-018 Optical Network Specification for FTTH Cable Television System
- STD-021 18 GHz Band Wireless Access System

Red letters: related to digital transmission

Only the Japanese edition is available now.
Review of JCTEA
Summary of JCTEA

- **Establishment**: Organized in 1975
- **Number of members**: 660 (Sep. 2010)
- **Objective**
  
  JCTEA aims to contribute to the smooth and sound development of a highly networked information society through
  
  - The improvement and spread of CATV technology
  - The realization of good television reception
## Activities of JCTEA

- **Research and development of CATV network technology**
- **Standardization of CATV network technology**
  - Discussion and drawing of standards for technology and measurement
  - Publication of standards books
  - Certification of standards conformity
- **Certification of “CATV broadcast” engineers**
- **Technical consultation on television reception (digital & analog)**
  - Support for terrestrial TV digital conversion
  - Research on television reception interference caused by buildings, etc.
- **Workshops and lectures on CATV technology**
Current Major Topics

• FTTH for outside plant and building wiring
• Ultra high-speed internet system (DOCSIS 3.0)
• IPTV (IP broadcasting, storage-type broadcasting)
• Home networks (high-speed house wiring for Internet, high-definition TV signal exchange)
• Smooth digital conversion for terrestrial TV broadcasting (complete conversion to digital TV broadcasting from analog TV broadcasting in July 2011)
• Broadband wireless cable systems (WiMAX, etc.)
• Small power broadcasting repeaters (gap-fillers) for terrestrial digital TV
• Introduction (2011-2015) of temporary conversion from digital signal broadcasts to analog signal broadcasts
• Area-based one-segment broadcasting

Thank you for your kind attention!!