Digital Broadcasting Facilities and System for DTTB

Part 1 ; Studio System for On Air

Oct. 14th 2004

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Introduction
### Service and Business Revolution by Digital Broadcasting

<table>
<thead>
<tr>
<th>Analog Broadcasting</th>
<th>Digital Broadcasting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service</td>
<td></td>
</tr>
<tr>
<td>Number of Channel</td>
<td>Single Channel</td>
</tr>
<tr>
<td>Video Quality</td>
<td>Standard (SDTV)</td>
</tr>
<tr>
<td>Communication</td>
<td>Casting</td>
</tr>
<tr>
<td>Target</td>
<td>Viewer</td>
</tr>
<tr>
<td>Audience Action</td>
<td>Passive</td>
</tr>
<tr>
<td>Where</td>
<td>Home</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td></td>
</tr>
<tr>
<td>Source of Revenue</td>
<td>Sponsor (commercial station)</td>
</tr>
<tr>
<td>Advertising Target</td>
<td>Mass</td>
</tr>
<tr>
<td>Media</td>
<td>Broadcast</td>
</tr>
<tr>
<td>Potential</td>
<td>Low (Stability)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multi Channel</td>
</tr>
<tr>
<td></td>
<td>+ High quality (HDTV)</td>
</tr>
<tr>
<td></td>
<td>Interactive</td>
</tr>
<tr>
<td></td>
<td>Customer</td>
</tr>
<tr>
<td></td>
<td>Active</td>
</tr>
<tr>
<td></td>
<td>Anywhere</td>
</tr>
<tr>
<td></td>
<td>Convergence</td>
</tr>
<tr>
<td></td>
<td>Broadcast and Telecommunication by Digital</td>
</tr>
<tr>
<td></td>
<td>+ Subscriber, Industry</td>
</tr>
<tr>
<td></td>
<td>+ Segment, One to One</td>
</tr>
<tr>
<td></td>
<td>+ Interactive</td>
</tr>
<tr>
<td></td>
<td>High</td>
</tr>
</tbody>
</table>
Business and Source of Revenue on Digital Terrestrial Broadcasting

**Existing Service**
- **TV Broadcasting**
  - Core business
    - HDTV
    - Multi Channel
  - Capability of contents organization and production

**New Service**
- **Data Broadcasting**
  - New Business
    - Additional value for TV
    - New source of revenue
  - Organization combined with TV program confidence (for TV Commerce)
- **Mobile, Cellular phone**
  - Capability of contents production
  - Contents multi-use

**Source of Revenue**
- Traditional advertising
- New advertising
  - Electric leaflet
  - Marketing research
- Interactive service
  - TV Commerce
- Pay TV service
Requirements for Station System in Digital Broadcasting

- Quick and flexible production and transmission work
- Handling HD/SD program materials
- External network interface
- Preservation and rights management for second use of program materials
- Handling HD/SD program materials
- Compatibility with HD/SD mixed broadcasting and simulcast
- Flexibility for audio multi channel
- Compatibility with new services
- Affiliate network interface
- Efficient operations

WEB Basic System
On Air System Block diagram

On Air Server
- VTR
- Program server
- CM server
- VF/AF server

Master Control Switcher
- Host Computer
- Data Server
- Automatic Program Controller
  - Input
  - Router
  - MUX
  - Packetizer
- ENC
- MUX
- RMP
- Digital Broadcasting
- Analog Broadcasting

Notes:
- MK: Mix and Keyer
- SI / EPG: Service Information / Electric Programming Guide
- ENC: Encoder
- MUX: Multiplexer
- RMP: Rights Management and Protection
On Air Server
Additional Requirements regarding On Air Server for Digital Broadcasting

- Handling HD/SD Program Materials
  - Diversification of incoming program materials
  - Compatibility of broadcast equipment with HD

- Compatibility with Simulcast
  - Simulcast of digital and analog broadcasting is required for a given period

- Efficient Operations
  - Filing of diverse program materials to server
  - WEB preview (low resolution quality) by Personal Computer
Basic Concept of HD/SD Mixed System

- Analog broadcasting: SD system
- Digital broadcasting: HD system

### Materials

<table>
<thead>
<tr>
<th>Format</th>
<th>Aspect ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDTV</td>
<td>4 : 3</td>
</tr>
<tr>
<td>SDTV</td>
<td>16 : 9</td>
</tr>
<tr>
<td>SD(SQ)</td>
<td>16 : 9</td>
</tr>
<tr>
<td>HDTV</td>
<td>16 : 9</td>
</tr>
</tbody>
</table>

### Converter

- SQ Converter
- D / C
- U / C

### Studio System

- SDTV (4 : 3)
- HDTV (16 : 9)

### Notes:
- SQ: Squeeze
Method 1 Filing to match with on-air format

**Merit**
- Reliable preview including conversion of aspect ratio
- Fixed on air control timing (There are no converter in output part)

**Demerit**
- A massive storage is required because of filing SD and HD format

**Program/CM Server**

- SD Materials
  - D/C
  - Storage by SD format
  - SDTV

- HD Materials
  - U/C
  - Storage by HD format
  - HDTV

**Master Control Switcher**

- Analog Broadcasting
  - SDTV
- Digital Broadcasting
  - HDTV
  - SDTV
**Handling HD/SD Signals and Compatibility with Simulcast (2)**

**Method 2**  
Filing to match with materials format

- **SDTV**  
  - Analog Broadcasting  
  - SD Materials

- **HDTV**  
  - Digital Broadcasting  
  - HD Materials

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**Program/CM Server**

- **Storage by SD format**
- **Storage by HD format**
- **D/C**
- **U/C**

**Merit**
- Easy filing operation because of storage by original format
- Minimized storage capacity

**Demerit**
- Control matching with output switch and D/C, U/C is required
- Complex preview system is required for format conversion
System Example; Tokai-TV Program Server System

Remote

SD-VTR HD-VTR

Program Server

SD/HD Router

SD Router

HD Router

SD Server

HD Server

Raid Disk (130Hr.)

Network

To Master Control

SD OUT
OA1
OA2
OA3
Mon

HD OUT
OA1
OA2
Mon

Web Server

Pre-view Terminal

Notes; SAN : Storage Area Network

SD-VTR
HD-VTR

MPEG2 Long GOP
SD:20Mbps
HD:50Mbps

SYS-A
SYS-B

SD/HD Router

6 Inputs

6 Inputs

8 outputs

8 outputs

SD OUT

OA1 OA2 OA3 Mon

HD OUT

OA1 OA2 Mon

Pre-view Terminal

WEB Server

Notes; SAN : Storage Area Network
Tokai-TV Program Server System
Master Control Switcher
Additional Requirements regarding Master Control Switcher for Digital Broadcasting (1)

- Handling HD/SD Program Materials
  - Compatibility of broadcast equipment with HD

- Compatibility with HD/SD Mixed Broadcasting and Simulcast
  - HD program assembly for digital broadcasting
  - SD program assembly for analog broadcasting

- Flexibility for Audio Multi-Channel
  - Embedded audio processing (Multiplex to SDI ancillary data)

- Compatibility with New Services
  - SI / EPG transmission, Captioning transmission
  - Data Broadcasting, Broadcasting service for mobile and cellular
  - High compression HD encoder
Additional Requirements regarding Master Control Switcher for Digital Broadcasting (2)

- **Affiliates Network Interface**
  - HD and SD program transmission between key station and local station

- **Efficient Operations**
  - Integrated monitoring system
  - Monitoring of MPEG transport stream
Master Control Switcher Block Diagram

Data Server

Automatic Program Controller

SI/EPG

Packetizer

Encoder/MUX subsystem

HD encoder

SD encoder

Low bit-rate encoder

MUX

Digital Broadcasting

Transmitter system

Audio/Video system

Data Broadcasting

Transmitter system

Data Server

Automatic Program Controller

HD/SD multi-format router

HD assembly line

SD assembly line

Digital Broadcasting

Transmitter system

HD program materials

SD program materials

Input part

Notes: RMP : Rights Management and Protection
Characteristics of Switcher and Controller Block

- **Input part**
  - Input signal format: HD-SDI, SD-SDI or Analog
  - HD signal: Transferred to the HD assembly line
  - SD signal: Transferred to the SD assembly line
    (Analog signals are converted to SDI by A/D converter)
  - Audio embedded processing is carried out by Multiplexer for multi-channel audio (5.1Ch surround etc.)

- **Program assembly part**
  - Adopting HD/SD multi-format router
  - Composed of HD assembly line for digital broadcasting and SD assembly line for analog broadcasting
  - HD signals are inputted to SD assembly line through D/C for analog broadcasting
  - SD signals are inputted to HD assembly line through U/C for digital broadcasting

- **Controller (APC)**
  - Execution of base material switching, OL processing and MIX processing
  - Control of assembly and transmission of programs on data received from Data Server
  - Transfer of PSI (Program Specific Information) data to MUX and control of encoder
Example of Controller Display

Service identification
On Air program name
Event data
Information on next program

<table>
<thead>
<tr>
<th>Time</th>
<th>Channel</th>
<th>Service</th>
<th>Program</th>
<th>Event</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>16:06:51</td>
<td>VHI</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:06:31</td>
<td>OFF</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:08:03</td>
<td>VHI</td>
<td></td>
<td></td>
<td>FJX00501H015</td>
<td>16:08:11</td>
</tr>
<tr>
<td>16:08:11</td>
<td>CH1</td>
<td>CH1</td>
<td>S</td>
<td>Q</td>
<td>16:05</td>
</tr>
<tr>
<td>16:10:56</td>
<td>SH1</td>
<td>SH1</td>
<td>S</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>16:10:59</td>
<td>OFF</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:24:15</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REMIND:
- Time: 01:31
- Other

Information on next program

- 16:50:00 SH1 SH1 S NST DHSF 43 B1002070100H010 16:45:15 J.C.T 91
- 16:53:30 OFF N OFF N S 43
- 16:53:30 CH1 L CH1 L S NED 16 A02070801Z1L 16:45:45 CM 06
Characteristics of Encoder/MUX Subsystem

**Encoder**
- HD encoder and multiple SD encoder for HD/SD mixed broadcasting
  * HD encoder is required high compression and high quality for effective use of bandwidth
- Including audio encoder (Dolby AC-3, MPEG1-L2, AAC etc.)
- Low bit-rate encoder for mobile and cellular
  * Standardized H.264 in Japan
- Multiplex of captioning data to MPEG-2 transport stream

**MUX**
- Multiplex of each transport streams, above encoder outputs and data broadcasting
- Multiplex of SI/EPG data and PSI
  
  SI : Service description table, Broadcaster information table, Event information table etc.
  PSI : Program association table, Program map table, Network information table etc.
  * SI/EPG section data is transferred by data server and converted to packet data through packetizer
Background of HDTV Encoder Development

Example of ISDB-T

- 15.5Mbps / 13segments
  - HDTV service for TV receiver (15.1Mbps / 12seg.)
  - HDTV 14.5Mbps (Video, Audio, Caption)
- EPG 375Kbps
- System 476Kbps
- Data Broadcasting 1.5Mbps
- Low bit-rate video service for Cellular (374Kbps / 1seg.)

High compression (11~14Mbps) and high quality HDTV encoder is indispensable
NEC VC-5300 HDTV Encoder
Characteristics of VC-5300 HDTV Encoder

- Adopting 1 chip HD coding LSI
- Multi-format
  - Compatibility with 1080i, 720p, 480p, 480i
- High compression encoding
  - Adopting high compression algorithm by pre-analysis processing
- Compatibility with embedded audio and integrated MPEG-2 AAC
  - Input Audio: Embedded audio or AES/EBU
  - AAC coding circuit: 5.1ch surround mode, 2ES
- VBR (Variable Bit Rate) encoding
  - Optimization of encoding rate matching with input video
- Adopted by major broadcaster for terrestrial digital broadcasting
  - 12 out of 19 stations in Tokyo, Nagoya, Osaka area
Comparison of Transmission Method of Affiliate Network

<table>
<thead>
<tr>
<th>Delay</th>
<th>Non-Compression</th>
<th>Compression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approx. 0(zero)</td>
<td>Approx. 1sec</td>
<td></td>
</tr>
<tr>
<td>Preservation</td>
<td></td>
<td>Quality down</td>
</tr>
<tr>
<td>Requires broad band network</td>
<td></td>
<td>* only can be improved by transcoding technique</td>
</tr>
<tr>
<td>HD-SDI:1.4Gbps, SD-SDI:270Mbps</td>
<td></td>
<td>Available both satellite and terrestrial intermediate band network</td>
</tr>
<tr>
<td>Commercial stations</td>
<td></td>
<td>Cost effective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Broadcasting TS rate:Approx.22Mbps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NHK</td>
</tr>
</tbody>
</table>

Results in Japan
Non-Compression Transmission

Key Station
Encoder
HD-SDI, SD-SDI
Non-compression

On Air

Broad band Network

Local Station
Master Switcher
Encoder

On Air

Compression Transmission

Key Station
Encoder

On Air

Satellite Network

Broadcasting MPEG-2 TS

Intermediate band Network

Local Station
Decoder
Master Switcher
Encoder

Trans-coding TS Processor

Local Program
Why is the Integrated Monitoring System Important in Digital Broadcasting?

- Monitor of both digital broadcasting and analog broadcasting
- Monitor of specific items on digital broadcasting
  - Multi-channel (Service and audio)
  - MPEG-2 transport stream monitor

Increase of monitoring items

Not increase the number of operators
Example of Integrated monitoring Display
Examples of monitoring screen and error log

- TS is constantly monitored at monitoring points, and the error log can be displayed.
- When there is any failure in video/audio/data, the TS of the corresponding period can be withdrawn from the accumulation device and regenerated.
TV-Asahi Master Control Switcher System

SD/HD-Router
256X128
(Program)

SD-loc
SD-Net

SD/HD-MTX
128X128
(OUT SW)

SD-Loc
SD-Net

Analog-Loc
Analog-Net

Integrated monitoring system
Multi Projector

Remote
Studio Net
PGM SV
CM SV
VTR
NM,CB,BC,BB
VAF
CG

SD
Studio Net
PGM SV
CM SV
VTR
NM,CB,BC,BB
VAF
CG

Analogue Net

SD/HD-MTX
256X64
(Monitor)

SD
ENC
MUX

SD/HD-MTX
128X128
(OUT SW)

TV-Asahi Master Control Switcher System
Characteristic of TV-Asahi Master Control Switcher System

- Massive and SD/HD Multi-format System
  - SD/HD router ; 256 x 128

- High Reliability
  - Triple redundant system
  - Input part ; Dual

- Scalability
  - Easy extension by addition of MK part
  - Software update by using Test part

- Efficient monitoring and operations
  - Integrated monitoring system
  - Multi-monitor, Touch panel
TV-Asahi Master Control and Remote

Master Control Room

Remote Center