1. Introduction

Full-scale next-generation network (NGN) service has already started, and the development of broadband and high-reliability network infrastructure is in progress. Meanwhile, the number of network-connectable household devices such as personal computers (PCs), audio visual (AV) equipment, and home security equipment continues to increase. Home information and communication technology (ICT) provides users with new services by linking the customer premises equipment with the network.

Mitsubishi Electric has been working on the development of key technologies required to realize the home ICT, including: Home Gateway (HGW), Internet Protocol Television (IPTV) technology, and Digital Living Network Alliance (DLNA) compliant home network technology.

This paper describes Mitsubishi Electric’s approach to ICT, centering on IPTV technology that makes it possible to enjoy video streaming services.

2. Trends in the IPTV Industry

Domestic IPTV services are largely divided into two categories: those provided over the controlled Content Delivery Network (CDN) that uses a highly reliable network such as NGN, and those provided over uncontrolled Internet services. The former service mainly assumes an optical line as the access network to provide high-quality Hi-Vision video content, and its subscribers have already exceeded two million. In addition, because of its high reliability, an IP retransmission service for Digital Terrestrial Broadcasting (DTB) has also been provided since May 2008, and another IP retransmission service for Broadcast Satellite (BS) broadcasting has started since October 2010. Meanwhile, Internet-based IPTV services, such as “acTVila” sponsored by the home appliance industry and user-contribution-type video sites, are also spreading. By making the best use of the interactive features of IPTV, more new services are expected to emerge in the future.

3. IP-STB

3.1 Approach to the development of IP-STB

As IPTV is an important technology for combining communications and broadcasting, Mitsubishi Electric has been working since 2006 to further develop IPTV based on its own technologies for optical communications, video encoding, and AV home appliances. As a result, an IP set-top box (IP-STB) has been developed for receiving and playing IPTV service programs. In 2007, pioneering the industry, we successfully cleared the guideline for the retransmission of DTB. We also participated in an NGN trial conducted by the communications carrier. In 2008, we delivered our IP-STBs to the IPTV carrier for their internal evaluation. After that, the system-on-a-chip (SoC) was upgraded to the latest version; more compact size and lower power consumption have been achieved; and in May 2010, the first commercial products were released.

3.2 Outline of IP-STB

In May 2010, Mitsubishi Electric launched the IP-STB shown in Fig. 1, which is in compliance with the IPTV forum specifications and can receive and display Hi-Vision quality video content delivered over the CDN configured with the NGN.

Fig. 1 External appearance of IP-STB

This IP-STB covers the services of IP multi-channel broadcasting, IP retransmission of DTB and BS broadcasting programs, and video on demand (VoD). In addition, broadcasting content can be recorded and replayed maintaining the Hi-Vision quality to/from an external hard disk drive via a universal serial bus (USB) port.

This IP-STB makes it possible for the service provider to supply the service menu screen on-line, for example, for the user to select the desired video content, rather than pre-installing it as embedded software; and thus the provider can easily add and/or change the service menu. Regarding the recent topic of 3D broadcasting service, this IP-STB already covers the side-by-side method with half-HD quality, and 3D broadcasting can also be enjoyed by connecting it to a
Table 1 Functional overview of IP-STB

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP version</td>
<td>Hybrid of IPv4 and IPv6</td>
</tr>
<tr>
<td>Transmission protocol</td>
<td>IP/UDP/RTP</td>
</tr>
<tr>
<td>Multiplexing system</td>
<td>MPEG-2 TTS</td>
</tr>
<tr>
<td>FEC</td>
<td>Pro-MPEG CoP3 1D/2D</td>
</tr>
<tr>
<td>IP broadcasting channel selection</td>
<td>MLDv2 (IPv6), IP multicast</td>
</tr>
<tr>
<td>VoD control</td>
<td>RTSP, IP unicast</td>
</tr>
<tr>
<td>Video coding</td>
<td>MPEG-2 MP@ML, MP@HL, MPEG-4 AVC (H.264) MP/HP Level: 3/3.1/3.2/4</td>
</tr>
<tr>
<td>Voice coding</td>
<td>MPEG-1 Layer2, MPEG-2 AAC-LC</td>
</tr>
<tr>
<td>Subtitle ES</td>
<td>Available for IP broadcasting, VoD, DTB/BS Retransmission</td>
</tr>
<tr>
<td>BML browser</td>
<td>For data broadcasting</td>
</tr>
<tr>
<td>Reservation function</td>
<td>Viewing reservation and Recording reservation are available</td>
</tr>
<tr>
<td>Video recording</td>
<td>Digital recording on USB external HDD (TS recording)</td>
</tr>
<tr>
<td>Trick play</td>
<td>Fast forward, Fast reverse, Pause, Skip chapter</td>
</tr>
<tr>
<td>Configuration information</td>
<td>Available for IP-B, VoD, DTB/BS Retransmission</td>
</tr>
<tr>
<td>Program guide</td>
<td>Program guide/ Competing program guide for IP broadcasting, DTB/BS Retransmission Display control of adult service for IP broadcasting</td>
</tr>
<tr>
<td>3D display</td>
<td>Side-by-side method (Half-HD quality) (TV set needs to be manually set to 3D mode)</td>
</tr>
</tbody>
</table>

UDP: User Datagram Protocol
RTP: Real-time Transport Protocol
TTS: Timestamped Transport Stream
FEC: Forward Error Correction
CoP: Code of Practice
MLD: Multicast Listener Discovery
RTSP: Real Time Streaming Protocol
AVC: Advanced Video Coding
AAC-LC: Advanced Audio Coding-Low Complexity
ES: Elementary Stream
BML: Broadcast Markup Language

4. Approach to the Future

4.1 Home network interoperability

Increasingly more digital TVs, Blu-ray recorders, and other devices from major domestic AV device manufacturers are equipped with DLNA-based home network connectivity. Many PCs and network-attached storage (NAS) HDDs are also DLNA compatible. There is a growing trend in content sharing between home networked devices. Since 2003 when the DLNA was established, Mitsubishi Electric has been involved in the standardization and R&D activities of DLNA. At the Plugfest interoperability event hosted by the DLNA, the developed DLNA middleware was tested to enhance the interoperability. In May 2011, a new IP-STB product
was developed with home network connectivity and interoperability. Figure 2 illustrates an example of the home network interoperability of this IP-STB.

4.2 Interactive service support

By making full use of its interactive features, IPTV is expected to provide various new services including: TV commerce, remote education, security service, and remote healthcare. Mitsubishi Electric is considering the use of widgets as one approach for realizing an environment that allows for easy installation and execution of various applications on the IPTV set, that is, a platform for flexibly performing these services.

A widget is a small Java script application that links to web information. Mitsubishi Electric is conducting research and development on a compact widget execution environment for embedded devices, which makes it possible to run widgets in compliance with the industry standard World Wide Web Consortium (W3C).

4.3 Reducing Power Consumption

Reducing power consumption is a recent attention-attracting topic. Mitsubishi Electric has optimized the standby mode, and in addition to the power-saving standby mode (power saving by 90%), has developed a new standby mode (power saving by 20%) with a reservation start and quick start (within 5 s) function, which encourages power saving in accordance with the use scene. We plan to further reduce the power consumption by adopting the latest SoC, and further optimize the standby mode for additional power saving. In addition, we are also considering linking various customer premises equipment centering on the HGW, and collecting real-time power usage conditions through the HGW for displaying on the TV monitor.

5. Conclusion

This paper described the IPTV service, one of the representative home ICT services, specifically the trends in service and standardization, and Mitsubishi Electric’s IP-STB. We will continue working on technology development to provide users with convenient and easy-to-use home ICT services. In parallel, we will also pursue lower power consumption and total energy saving at home by achieving connectivity and interoperability of the equipment.

References

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