# ITU IPTV Standards Testbed System based on OKI MediaServer

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Spread of broadband has spurred worldwide growth of IPTV (Internet Protocol TV), which uses IP to stream video. In Japan, commercial service is already being provided to over 2.3 million subscribers, and the number is increasing yearly by hundreds of thousands. Initial service began with basic IPTV services that included linear TV and VOD (Video On Demand). Linear TV uses the IP network to deliver TV programs which are traditionally broadcasted using radio waves. VOD enables control of viewing video through the IP network in a way similar to watching a recorded program at home. Recently, types of available services are growing yearly with such new services as allowing viewers to restart a program during the middle of the broadcast, viewing programs on tablets/smartphones, interacting with twitter and buying e-books.

In Japan, considered a leading country in FTTH, the IPTV systems use several standards from ITU[1)], the communication standards agency for the United Nations. In order to promote the standards, ITU has been conducting workshops and exhibits in various countries. Countries/regions considering the implementation of IPTV have high interest in such efforts, but they need more than to view exhibits in order to decide on the implementation of ITU-based IPTV. They must determine how the services they actually wish to implement are achieved using the standards. To do so, requires an understanding of the standards. Unfortunately, ITU's effort mentioned above only shows a portion of existing services and time-wise is insufficient for such purpose.

Therefore, OKI together with Hokkaido Television Broadcasting Co., Ltd. (HTB) launched an experimental video distribution environment called "ITU IPTV IPv6 Global testbed (I3GT)" in October 2012. The testbed setup consists of the ITU IPTV standards-compliant video distribution system "OKI MediaServer" in the cloud environment of the JGN-X network, which was built and is operated by the National Institute of Information and Communications Technology (NICT), and LIME –based contents produced by HTB.

The testbed gives service providers, research institutes and universities of various countries capable of interoperating with JGN-X an environment to conduct IPTV-related experiments that will help them deepen the understanding of the ITU IPTV standards' value and as a result promote the spread of services based on the ITU IPTV standards.

This article gives an overview of the IPTV standards, the testbed system, past experimental trials and future efforts.

## Overview of ITU IPTV Standards

It is assumed that in IPTV, video distribution service is carried out over an IP network managed by a communications carrier. In April 2006, ITU established an IPTV focus group to begin coordination and promotion work for international IPTV standards. During the course of seven meetings, the IPTV focus group gathered 1,300 participants and produced 20 documentations, which were passed over to the IPTV-GSI (Global Standard Initiative) where recommendation work was initiated. The major recommendations and advantages of standards adoption are given below.

**(1) Application Middleware LIME (H.762)**

Not only is IPTV good for streaming video, but it is also capable of services utilizing the bi-directionality of IP and integrating with other IP-based services. H.760 defines the multimedia framework for making those services possible. H.761 includes specification based on GINGA that is used in digital broadcasting in Brazil. H.762 is based on BML used by Japanese digital broadcasters and includes extension for internationalization and IPTV control. H.762 is also referred to as LIME (Lightweight Multimedia Environment), and variety of application development is underway worldwide.

**(2) Terminal System (H.721)**

The H.721 recommendation is based on specifications standardized by IPTV Forum Japan. Its feature lays in the fact that IPTV terminal definition remains consistent with receiver specifications of Japan's existing digital broadcasting, hence can be incorporated into TV

receivers as well as set-top boxes. Additionally, the video transmission protocol between server and terminal defined in H.721 employs RTP capable of real-time video transmission. Consequently, highly responsive trick plays such as fast-forward and rewind are possible.

**(3) Advantages of ITU IPTV Standards Implementation**

ITU IPTV standards assume the existence of multiple service providers on a network, and a user is able to receive services from several providers through a single terminal. As a result, service providers need not prepare terminals for each new service, thus advancement in introduction of new services can be expected. By adopting the standards, countries or regions planning to introduce IPTV can easily implement terminals and contents used elsewhere to reduce implementation time and cost.

## Overview of ITU IPTV Standards Testbed I3GT

To advance the adoption of the above ITU IPTV standards, OKI and HTB launched I3GT in October 2012. Using an IPv6 network, I3GT is intended to provide a worldwide testing environment for the ITU IPTV standards. The testbed can be used to verify (1) a network has the bandwidth and quality (delay, loss) capable of IPTV video distribution; (2) the interactive functionality of applications with video/still image/text of LIME compliant contents; and (3) the interface during terminal development, thereby enabling a better understanding of the standards' value.

The testbed is built on a server located in NICT's JGN-X. OKI MediaServer, considered an ITU standards-compliant reference, is utilized as the IPTV platform.

Conceptual architecture of I3GT is shown in **Figure 1**. The tester at the left side of the figure interconnects the network, which his terminal is connected, to JGN-X where the I3GT is located. Here, the interconnected tester's network and JGN-X act as the managed network (pseudo-managed IP network) for IPTV.

The IPTV service description provider and IPTV service provider in **Figure 1** are functions on the distribution server side of the network and provided by the OKI MediaServer. Based on H.770, the IPTV service description provider maintains a database (DB) for the IPTV services available over the network and provides service-related information to the terminal. IPTV service provider is one of the service providers registered in the IPTV service description provider DB, and based on H.721 provides actual VOD, linear TV and other video service or delivers LIME contents based on H.762.

To the right of the IPTV service provider is the operations network used to add/delete contents, authenticate service, manage testers and manage software for the distribution server.

Besides testing the terminal, the tester can make use of "A", surrounded by dotted lines in the figure, to perform actual tests on distribution server performance and functions. To implement IPTV service provider functions such as VOD and linear TV into "A", the tester registers "A" with the IPTV service description provider DB. Then the tester can receive the services in "A" on his terminal following the steps below.

a) Connect to the IPTV service description provider when starting up the IPTV terminal.
b) The terminal will display "A" among the entries in the IPTV service description provider DB and IPTV service provider connected with JGN-X.
c) Tester selects "A" then the terminal will connect with service provider "A" and begin receiving

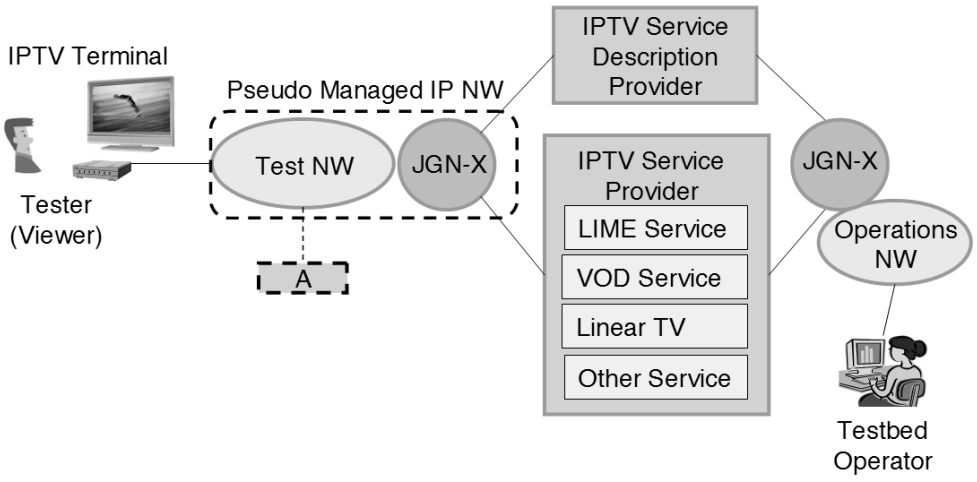


**Figure 1. I3GT Conceptual Architecture**

service.

The mechanism by which an IPTV terminal connects to a newly added service as described above is called service discovery.

Rather than implement new IPTV service provider functions described previously, “A” can simply be connected as a server placed at different geographic location. From the IPTV terminal’s view, it is connecting to a different server without notice while selecting content.

**Table 1** shows the ITU IPTV standards that can be currently evaluated with the testbed. Since IPTV service is still undergoing development, active discussions are continuing in ITU IPTV-GSI toward the establishment of new standards. Therefore, additions and revisions to the standards listed in the table are likely.

**Table 1. ITU Standards Evaluated with Testbed**

| | Description |
|---|---|
| H.762 | Standard for multimedia contents (LIME) that use IPTV |
| H.721 | Standard for receiving VOD, live, linear TV |
| H.770 | Standard for terminals to discover various services that exist on the IPTV network |
| H.701 | Standard for correcting packet loss and other errors that occur on the network |
| H.264 | Standard for viewing standard images, high-definition images |
| H.750 | Standard for metadata describing VOD/linear TV contents and viewer information |

## Overview of I3GT Experimental Trials

**(1) Trial at WTSA-12, November 2012**

The first I3GT experimental trial and exhibition was conducted on November 20 and 21, 2012 at the "ITU World Telecommunication Standardization General Assembly (WTSA-12)" held in Dubai, UAE. System architecture for the trial is shown in **Figure 2**. Dubai’s communication carrier, du, constructed a temporary 15Mbps IPv6 network to the trial site using IPv6 over IPv4. To demonstrate the system, a high-definition video created by HTB was delivered as VOD from Sapporo, Japan. Additionally, video from a camera installed at the entrance to the United Nations in Geneva was also transmitted to demonstrate live video delivery. Over 1,000 people from 101 of the 190 United Nations member countries associated with communication service providers or communication related regulatory agencies were in attendance. In ITU Secretary-General’s opening speech, I3GT was taken up as an example of ITU’s interconnection experiment prompting many attendees to visit the exhibit during the meeting.

Although temporary, the experimental trial proved that a system compliant with ITU ITV standards, which was originally created for video delivery in a closed network, can be built over intercontinental networks for viewing high-definition videos. This shows the I3GT can fulfill its goal as a worldwide testbed for the ITU IPTV standards.

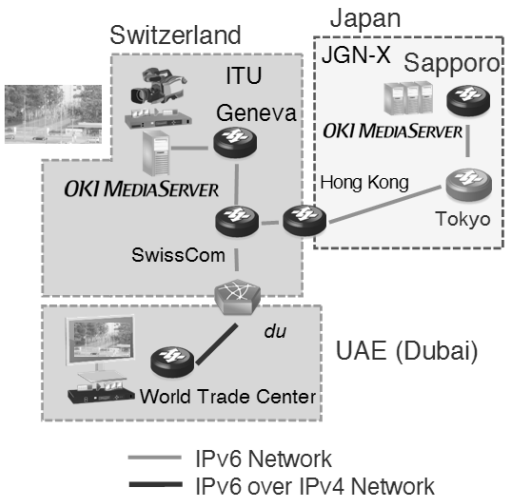


**Figure 2. I3GT Architecture at WTSA-12**

**(2)Trial at Sapporo Snow Festival, February 2013**

The second I3GT trial was carried out between February 5 and 7, 2013 at the “Sapporo Snow Festival”. **Figure 3** shows the system architecture used for the trial. While the first trial tested delivery to a temporary trial site, this second trial tested delivery from the trial site to terminals set up at the Singapore National Information and Communication Institute, Philippines’ Ateneo de Manila University and ITU headquarter.

Currently, transition to IPv6 is taking place globally. However, there are still many countries where actual construction is not progressing. For those countries, IPv6 packets are encapsulated with IPv4 at the server-side and delivered via IPv4 to the receiver location. At the receiver-end, the encapsulated IPv6 packets are extracted and sent to the STB. This feature was demonstrated at the trial with contents delivered to Philippines’ Ateneo de Manila University. The trial used live contents and high-definition VOD created by HTB especially for the snow festival as well as VOD contents provided by ITU.

Between the trial site and Singapore, a large-scale OpenFlow testbed known as RISE built over JGN-X by NICT was utilized. In addition to video contents mentioned above, 4K videos created with an encoder from MEDIAEDGE Co., Ltd. were used.

New IPTV applications that interact with SNS (Social Network System) and subtitle services on the Internet were also tested during the trial.

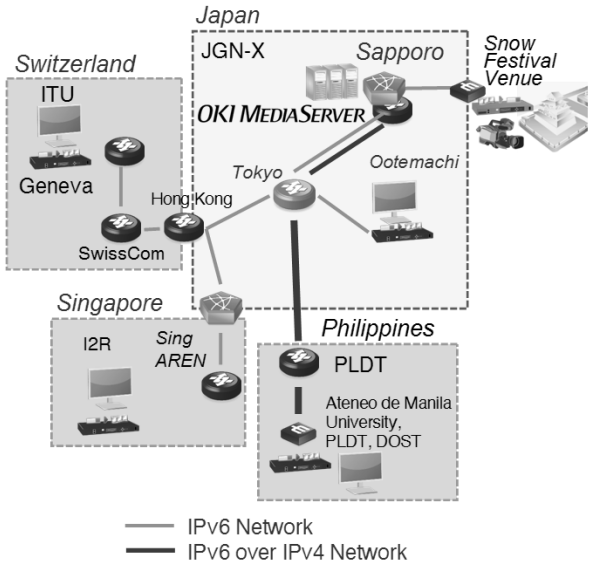


**Figure 3. I3GT Architecture at Sapporo Snow Festival**

The former service simultaneously displays high quality IPTV video and associated SNS information on the viewer's terminal enabling video contents to be enjoyed through SNS. It used technology to interact IPTV with SNS developed by NTT Communications Corporation.

In the latter, contents from the Internet subtitle service provided by ASTEM Inc. were synchronized with IPTV video contents using LIME's Internet communication function to deliver subtitles in the language and font size selected through the viewer's terminal. Unlike existing digital broadcasting that superimposes subtitle with video into a single stream, this method has the flexibility to offer subtitle languages and layout according to viewer choice improving service accessibility. Screen image is depicted in **Figure 4**.

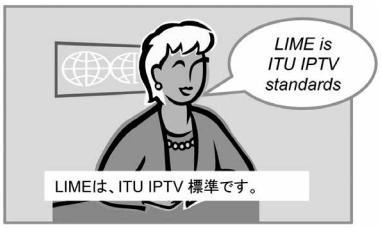


**Figure 4. Interaction with Subtitling Service over Internet**

The trial confirmed the two functions above work as originally intended. This means new IPTV services that interact with Internet services can be tested over I3GT and considered an important achievement in enabling the testing countries to confirm services they are actually planning to implement.

## Future Efforts

Based on the experimental findings, OKI plans to expand the scope of the IPTV testbed to countries/regions that (1) have not deployed IPv6; (2) has deployed IPV6 and are planning 4K and higher image quality; (3) are planning to improve accessibility or provide value-added video services such as SNS interaction. Additionally, OKI will enhance the features of the OKI MediaServer to meet market needs, push for standardization of those features[2], work to promote the standards and advance the deployment of an appealing video distribution platform.

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## References

1) Hideki Yamamoto, Standardization Trends of Internet Protocol Television (IPTV) and Activities Undertaken by OKI, OKI Technical Review, No.215 (2009)
2) Hideki Yamamoto, Standardization Trend for IPTV audience measurement, OKI Technical Review, No.218 (2011)

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## 【Glossary】

**JGN-X**
A testbed environment operated by NICT since April 2011 for the implementation and deployment of new generation network technologies.

**OpenFlow**
One of the technologies behind SDN (Software Defined Network), a network that uses software to perform configurations instead of hardware such as routers and L2 switches. Standardization is carried out by Open Networking Foundation (ONF).

**RISE (Research Infrastructure for large-Scale network Experiments)**
A large-scale OpenFlow testbed developed on top of JGN-X. It is one of JGN-X's new generation network plane virtually deployed over a wide area on an existing L2 virtual network.