TTC技術レポート
Technical Report

TR-1055

Workshop on Multimedia Technologiesの発表資料

Presentation Papers of
Workshop on Multimedia Technologies

第 1.0 版

2014 年 12 月 24 日制定

一般社団法人
情報通信技術委員会

THE TELECOMMUNICATION TECHNOLOGY COMMITTEE

目　　次

0. はじめに

TTCでは2008年にIPTV専門委員会を設置し、IPTVサービス事業者（通信キャリア）、コンテンツ事業者（放送局）、ネットワーク機器・受信端末製造事業者（メーカ）等が相互に協力し、国内の動向に国際標準化を合わせるべく提案活動を行う目的で活動してきた。一方、IPTV専門委員会では定期的に会員の皆様に向けてセミナーを開催しており、2014年度はITU-T SG16札幌会合（2014年6月30日~7月12日：札幌コンベンションセンターにて開催）に併催されたワークショップ Workshop on Multimedia Technology の一部を協賛して実施した。

ワークショップはSG16会合ホストである日本企業によって企画され、2014年7月1日の午後に小ホールにおいて開催された。ワークショップの主催はプログラム委員会が行ったが、IPTV専門委員会からも遠藤委員長及び田中副委員長が委員として協力した。なおワークショップの共催には総務省が名を連ねた。ワークショップの技術講演セッションは、TTC マルチメディアアドバイザリーグループ（MM-AG）がオーガナイズし、そのうちIPTVに関連する講演を集めた技術セッション1をIPTV専門委員会がオーガナイズした。当日の司会はそれぞれの委員会の芹沢MM-AGサブリーダと田中IPTV専門委員会副委員長が分担した。ワークショップへの参加者は81名であった。

この技術レポートは、IPTV専門委員会がオーガナイズした技術セッション1の講演資料を集約したものである。

ITU-Tにおいては日本が主導的に提案してきたIPTVの主要な勧告は出揃い、これからはサービスを一層発展させる標準化が進むと考えられる。日本においてもIPTVに関連する有望なサービスの標準化が求められることが想定されるため、そうした有望なサービスと早期に連携し、日本の商用サービスで採用している方式を国際標準として整合性を高めていくことが求められる。今回のワークショップで発表いただいた内容についても、今後のIPTV専門委員会の活動に反映していきたい。

IPTV専門委員会の活動および本技術レポート作成にあたり、IPTV専門委員会メンバーならびに諸兄のみなさまに多大な協力をいただき、心より謝意を申し上げたい。本技術レポートを国内の標準化・サービスと国際標準化の理解の一助としていただくとともにTTC活動への積極的な参加のきっかけとなることを期待する。

1. 作成担当

IPTV 専門委員会

2. 改訂の履歴

版　数	制　定　日	改　版　内　容
第 1 版	2014 年 12 月 24 日	制定

Innovative R&D by NTT

H.265/HEVC Encoder for UHDTV

July 1, 2014

Mitsuo Ikeda
NTT Media Intelligence Laboratories
Nippon Telegraph and Telephone Corporation

Agenda

- ✓ UHDTV services and video specifications
- ✓ H.265/HEVC overview
- ✓ Real-time video codecs developed by NTT

UHDTV services

- Rec. ITU-R BT.2020 was approved in 2012.
- UHDTV products such as 4K displays already have been developed.
- UHDTV broadcasting systems in Japan have been investigated.

UHDTV roadmap in Japan

Innovative R&D by NTT

2014

Improvement of the environment in which viewers, interested in 4K, can experience it

2016

Improvement of the environment in which viewers, interested in 8K, can experience it

2020

Improvement of the environment to make it possible for targeted viewers to enjoy watching 4K/8K TV

NTT

Reference: http://www.nextv-f.jp/en/pdf/press20130617_2.pdf

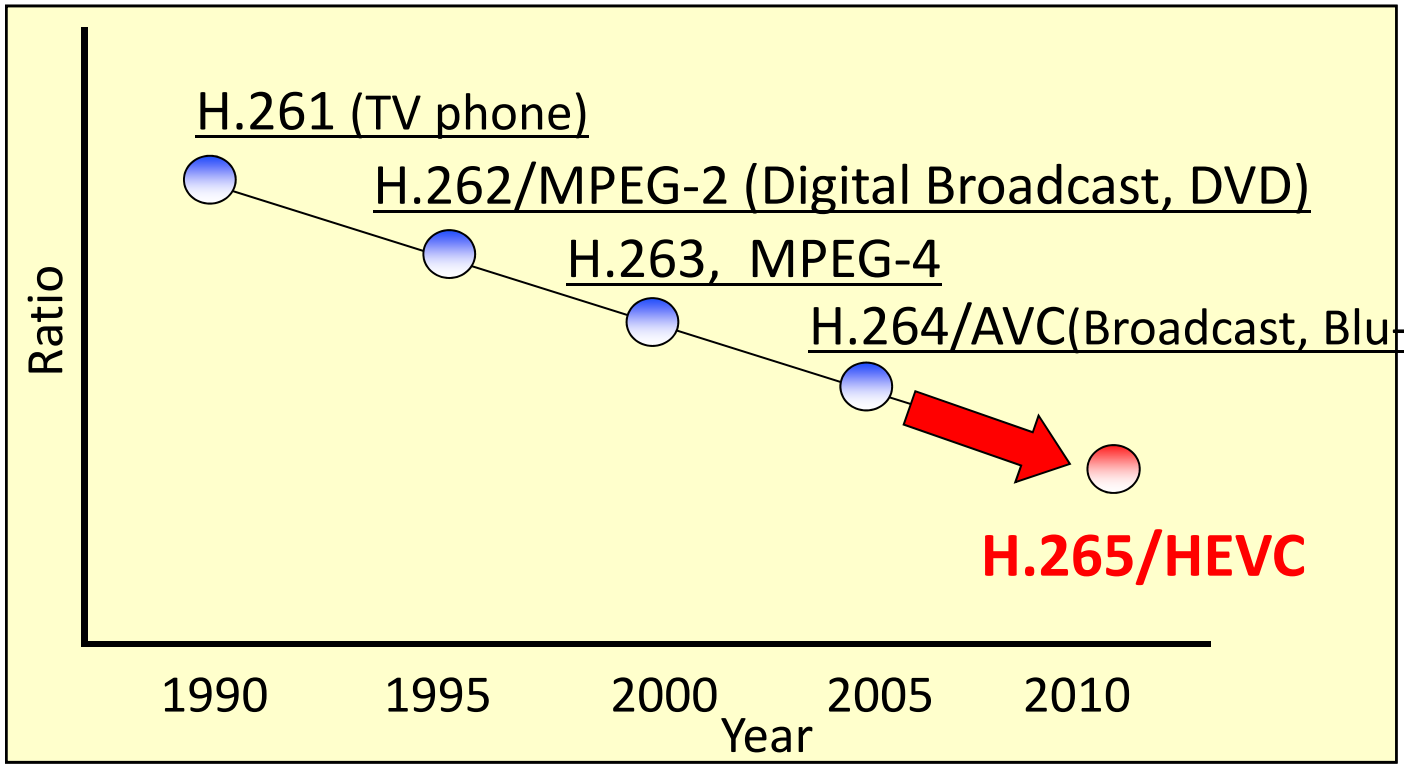
Video formats of UHDTV in Japan

	UHDTV		HDTV	
Video Format	8K	4K	1080p	1080i
Frame Size	7,680 x 4,320	3,840 x 2,160	1,920 x 1,080	
Frame Freq. [Hz]	120, 120/1.001, 60, 60/1.001		60, 60/1.001	–
Field Freq. [Hz]	–		–	60, 60/1.001
Video Throughput [pixel/s]	Max. 3,981 M	Max. 995 M	124 M	62 M
Ratio (to 1080i)	Max. 64	Max. 16	2	1

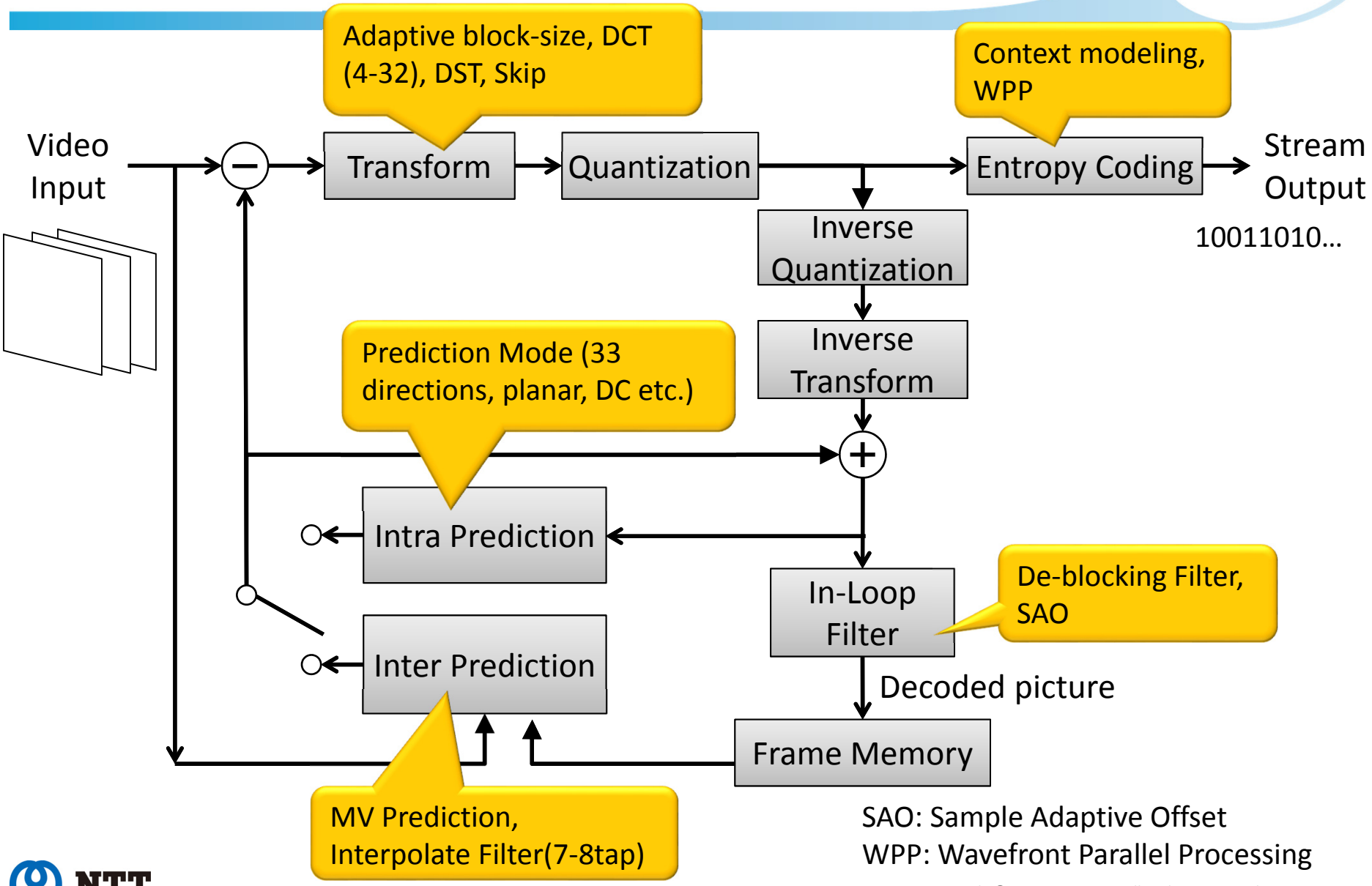
- It is rather difficult to provide UHDTV services at low bitrates using MPEG-2 or H.264/AVC.
- Developing technologies with higher video-coding efficiencies is highly desirable.

H.265/HEVC review

- HEVC: High Efficiency Video Coding [1]
- Aimed at achieving same level of video-quality at half rate of H.264/AVC
- Main/Main 10/Main Still Picture Profile: approved in 2013

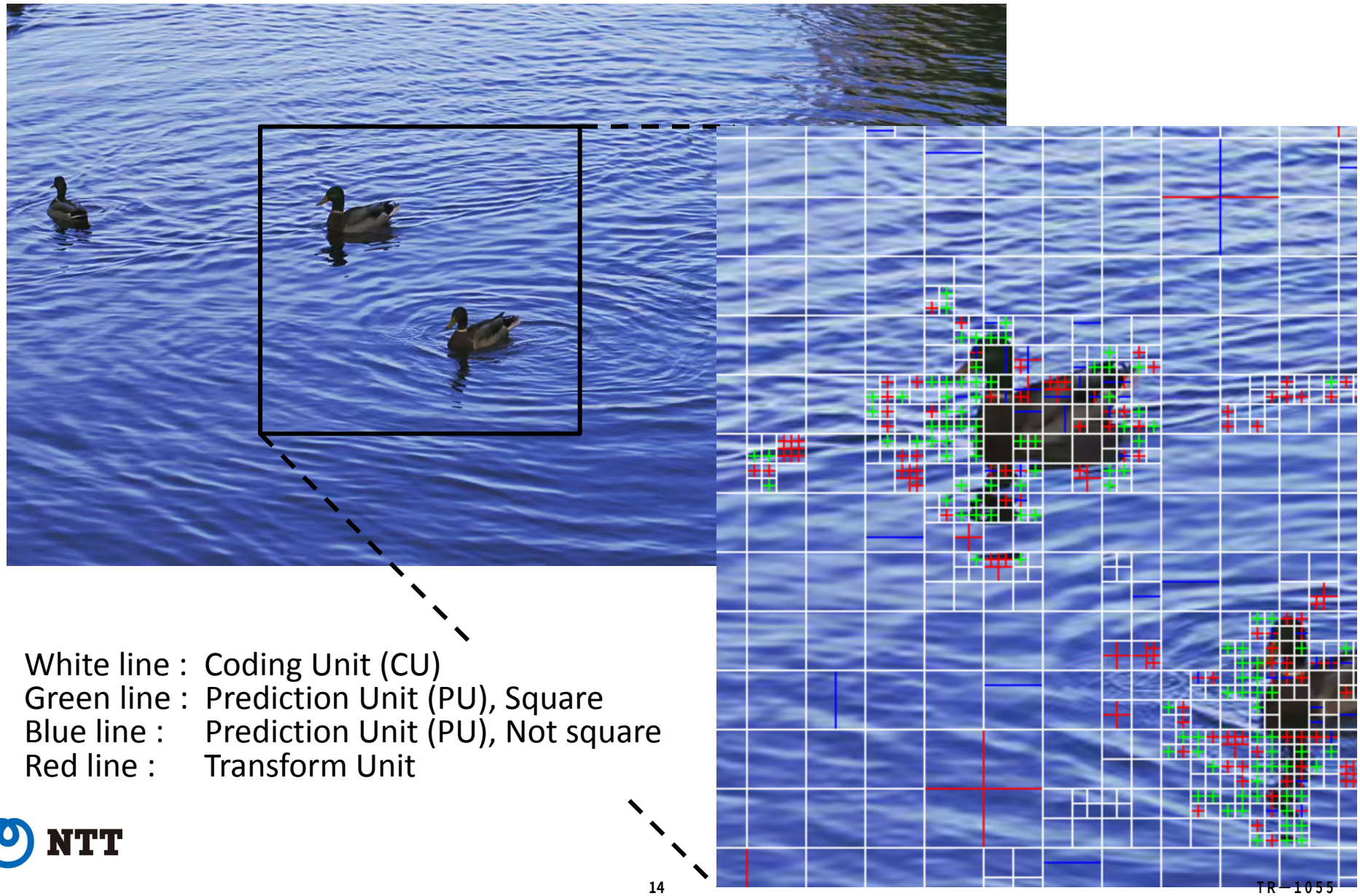


Main tools and flow of H.265/HEVC coding



SAO: Sample Adaptive Offset
WPP: Wavefront Parallel Processing

Example of CU/TU/PU partition

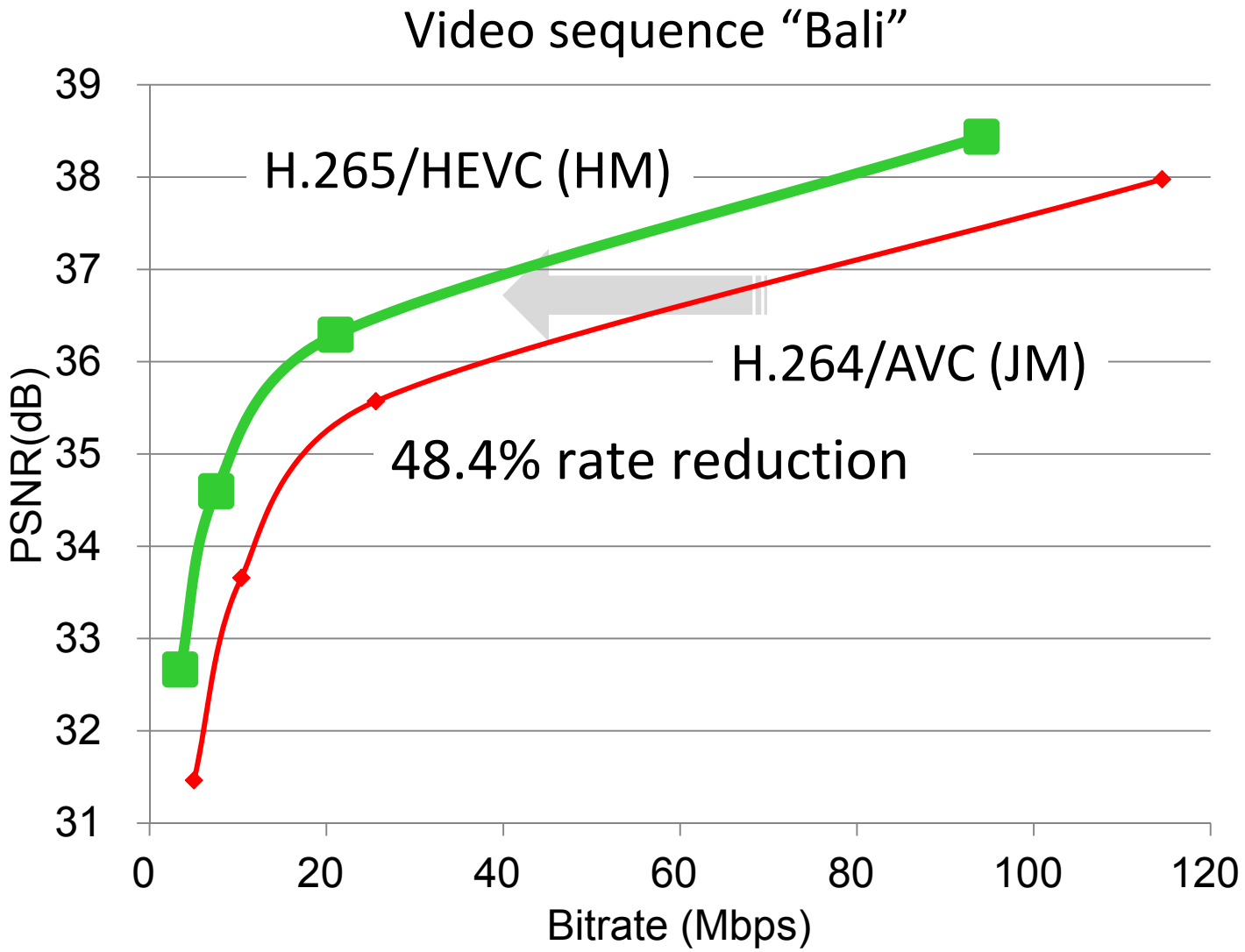


White line : Coding Unit (CU)
Green line : Prediction Unit (PU), Square
Blue line : Prediction Unit (PU), Not square
Red line : Transform Unit

4K coding experiment

- Video sequence
  - “Bali” dancing and Market
  - 3840 x 2160, 940 frames
- CODEC
  - H.265/HEVC: Test Model(HM)
  - H.264/AVC: Joint Model(JM)
- Coding conditions
  - GOP: IBBBBBBBP (only one I)
  - Reference frames: 4
  - Quantization Parameters: 22, 27, 32, and 37

H.264 and H.265 rate-distortion curves



Real-time video codecs of NTT

Innovative R&D by NTT

Analog Digital → SDTV HDTV → MPEG2 H.264 → HDTV UHDTV H.264 H.265

Encoder PCI Board

Portable HDTV Encoder (ICCE2001)

Encoder PC Card (ICCE2000)

ENC-C/-M (1995) (HotChips7)

SuperENC (1998) (HotChips10)

SuperENCII(2000)

NHK/NTT-COM Board

HDTV MPEG-2 Encoder

ISIL('02) (CICC2003)

VASA (2002) (HotChips14)

HDTV MPEG-2 Decoder

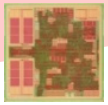
ISIL-II (2007) (CoolChips X)

MPEG-2/H.264 Transcoder

HDTV H.264 Encoder

HDTV H.264 Decoder

SARA/D (2008) (CoolChips XI)

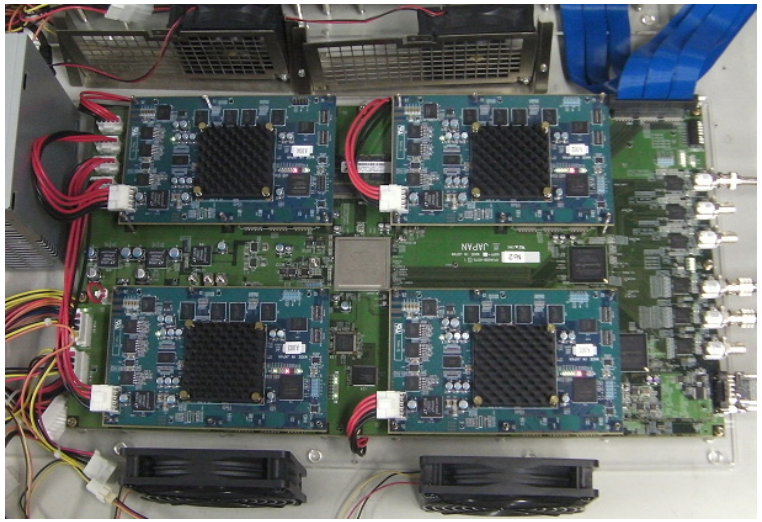


SARA(2007) (HotChips19)

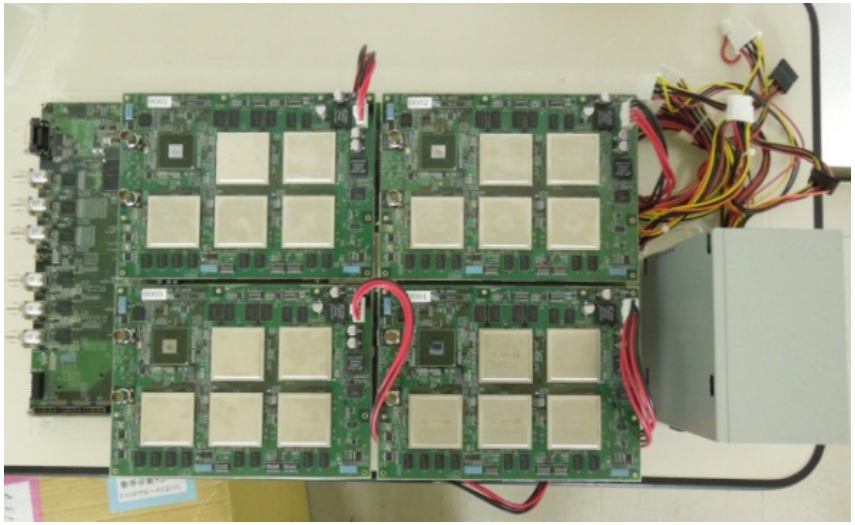
NTT

4K real-time H.265/HEVC codec

- NTT has been developing real-time H.265/HEVC codecs implemented in FPGAs on evaluation boards.
- A 4K intra codec was exhibited at NTT R&D Forum in Tokyo in February, 2013.
- A 4K inter codec was exhibited at NTT R&D Forum in Feb., 2014.

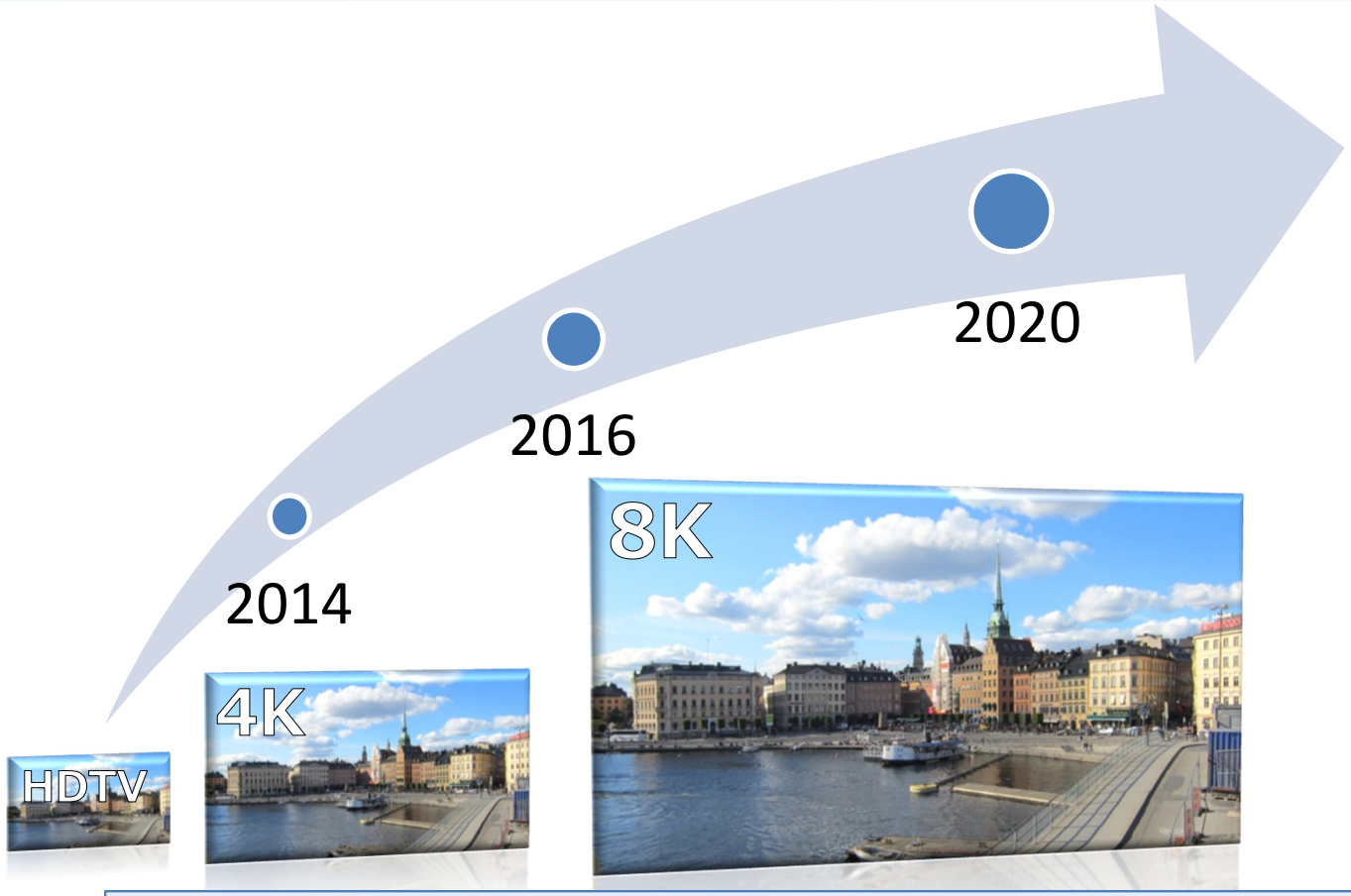


4K HEVC intra codec (2013)



4K HEVC inter codec (2014)

Trials and tests for UHDTV



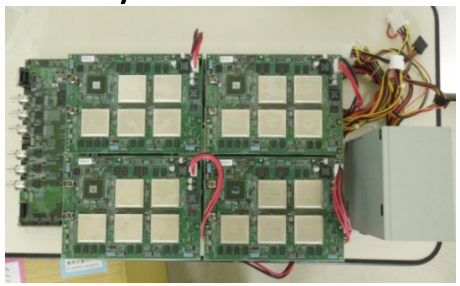
- 4K real-time H.265/HEVC with MMT-FEC (NTT, 2014)
- 8K Video Transmission via IP Network (NHK / NTT, 2014)

Exhibitions in “Showcasing”

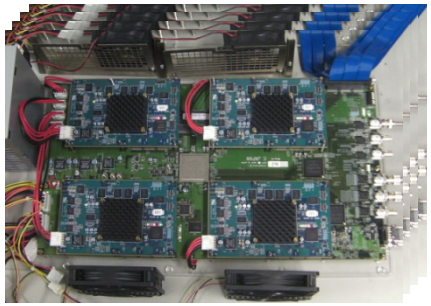
Innovative R&D by NTT

Reliable 4K H.265/HEVC Real-time Transmission by using MMT-FEC

H.265/HEVC Encoder



MMT Streamer
（Transmitter）



H.265/HEVC Decoder

MMT Streamer
（Receiver）

MMT : MPEG Media Transport [2]
FEC : Forward Error Correction

NTT

8K-UHDTV
H.265/HEVC Real-time Encoder

Atsuro Ichigaya

Japan Broadcasting Corporation (NHK)

Background

- 8K UHDTV (SUPER Hi-VISION:SHV)
  - Designed as the ultimate 2D-TV since 2000.
    - It can provide viewers a strong sensation of presence, as if they were actually there
  - Consists of 7,680 x 4,320 pixels(8K)
  - Bit depth : 10/12bit
  - Frame rate : up to 120 frames per second
- Test broadcasting of 8K is planned in 2016
  - 8K codec are strongly required
  - HEVC encoder was developed for the purpose

History of 8K-UHDTV codec

- 1st Generation Codec
  - 2006 MPEG-2 base codec
- 2nd Generation Codec
  - 2008 MPEG-4 AVC/H.264 base 1st codec
- 3rd Generation Codec
  - 2010 MPEG-4 AVC/H.264 base 2nd codec
- 4th Generation Codec
  - 2013 MPEG-H HEVC/H.265 base codec

First Generation Codec

- MPEG-2 base codec
  - Developed in 2006
  - Main/4:2:2 profile@HL (up to 640Mbps)
  - Assembled by a number of HDTV 30P codecs

Exhibited in many showcases:
NAB2006, IBC2006/2008, etc
Oversea transmission, including live relay
Interop Tokyo 2007, etc
Domestic live transmission

Used for domestic PV in Japan:
Annual music contest program 2006, etc
Domestic live transmission

Second Generation Codec

- 1st AVC/H.264 base codec
  - Developed in 2007
  - Main Profile@Level 4 (up to 340Mbps)
  - Assembled by a number of HDTV 30P codecs

Demonstration examples:

IBC2008,
Satellite transmission from Italy to Holland

Third Generation Codec

- 2nd AVC/H.264 base codec
  - Developed in 2010
  - High Profile@Level 4.2 (up to 280Mbps)
  - Assembled by a number of HDTV 60P codecs

This system was used for many exhibitions and public viewings.

Largest event:

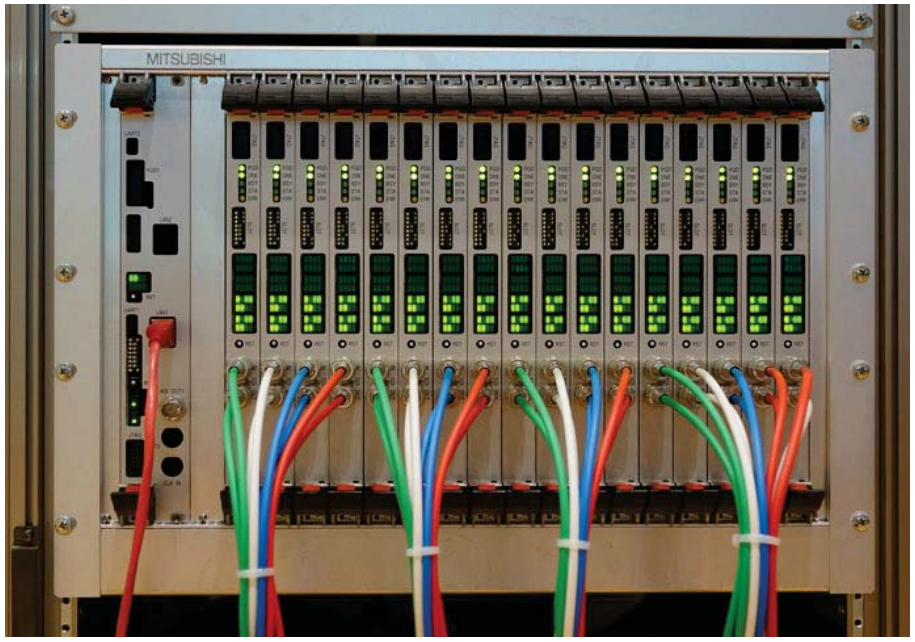
PV of 2012 London Olympics,
Transmitted from London to UK, US and Japan,
Including live relay

Ongoing event:

PV of 2014 FIFA World Cup,
Transmitted from Brazil to Japan,
Including live relay

HEVC encoder for 8K system

- World's first HEVC encoder
  - HEVC/H.265
  - Main 10@Level 6.1(Up to 340Mbps)
  - Output signals: MPEG-2 TS and local decoded video



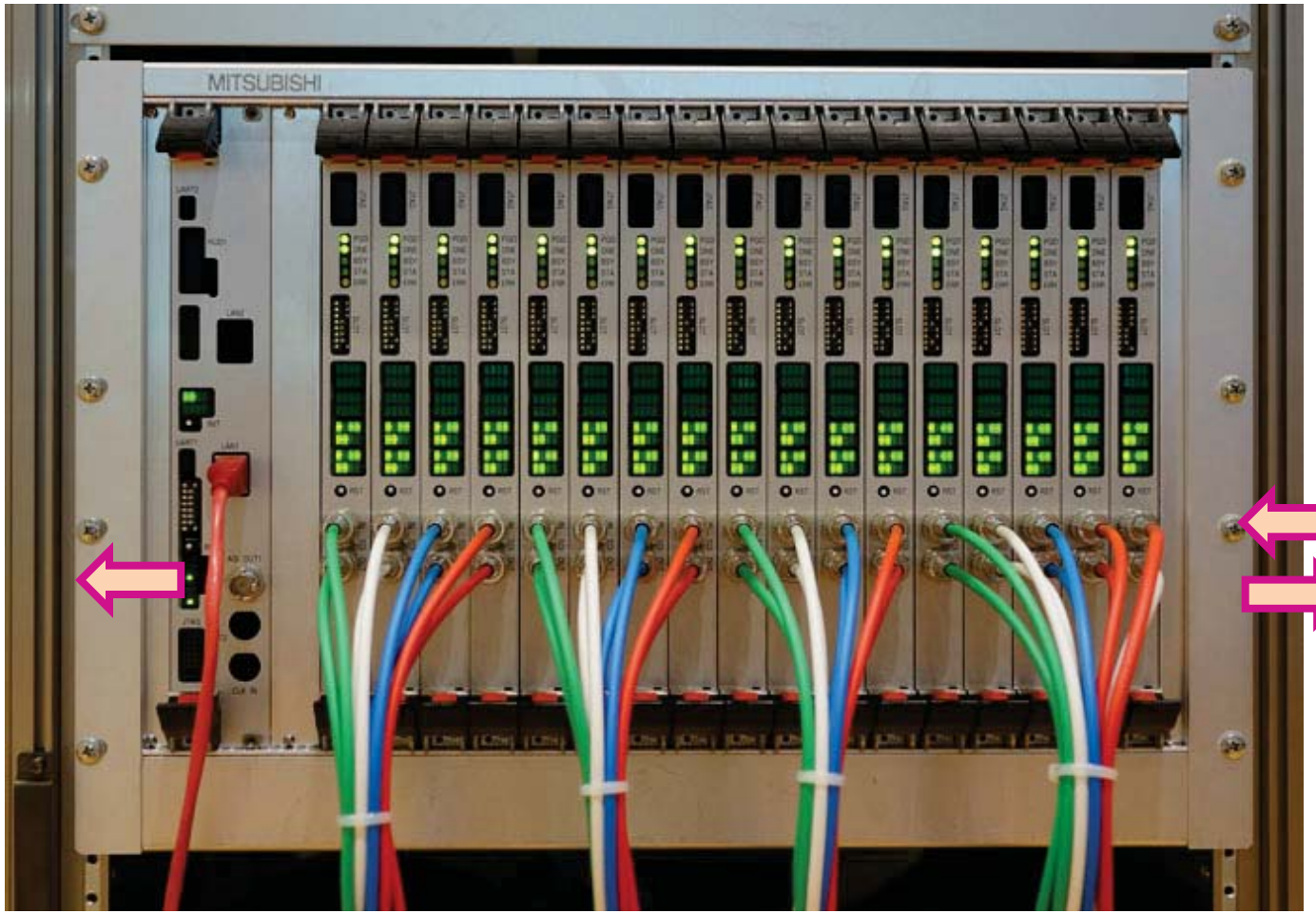
Video resolution	**7,6 0×4,320 pixels**
Frame rate	**60fps . 4fps**
Chroma format	**4 2 0**
Bit depth	**10 bit**
Maximum bit rate	**340Mbps**

Demonstration:
IBC 2013, NAB2014

Face of Encoder

CPU Unit

17 processing units



MPEG-2 TS Output

Source video

Local Decoded video

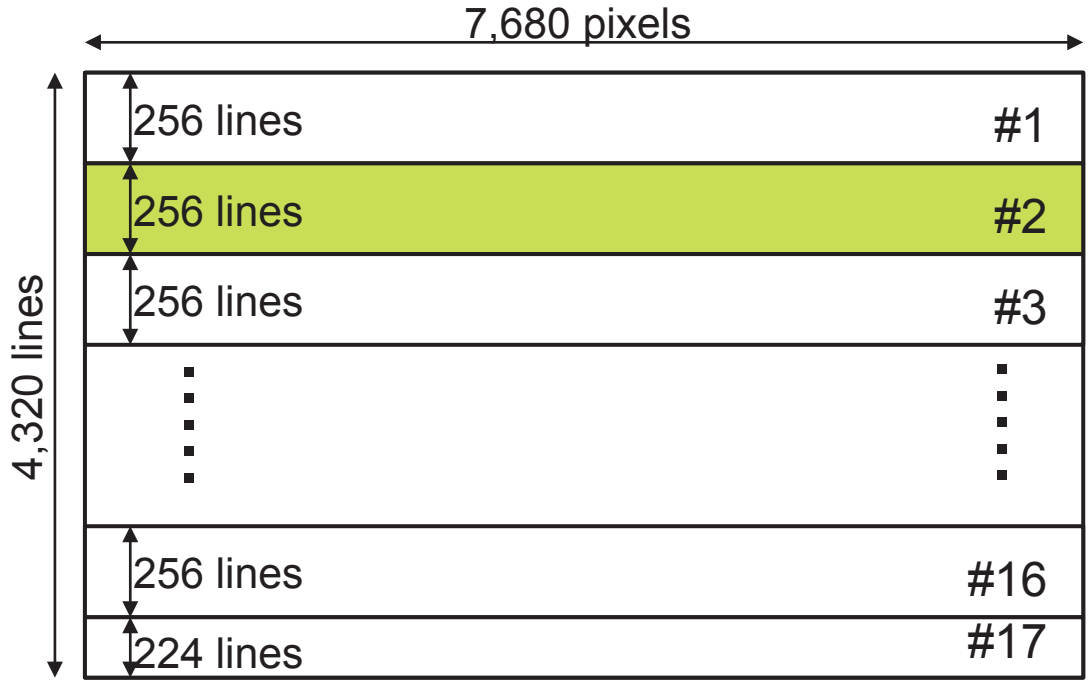
Displayed in the room 108.

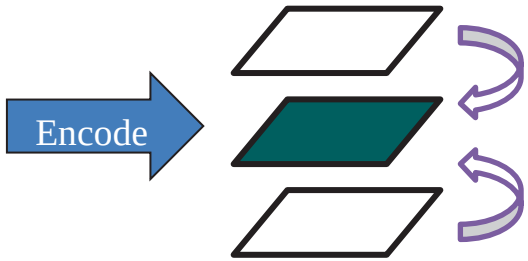
Encoding Tools

- CTU size: 64x64
- Hierarchical B structure: Supported
- Parallel encoding tool: Slice without WPP and Tile
- SAO: Unsupported
- AMP: Unsupported

Slice Structure

- Parallel encoding with 17 slice segments
- Size of each slice : multiple of 64 (CTU size)





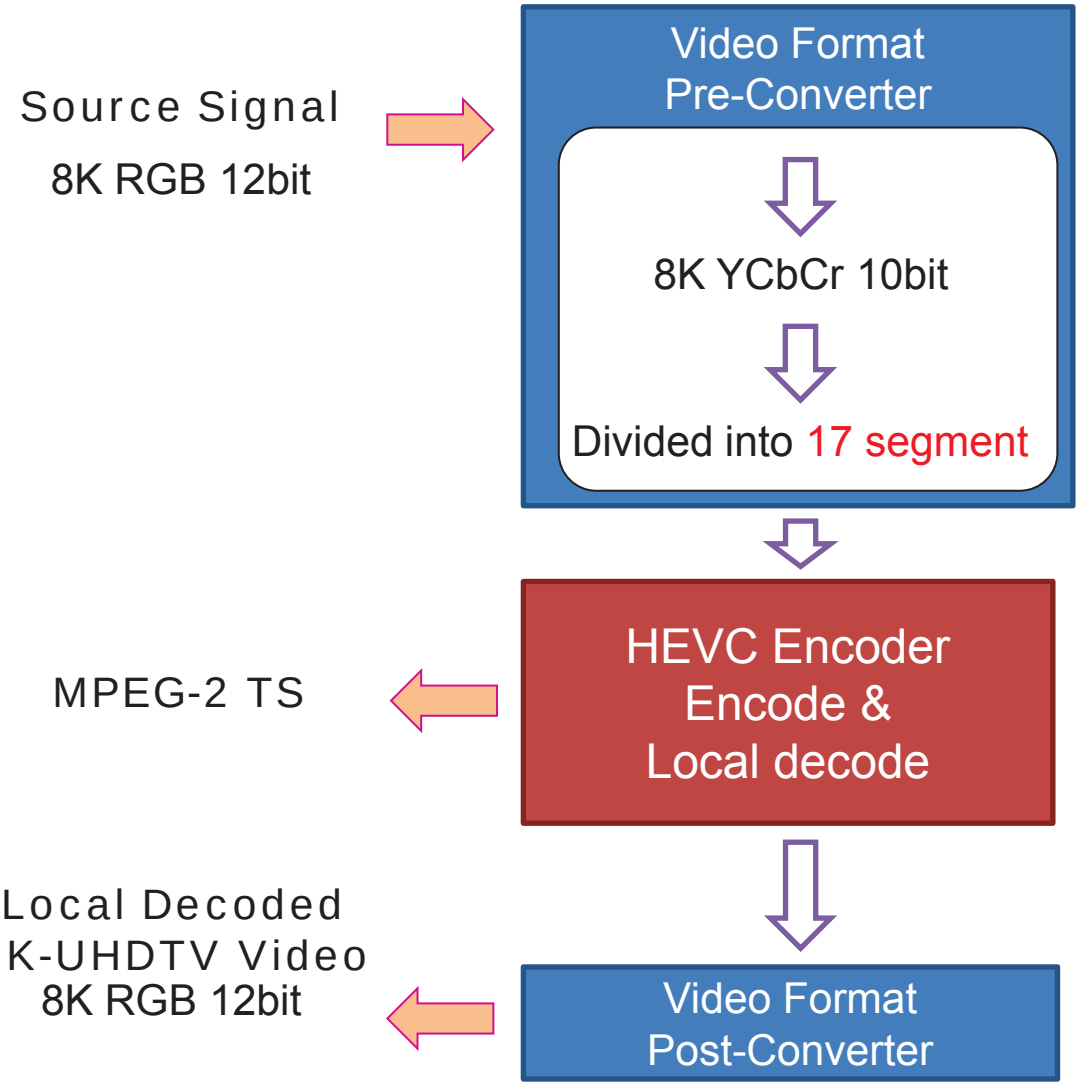
➢Each processing unit encodes the corresponding slice.

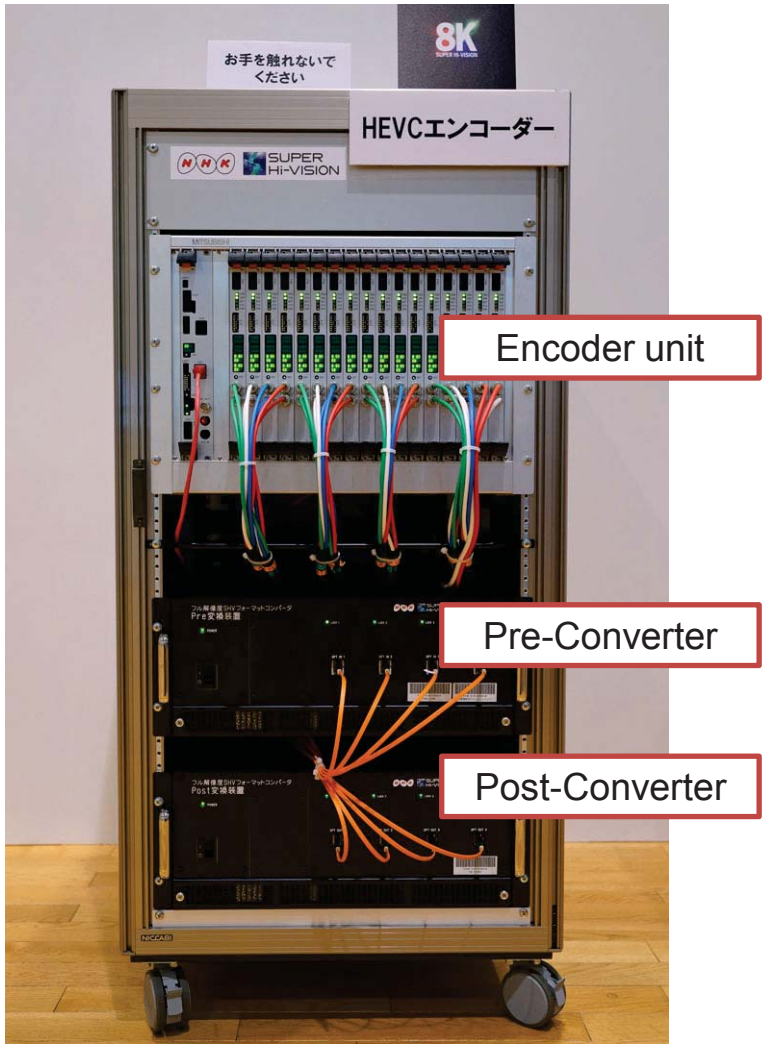
➢Reference image of adjacent segment are shared between neighboring units.

Horizontal splitting has advantages to a latticed splitting:

- Suitable for panning scene
- Only two neighbor units are to be connected

Overview of the system





The system is displayed in the room 108

Demo of the encoder in the room 108

At the Open House of our laboratory, May 2013

- The demonstration bitrate: 85 Mbps
  - Enough low bitrate to broadcast via broadcasting satellite
  - The coded image quality is sufficiently high for the test broadcasting.

Conclusion

- The world's first 8K HEVC hardware encoder
  - 7,680 x 4,320 pixels, 10bit, 60/59.94fps
  - Coded picture quality is considered sufficiently high for the test broadcasting in 2016
- Future works
  - Develop a decoder
  - MMT Implementation

Workshop in ITU-T SG16 meeting in Sapporo

ITU-T standards based IPTV solutions and the global testbed

1 July 2014

OKI Oki Electric Industry Co., Ltd.

Contact Hideki Yamamoto
Oki Electric Industry Co., Ltd.
Japan

Contents

- OKI Corporate overview
- Market trends and OKI's solution about IPTV
- ITU IPTV IPv6 Global Testbed (I3GT)
- Conclusions

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OKI Corporate overview

OKI at a Glance

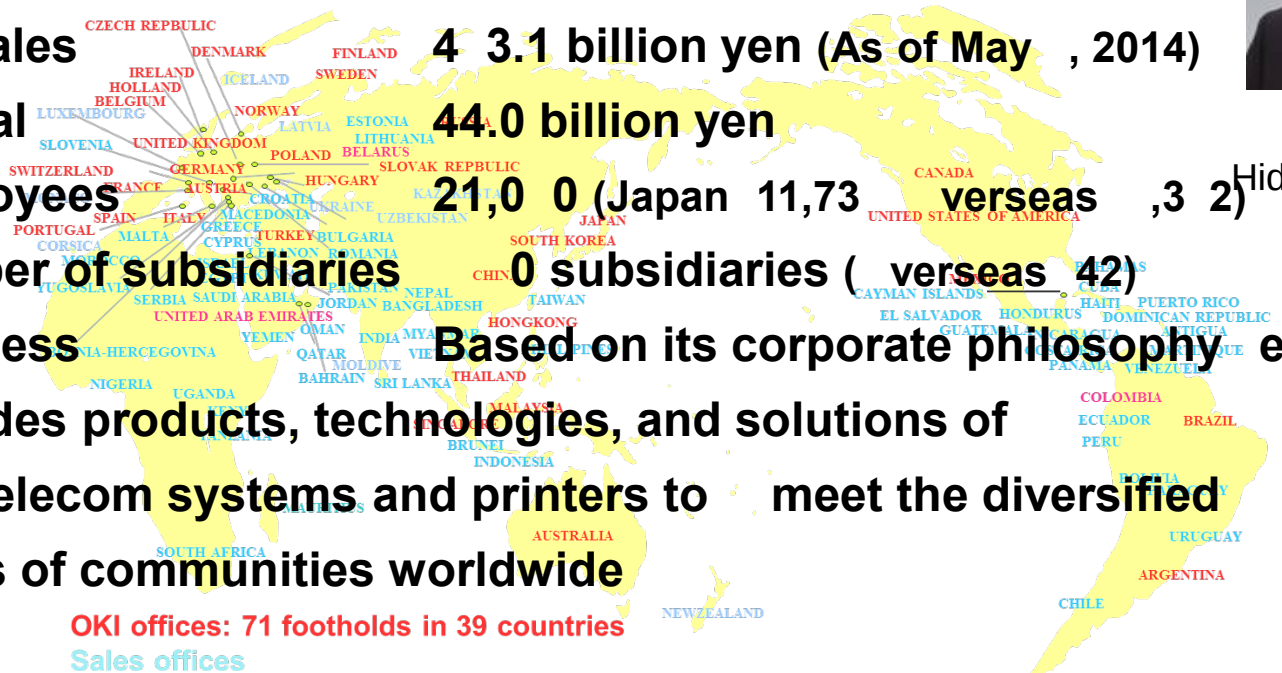
130th year since manufacturing the first telephone in Japan.
Now, OKI is a global company operating in over 120 countries world wide.

(The * mark represents data as of March 31, 2014)

President
Hideichi Kawasaki

Founder:
Kibataro Oki

- **Founded in** 1 1 by Kibataro ki
- **President** Hideichi Kawasaki
- **Net sales** 4 3.1 billion yen (As of May , 2014)
- **Capital** 44.0 billion yen
- **Employees** 21,0 0 (Japan 11,73 verseas ,3 2)
- **Number of subsidiaries** 0 subsidiaries (verseas 42)
- **Business** Based on its corporate philosophy enterprisingspirit, KI provides products, technologies, and solutions of info-telecom systems and printers to meet the diversified needs of communities worldwide



OKI offices: 71 footholds in 39 countries
Sales offices

Note: On Oct. 1, 2008, OKI spun-off its semiconductor business and transferred its shares to Rohm Co., Ltd.

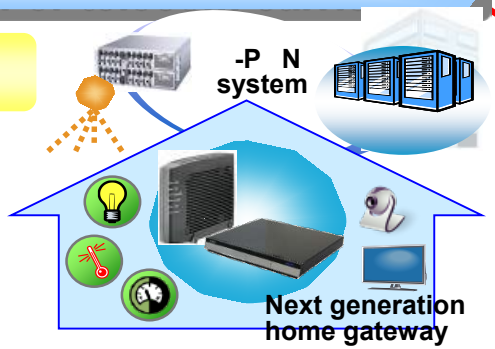
Telecom Systems Business in OKI

- Provide systems with high reliability to telecom carriers.
- Offer solutions with excellent security and mobility that converge voice/video/data/wireless, to enterprises.
- Provide smart network solutions focusing on 920MHz range wireless multihop, such as smart meter, energy management to social infrastructure.

For telecom carriers

Home ICT Platform

-P N system



Next generation home gateway

IP broadcast video-on-demand

IP Network System

ptical core network

Video delivery system

ession border controller

Large-scale IP telephone system

For enterprises

IP telephony system

Video conference

Enable IP centrex

FMC

Com@WILL

Visual Nexus

IP telephone

Network solution

IP contact center

CTstage

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For smart houses

Energy management (BEMS MEMS)

Smart house (HEMS)

M2M infrastructure

20MHz range wireless unit

20MHz range Multihop module

IPv6 compatible 20MHz software license

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Market trends and OKI's solution about IPTV

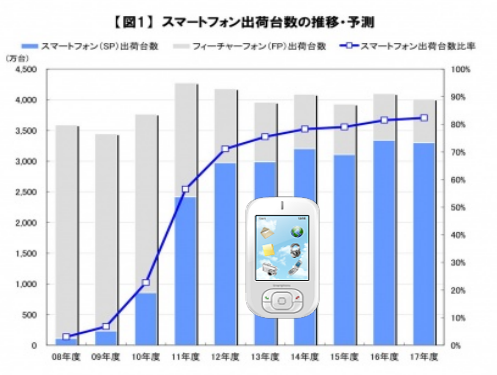
Environment of video service

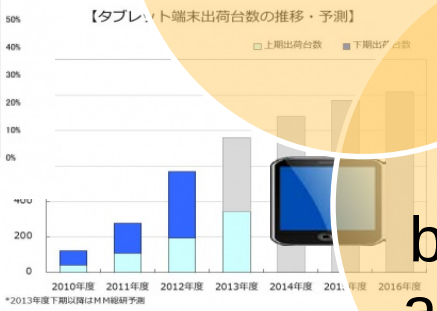
Video service environment is rapidly changing

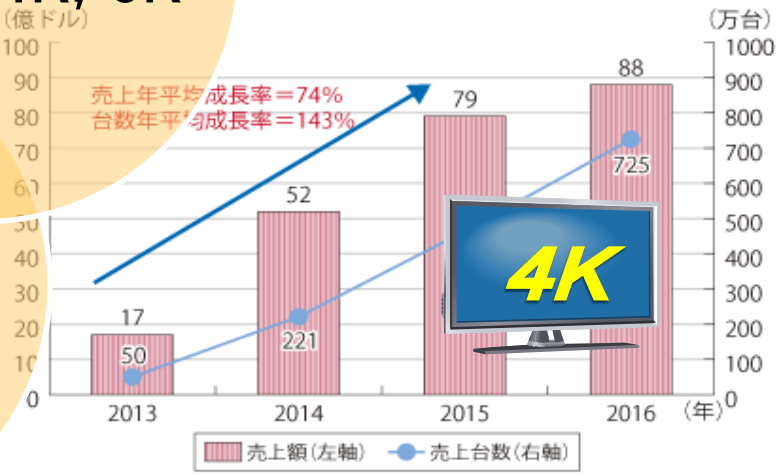
Broadband, Mobile

2K, 4K, 8K

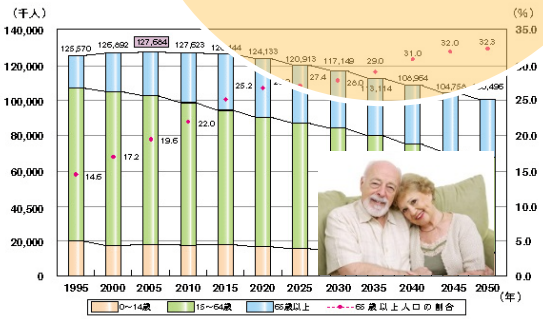
declining birthrate and aging society







図表② 日本の将来推計人口



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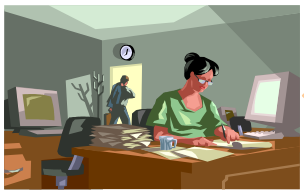
Needs to video service in near future

Variety of video service

Requirement of high resolution (2K, 4K, 8K)



Change of viewing environment (Video on demand, time shift)

Indifferent to TV by young people (Smartphone, tablet)

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To satisfy the needs

Technologies to satisfy the needs

		Server	Access NW	STB
2K high resolution	• FTTH • IP Multicast	●	●	●
Video on demand / Time shift service	• IP video delivery • Server – STB combination	●		●
Multidevice	• Protocol for mobile device • Encryption	●		●

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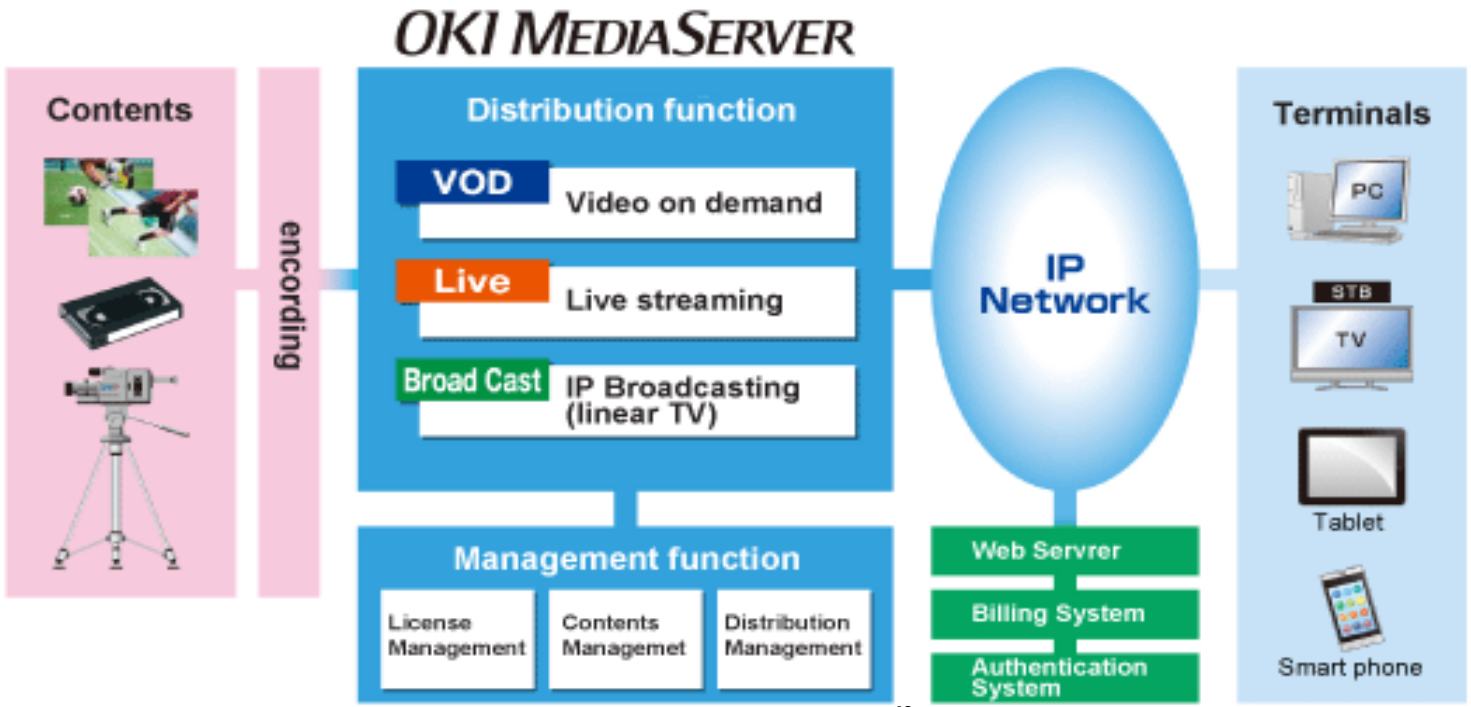
IPTV Streaming server by OKI

- **Integrated IPTV Platform**
  - VOD, live streaming, IP broadcasting (linear TV) and their combined services
- **Standard based system**
  - ITU-T IPTV standards and de-facto standard, IETF HLS, compliant
- **Large scale system**
  - It supports distributed VOD system for large scale system



(*1) http://www.oki.com/en/streaming/

Usages of OKI MediaServer

Commercial IPTV service provider in Japan adopted KI MediaServer

- More than **2.6 million** of subscribers
- Commercially successful **IPTV over IPv6 network**.

ITU IPTV IPv6 Global Testbed adopted the same PF

- ITU IPTV standards (H.721, 762, 770, 264 ..) and IPv6
- National institutes / universities in Thai, Malysia, Geneve, Phillipines, Singapore and South Africa used.
- Lots of other countries are interested in this project.

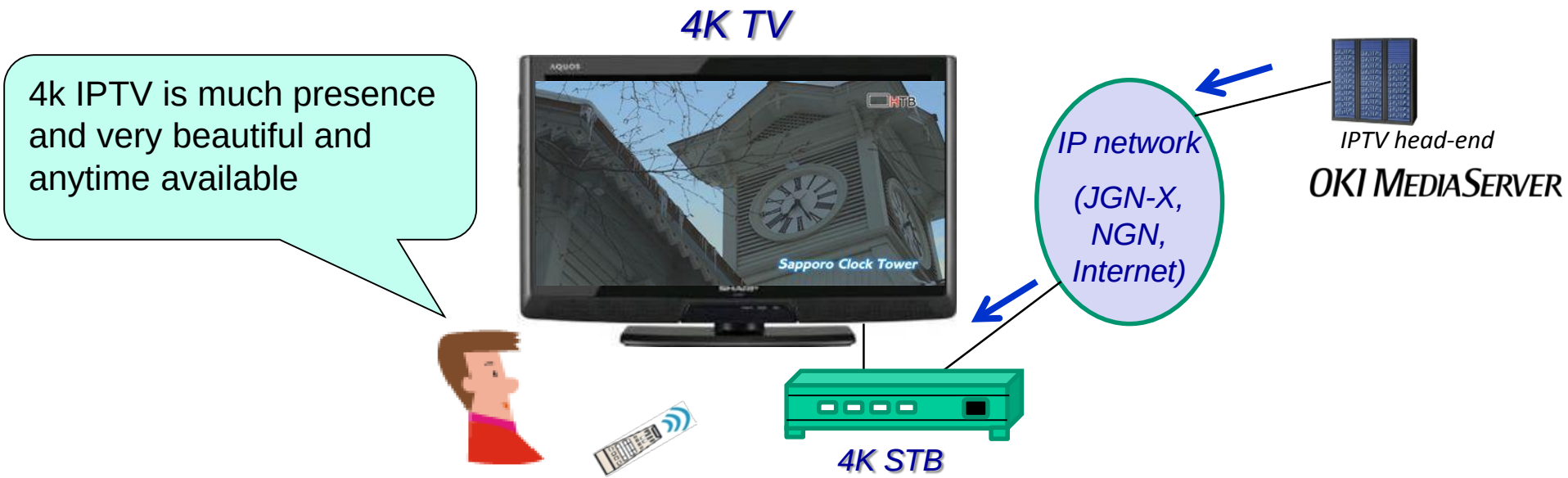
Researchers in the world used it for future IPTV services

- Resilient disaster information system
- E-health application over IPTV

4K Ultra HD contents come to you via IPTV

4K

- IPTV head-end system, OKI MediaServer. provides high quality 4k video with you.
  - Users can experience higher resolution (3,840 x 2,160) and more smooth motion (60 fps) than a full HD 1080p.
  - OKI MediaServer can deliver 4k contents encoded by H.265 video encoders anytime over IP network.
- Ultra HD video streaming makes new services into reality.
  - Digital signage, telemedicine, surveillance system, and design work with high resolution displays.



HTB Hokkaido Television Broadcasting

Several 4K video contents were produced by HTB (Hokkaido Television Broadcasting).
Copyrights of several 4K contents are reserved by HTB.

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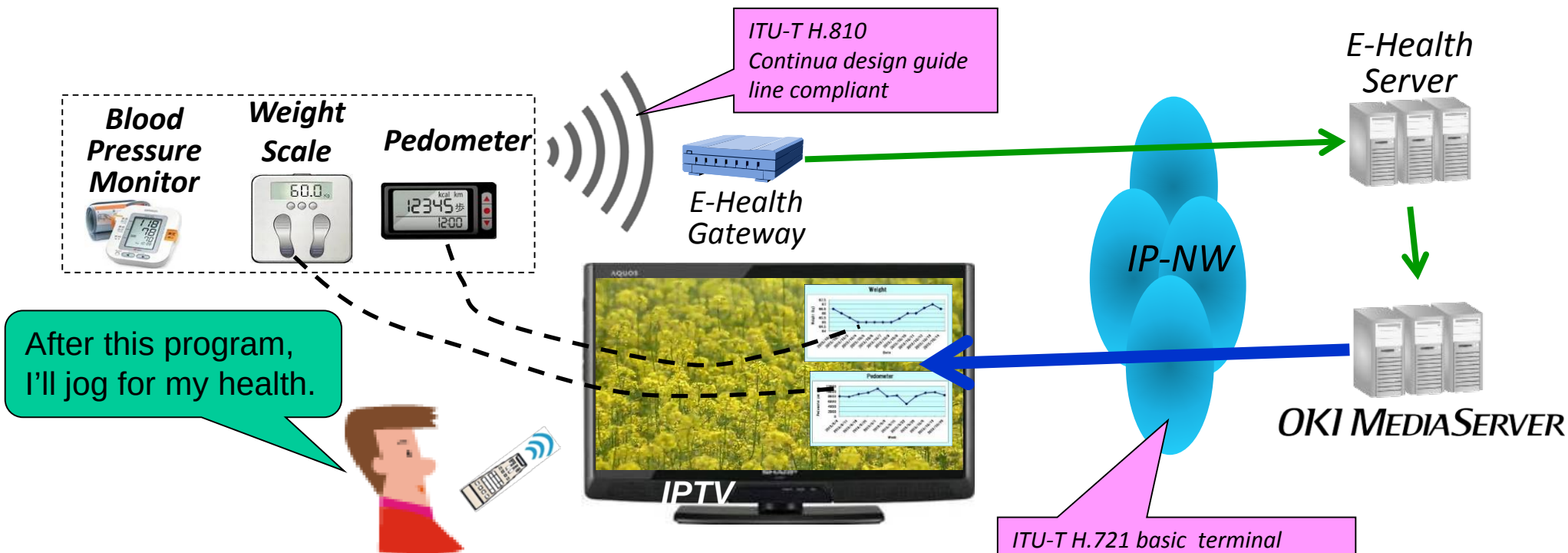
Visualization of your health condition on IPTV

E-Health

- Audience can see their personal health data such as weight, blood pressure and distance walked on their IPTV screen.
- Visualization of health condition will encourage audience to control their health condition.
- Global standard technologies such as ITU IPTV (LIME*) and E-health (personal health systems**) are used to extend services more cost effectively and easily.

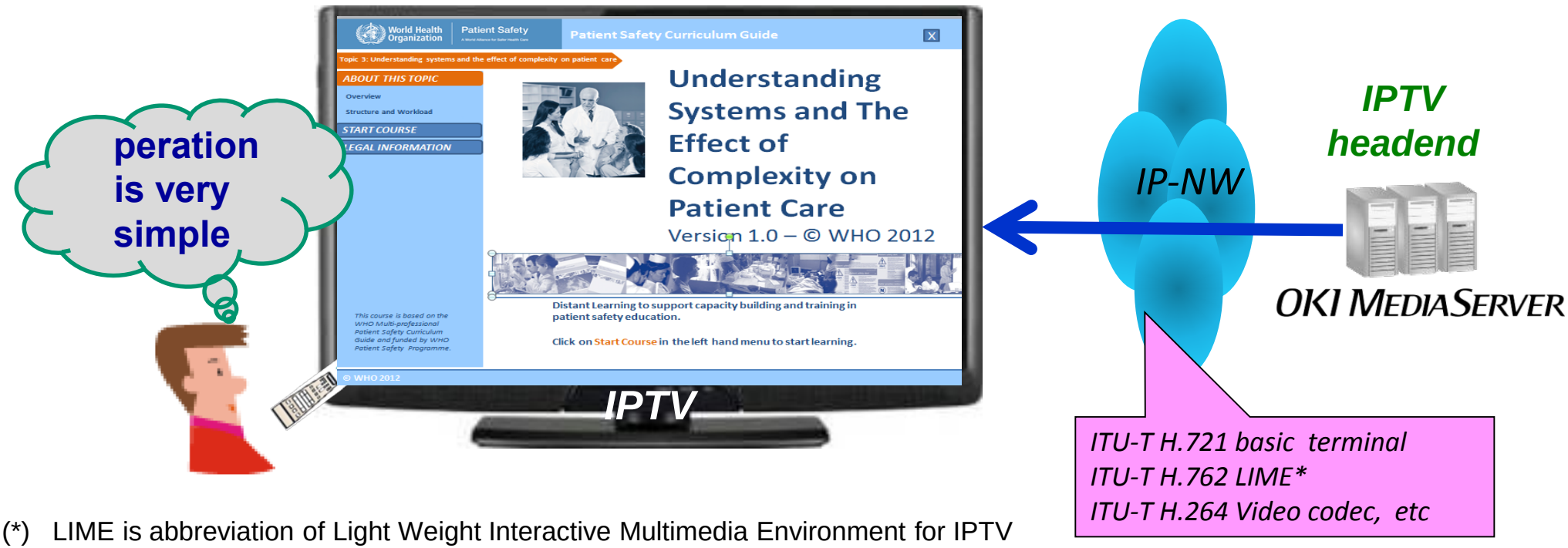


(*) ITU-T H.762 Lightweight interactive multimedia framework (LIME) for IPTV services
(**) ITU-T H.810 Interoperability design guidelines for personal health systems

Simple e-learning by IPTV

E-Learning

- E-learning by IPTV uses remote controller as input devices.
- Students can study interactive multimedia courseware provided by LIME
- Patient care" courseware is considered to be developed as a first example.



(*) LIME is abbreviation of Light Weight Interactive Multimedia Environment for IPTV

Resilient NW and Info. System with IPTV

Disaster information

- An APT-J2 1024 project, “Broadband Wireless for Disaster Operations : Resilient Networks and Reconfigurable Information Systems for Rapidly Deployable Disaster Response(*)”, developed a disaster risk reduction system by using of IPTV network.

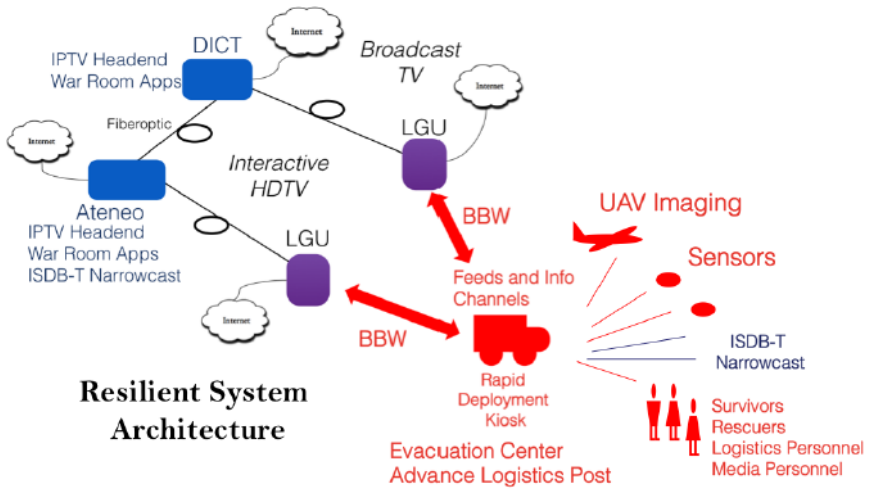
Use case for Resilient system

Pre-Disaster Preparedness
- Social Network information - Learned Experience√
- Assets Preposioned And Ready And Resilient √
- Assist The Young And Disabled in Disasters √

Decision Support Systems
- Resilient Information Sharing Across Multiple Platforms √

Post Disaster Response
- Support System for Victims, Survivors and Families√
- Support the Long Term Recovery and Reconstruction √

Resilient system architecture

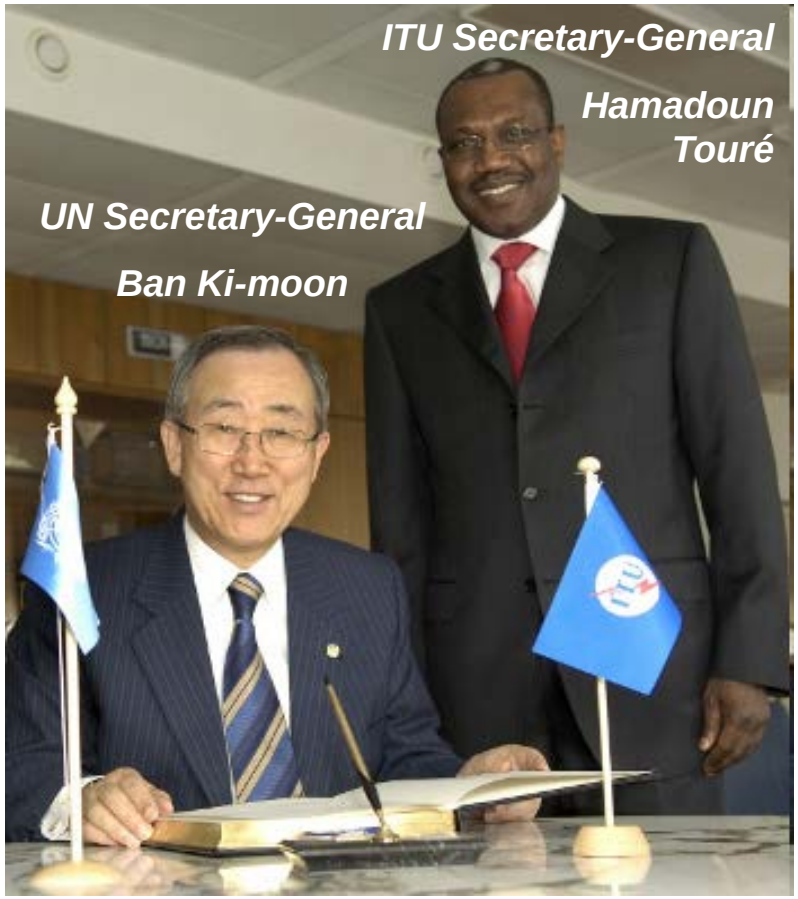


Local broadcast over ISDB-T

(*) Ateneo de Manila University, DOST, PLDT, Mitsubishi Electric, and OKI practiced this project founded by APT HRD program.

Introduction to ITU IPTV Standards

ITU global standard



- **ITU is United Nations agency** for telecommunication and ICTs
- **Members**:
  - **1 3 Governments** and regulatory bodies
  - **700 Private Sector**
  - **20 Academia**

IPTV Testbed content for “Sapporo snow festival 2013”
（Malcom Johnson, ITU-T Director）

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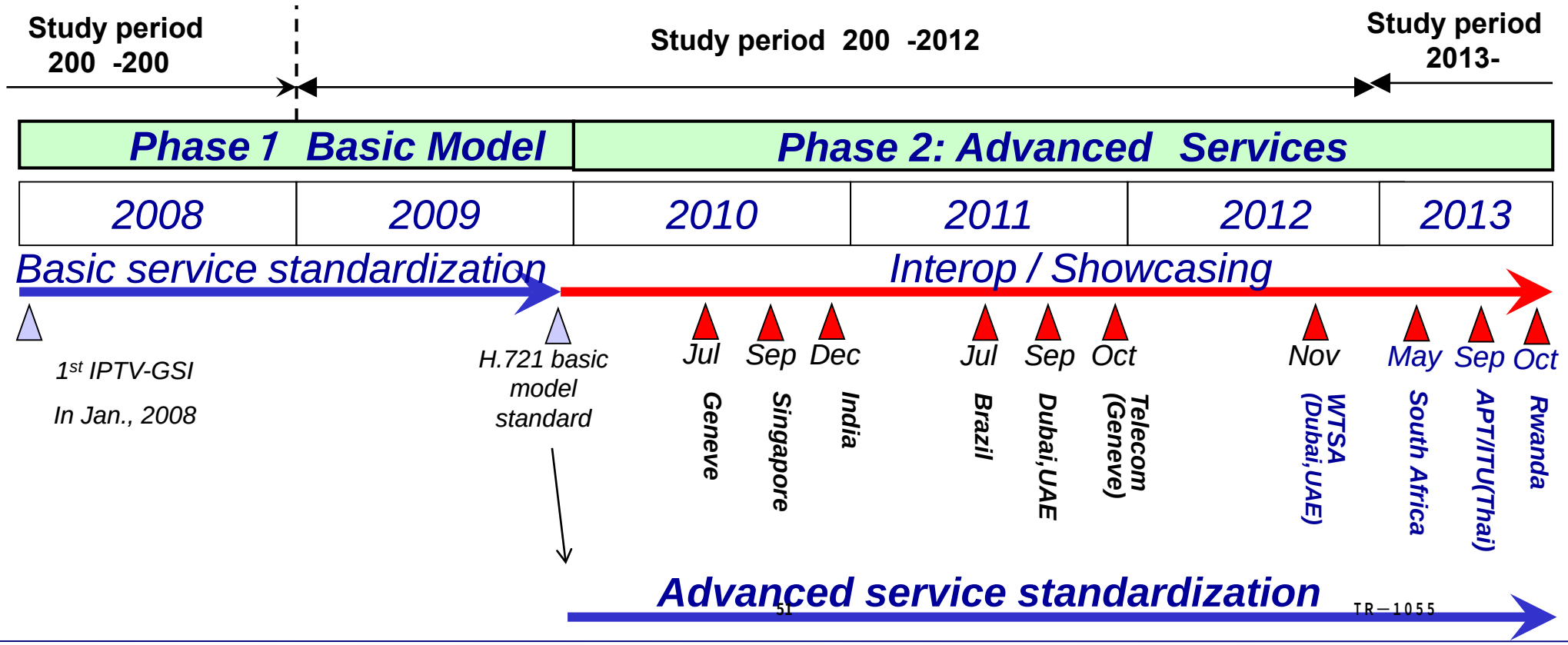
IPTV defined in ITU IPTV standards

- **IPTV ≠ Internet Video**
- **Defined as multimedia services, such as Television Video Audio Text Graphics Data, delivered over IP based networks managed to provide the re uired level of oS oE, security, interactivity and reliability .**



Overview of ITU-T Recommendations for IPTV

- End-user functions and Application functions are hot topics now.
- Draft recommendation about IPTV terminals for 4K services, audience measurement, and convergent service with sensor devices are hot topics (by OKI).

Home networking

H.622.1: eq Arch for IPTV Home networ s

Applications and end-systems

H.750: Metadata for IPTV Services

H.721: IPTV Terminal (Basic)

H.770 : IPTV Service discovery

H.761: Ginga-NCL

H.741. : Audience Measurement

H.762: LIME

H.763.1: Cascading style sheets for IPTV services

H.264: video

Architecture, requirements, network

.2007: NGN Capability Set 2

.Sup 5: IPTV Service use cases

.Sup 7: NGN elease 2 Scope

.1 10: IPTV Functional Architecture

.1 01: IPTV Service equirements

.3010: Authentication protocol

Quality of Experience

H.701: Content Error- ecovery

G.1080: IPTV oE

G.1081: Performance Monitoring

G.1082: Improving robustness of IPTV performance

Security and Content Protection

.11 1: eq arch for IPTV security

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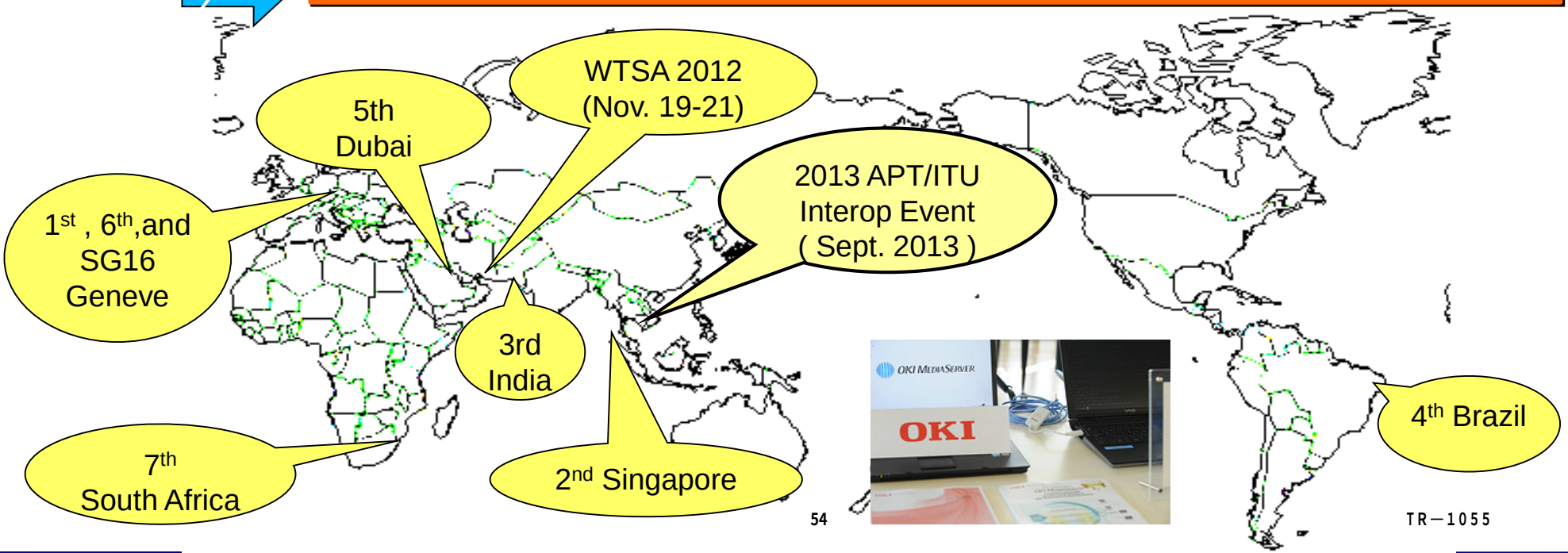
ITU IPTV IPv6 Global Testbed

Why IPTV global testbed is necessary?

- ITU IPTV standards are expected to remove vendor locks because they are open standard.
- After ITU output IPTV standards, interoperability events and showcaing events were started to promote ITU IPTV standards in the world from 2010.
- Visitors became interested in IPTV standards, but these events were too short to understand details and test them to know whether these can be used or not.

The global testbed is needed to satisfy these requests.



Steps from understanding standards to real services

- In order to spread real commercial services based on standards, testbed is useful

Understanding global standards → Decision to adopt standard based products → Spreading terminals and contents → Development of new services and growing

Watching demo	Listening to tutorials	Test content develop.	Test terminal develop.	Testing of conformance and interoperability
Show-casing by testbed	Tutorial and workshop	Contents contest (eg., Application challenge)	Testbed	Testing event by regional global organization

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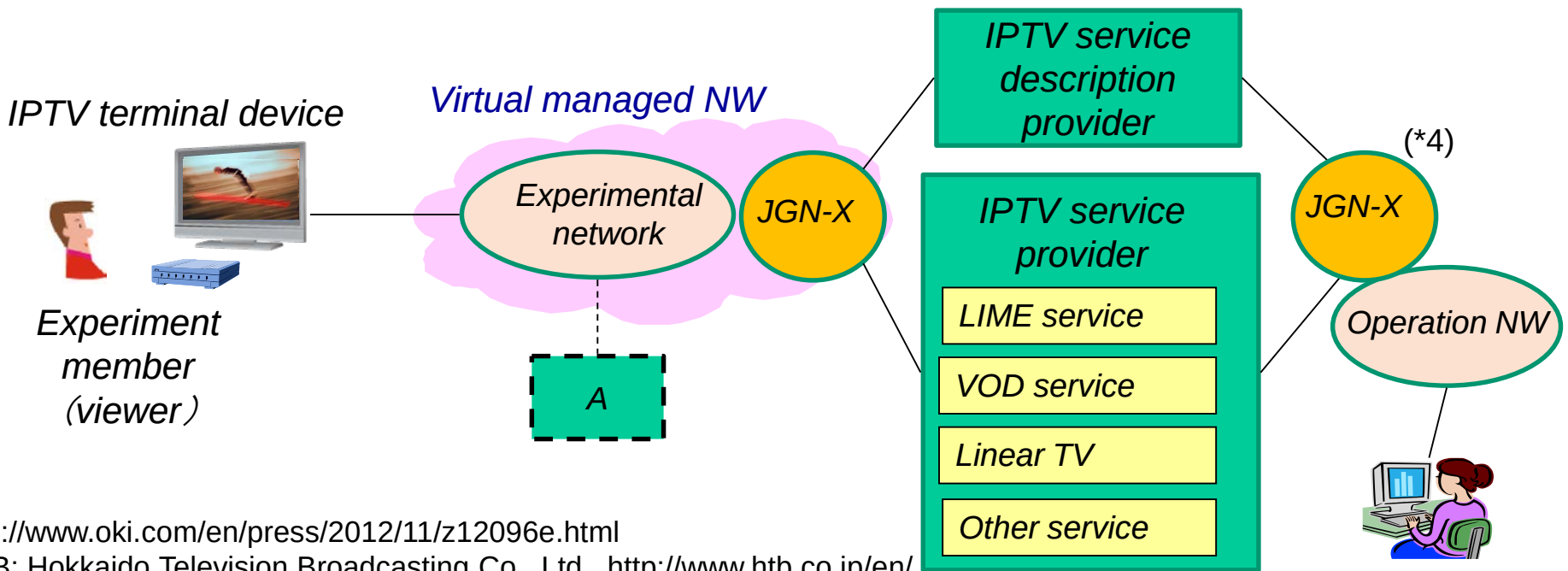
What is ITU IPTV IPv6 Global Testbed?

- ITU IPTV IPv6 Global Testbed (I3GT) (*1) is a testbed for the parties that are interested in ITU IPTV standards and IPv6 network.
- I3GT was developed by OKI and HTB(*2) in October, 2012 in the cloud environment of NICT(*3).
- I3GT was demonstrated in WTSA-12 and Sappro Snow Festival experiment 2013 by NICT.



(*1) http://www.oki.com/en/press/2012/11/z12096e.html
(*2) HTB: Hokkaido Television Broadcasting Co., Ltd., http://www.htb.co.jp/en/
(*3) NICT: National Institute of Information and Communications Technologies, http://www.nict.go.jp/en/
(*4) JGN-X (Japan Gigabit Network -eXtreme), http://www.jgn.nict.go.jp/english/index.html

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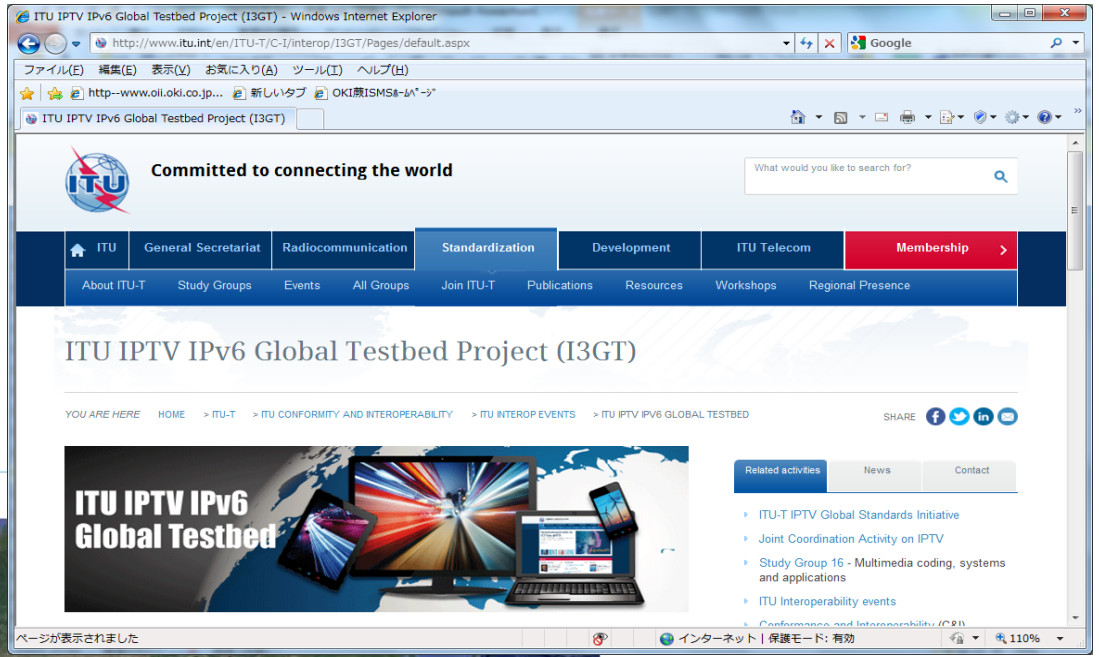
ITU IPTV IPv6 Global testbed

Official Web

http://www.itu.int/en/ITU-T/C-I/interop/I3GT/Pages/default.aspx



SITES

A. Hokkaido Television Broadcasting Co., Ltd. (HTB), Hokkaido, Japan
B. National Institute of Information and Communications Technology (NICT), Tokyo, Japan
C. International Telecommunication Union (ITU), Geneva, Switzerland
D. Institute for Infocomm Research (I2R), Singapore
E. Dubai Convention Centre (during WTSA-12) hosted by the government of United Arab Emirates, Dubai, UAE
F. Chulalongkorn University, Bangkok, Thailand
G. University of Ateneo de Manila, Manila, Philippines
H. Universiti Sains Malaysia, Penang, Malaysia
I. Council for Scientific and Industrial Research (CSIR), Johannesburg, South Africa

View Larger Map

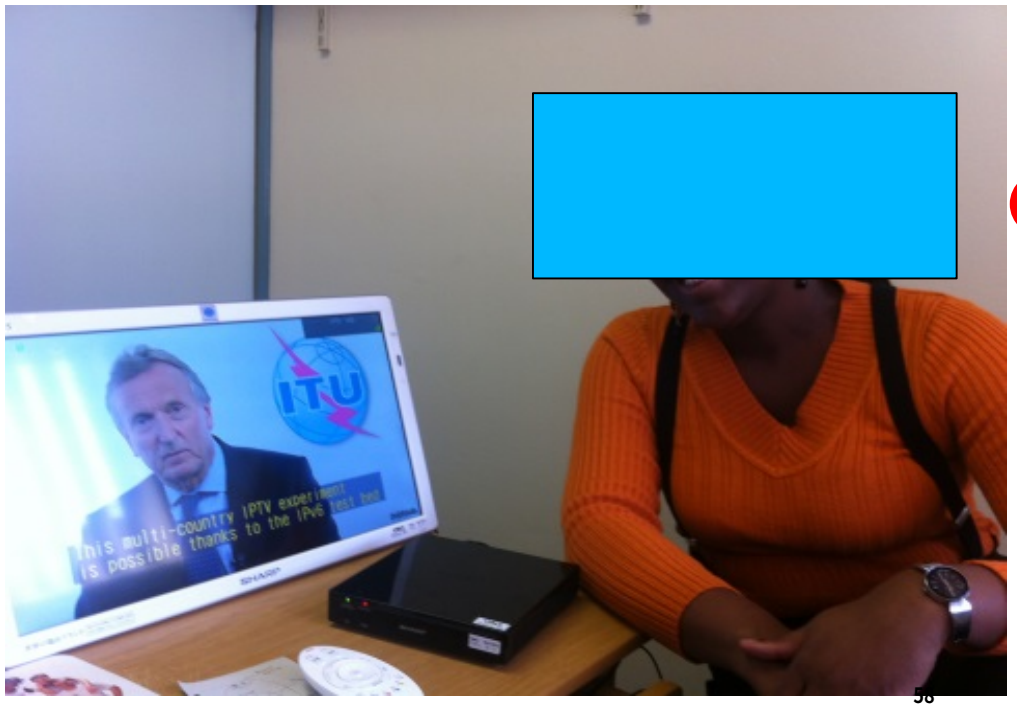
Testing Site

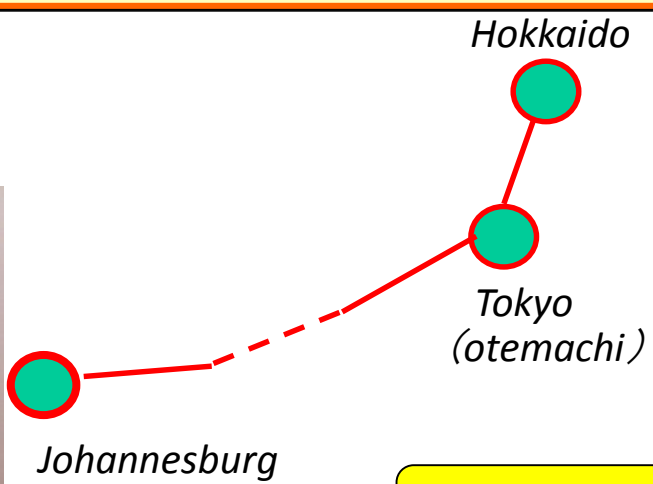
TR－1055

Expanded I3GT network

- National Advanced IPv6 Center of Excellence in Universiti Sains Malaysia in Malaysia was connected in March 2013
- CSIR (Council for Scientific and Industrial Research) in South Africa was connected in June 2013

South Africa





Malaysia

Where will I3GT go?

- It is planned to connect with more countries that are considering to deploy ITU IPTV standard based system (E.g., universities, research labolatores, SDOs, carriers,..)
- In order to catch up state-of-the-art technologies and potential user needs, it is planned to support new standards and services, such as:
  - **E-health, e-learning**
  - Mobile (HLS, DASH, Multiple terminal control standards, ..)
  - New codec (ITU-T H.265), 4K
  - Audience measurement (ITU-T H.741.0-4, …)
  - Digital signage (ITU-T H.780,…)

Conclusions

- Requirements of video services are rapidly changing to higher resolution video services (4K), multi device services and life supports.
- OKI's IPTV head-end solution, OKI MediaServer, satisfies such requirement by supporting ITU-T IPTV standards including H.265 codec.
- OKI MediaServer is adopted in IPTV commercial services ITU IPTV IPv6 Global Testbed, too.
- *OKI will open up your dream to the better quality of life by IPTV*

OKI

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Changes for the Better

ITU-T Standards for Multimedia Application Frameworks

Fernando Masami Matsubara

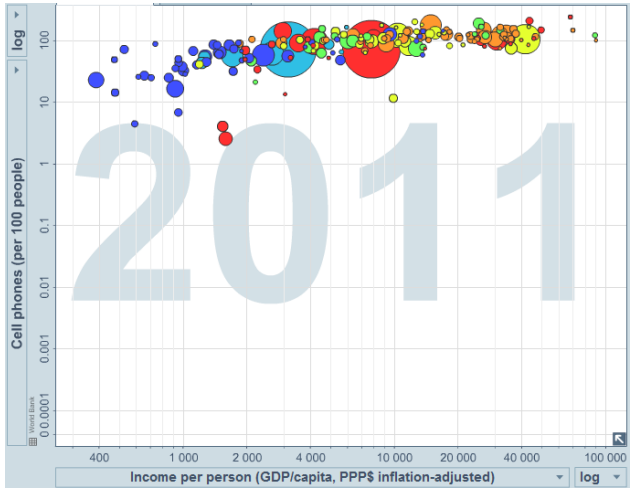
Global Standardization and R&D Relations Group
Planning & Administration Department
Corporate Research and Development

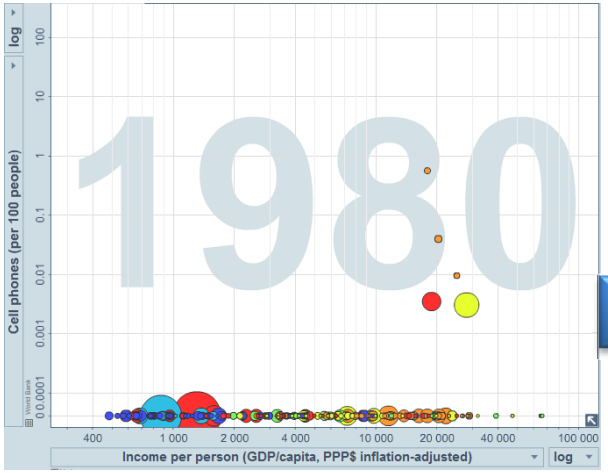
1 July 2014

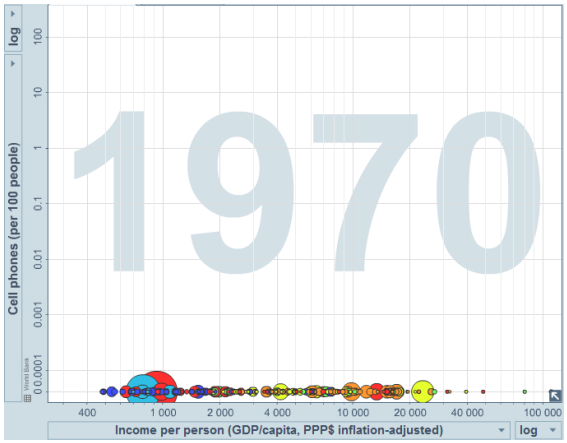
Importance of global standards

Importance of global standards

Communication infrastructure including broadband and mobile is increasing at never imagined rates even in low income economies
Global standards play a key role in this achievement







No. of cell phones (per 100 people)

GDP per capita

Grew to >100 in most regions (2011)

No. Cellphones (per 100 people) was practically 0 (in 1980)

Based on World Bank global statistics
Each circle represents a country
Diameter proportional to population

Visualization from **Gapminder World**, powered by Trendalyzer from www.gapminder.org.

SG16 approach to multimedia standardization

Use existing standards as much as possible

Practical approach for faster deployment and for meeting industry demands

Close collaboration with key ecosystem players:

- **Collaboration with other de jure and forum groups**
- Broadcasters
- CE manufacturers

Truly interoperable global standard

Conformance and Interoperability

Long term stable standards

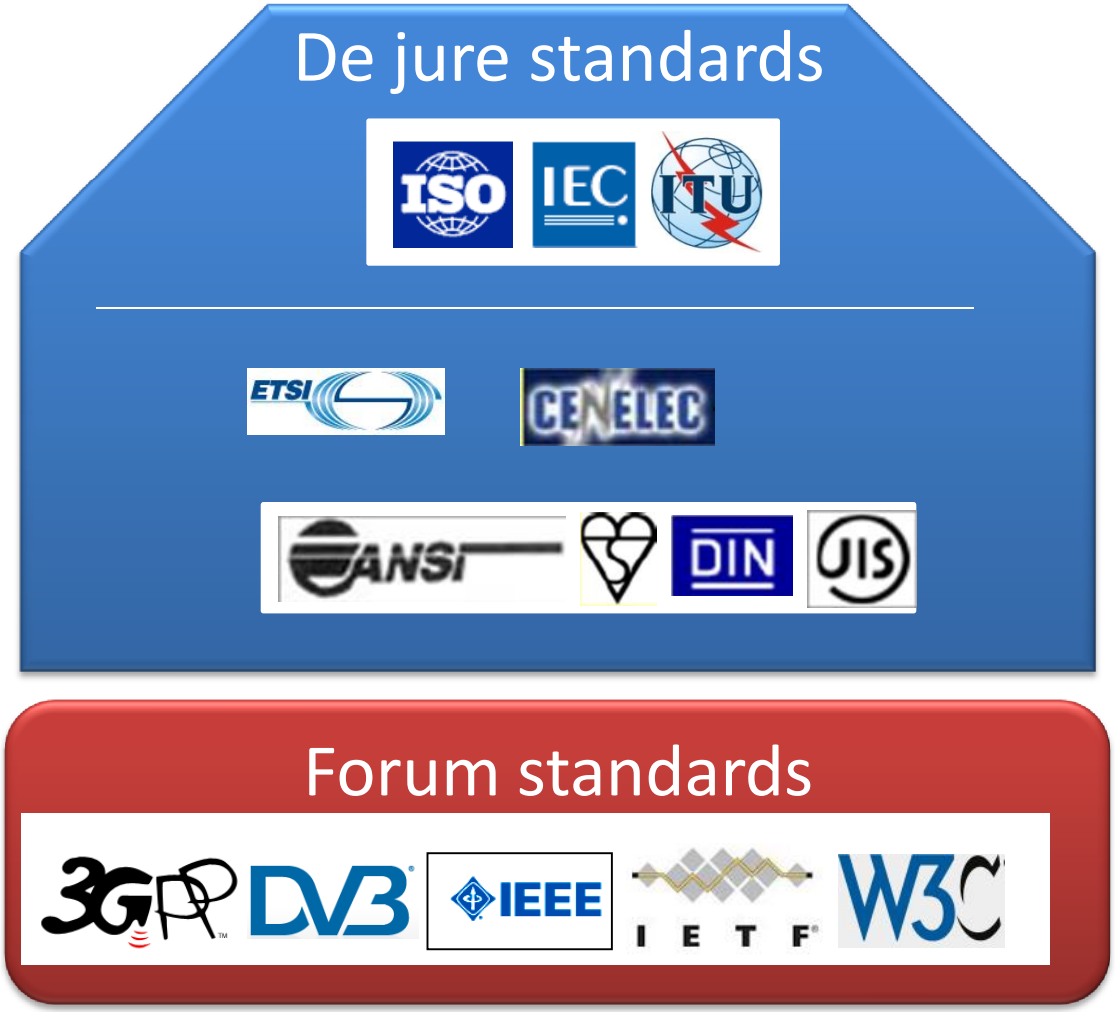
De jure and forum standards

International

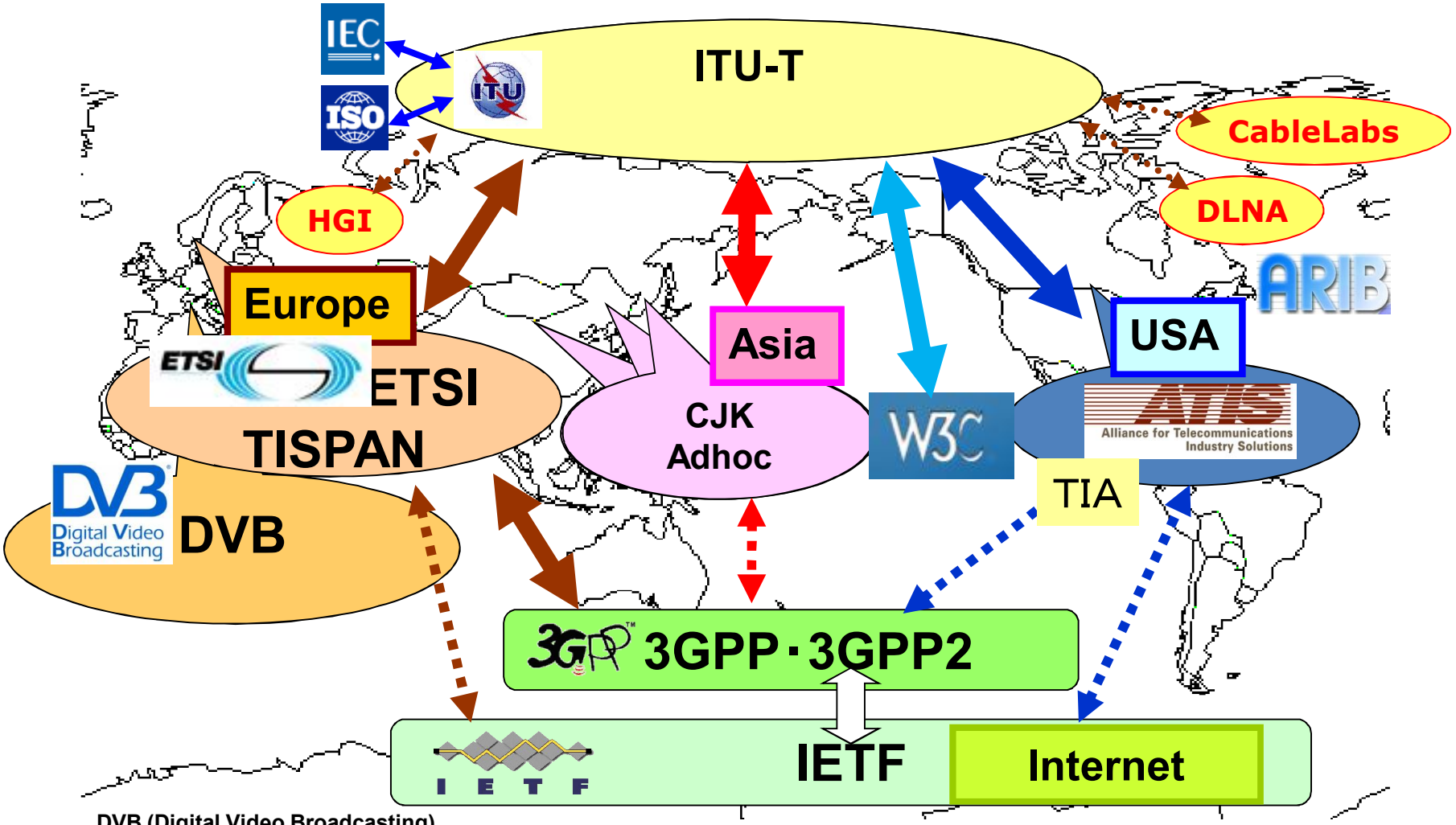
Regional

National

Forum



SG16 relations with SDOs & fora



DVB (Digital Video Broadcasting)
FG IPTV (Focus Group on IPTV)
ETSI (European Telecommunications Standards Institute),
TISPAN (Telecoms & Internet converged Services & Protocols for Advanced Networks)

ATIS (Alliance for Telecommunications Industry Solutions)
TIA（Telecommunications Industry Association ）
CJK (China, Japan, Korea)
IETF (The Internet Engineering Task Force)
W3C World Wide Web

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Changes for the Better

Standardized multimedia solutions

Open infrastructure

Lower cost

Wider market

Wider content availability

Better Quality of Service

Harmonized security

Increased revenues from ads

Focus on innovation and new services

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Changes for the Better

IPTV multimedia framework standardization

IPTV multimedia services discussed in ITU-T

Linear (Channel Service) Broadcast TV

Audio services

Video On Demand (VoD)

Karaoke, gaming

Public Services

Billboards, disaster alerts, traffic news, etc

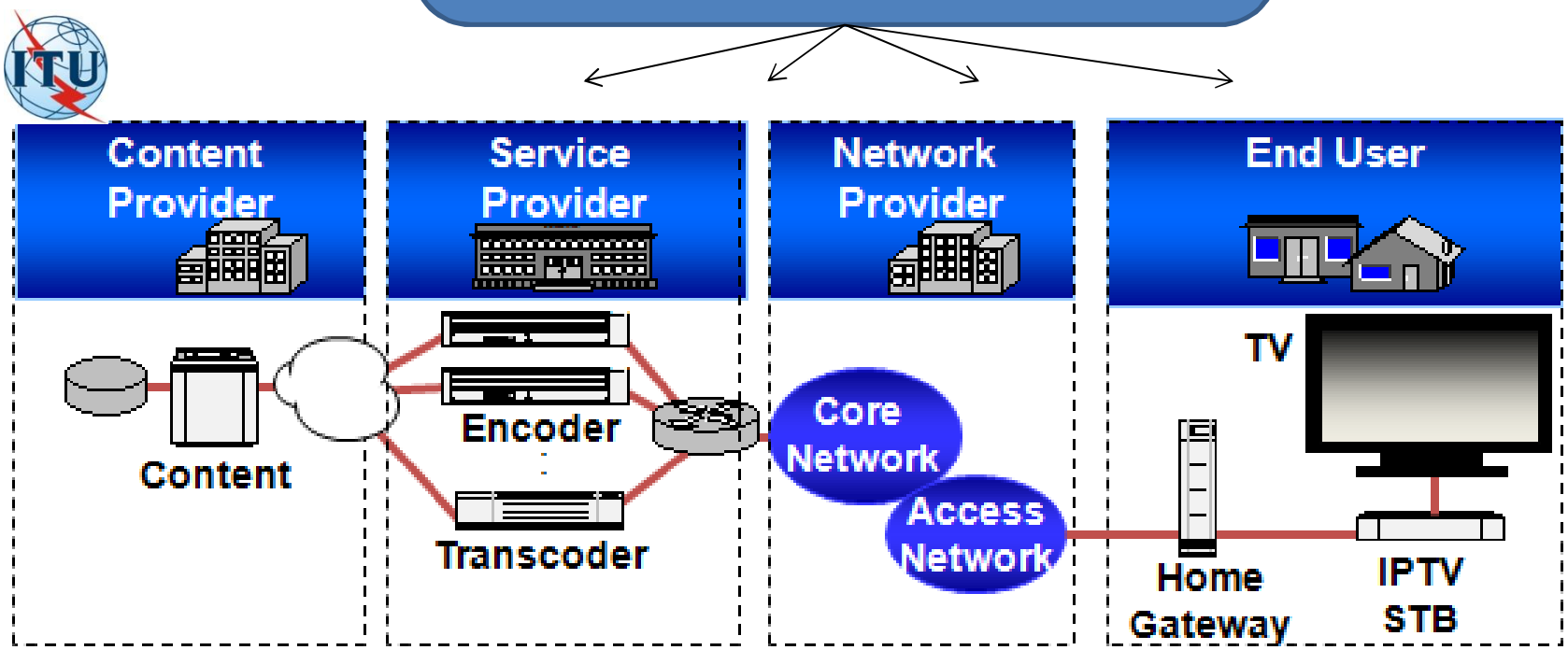
Accessibility: *captioning, descriptive audio*

E-health (telemedicine, tele-healthcare)

… Digital signage

Scope of ITU-T IPTV standardization

Global standards enable competition among multiple providers, contribute to better compliance and benefit end users



ITU-T IPTV Recommendations

Home networking

H.622.1: Req & Arch for IPTV Home networks

Security/Content Protection

X.1911 Req & arch for IPTV security

Applications and end-systems

- H.700-H.719: General aspects
- H.720-H.729: IPTV terminal devices
- H.730-H.739: IPTV middleware
- H.740-H.749: IPTV application event handling
- H.750-H.759: IPTV metadata
- H.760-H.769: IPTV multimedia application frameworks
- H.770-H.779: IPTV service discovery up to consumption
- H.780-H.789: Digital Signage

Architecture, requirements, network

- Y.2007: NGN Capability Set 2
- Y.sup5 IPTV Service use cases
- Y.sup7 NGN Release 2 Scope
- Y.1910 IPTV Functional Arch
- Y.1901 IPTV Service Requirements

Quality of Experience

- H.701: Content Error-Recovery
- G.1080: IPTV QoE
- G.1081: Performance Monitoring
- G.1082: Improving robustness of IPTV performance

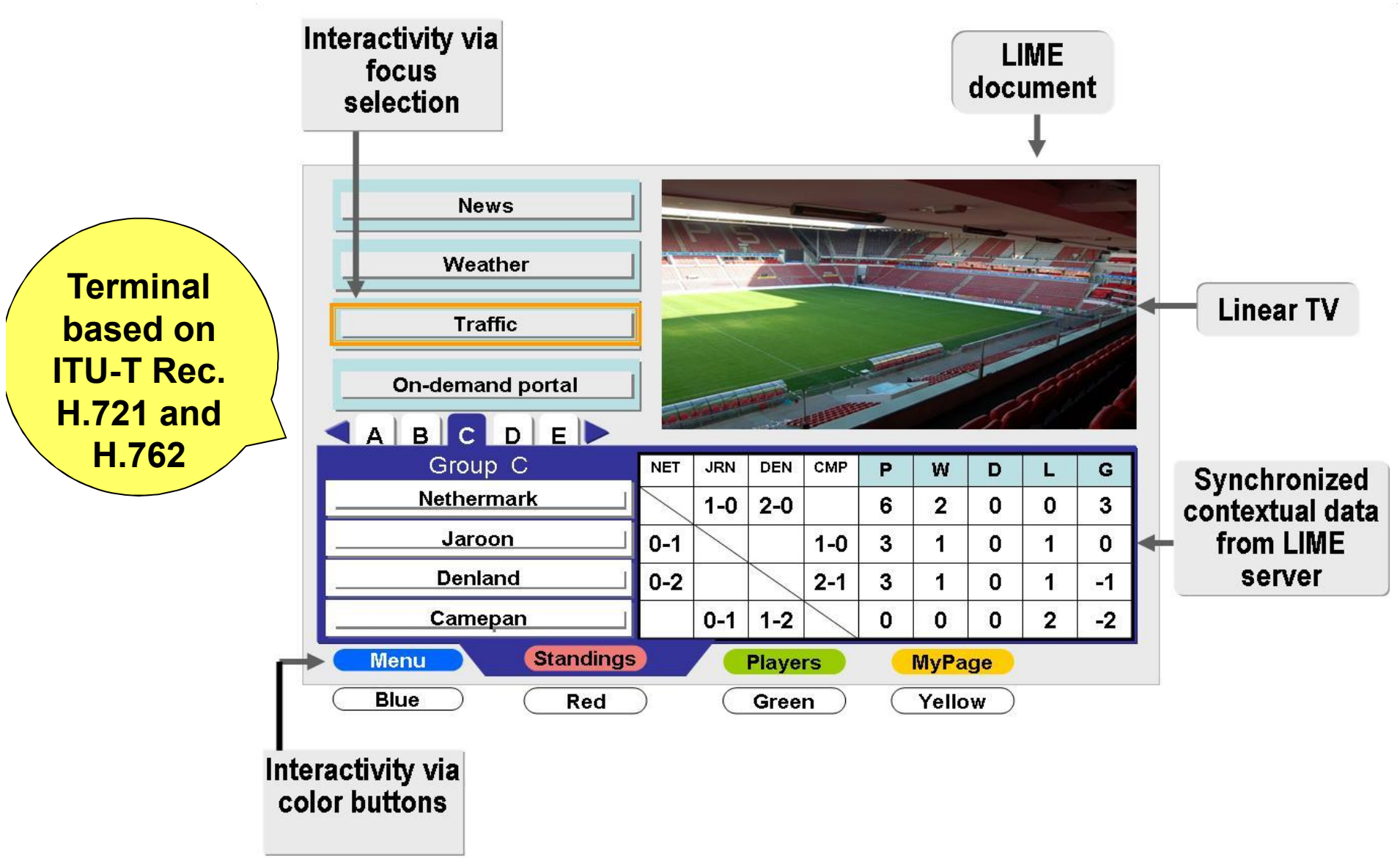
ITU-T IPTV Recommendations

Applications and end-systems

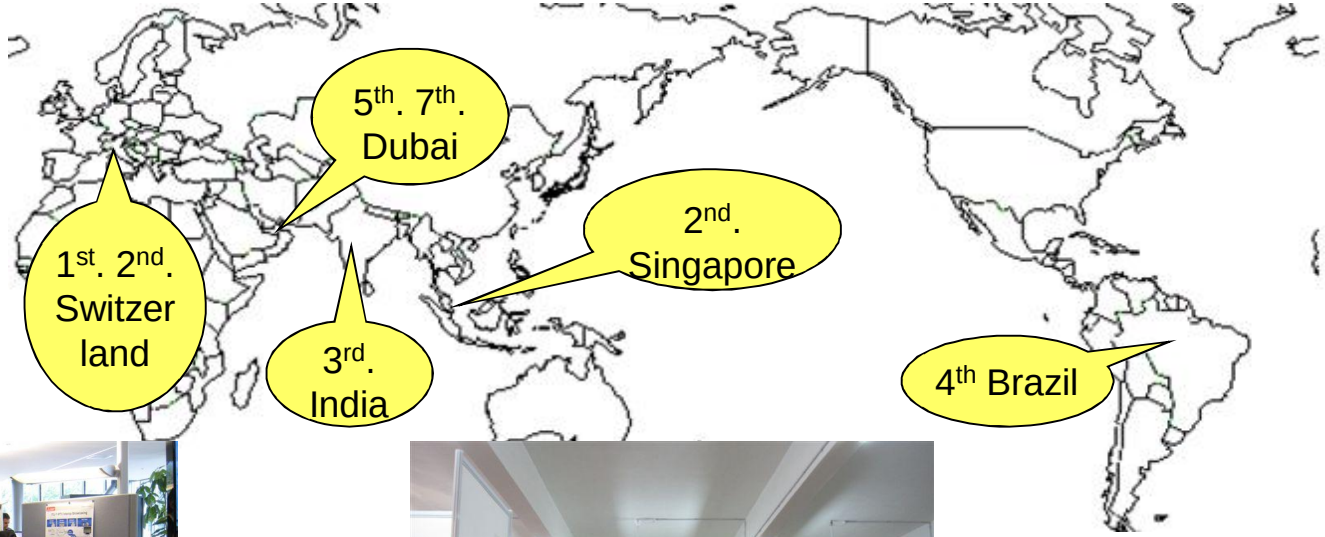
- H.720: Overview of IPTV terminal
- H.721: IPTV Terminal (Basic)
- H.722: IPTV terminal device: Full-fledged
- H.730: Web-based terminal middleware
- H.740: Application Event Handling
- H.741: Audience Measurement
- H.750: Metadata for IPTV Services
- H.751: Metadata for rights information
- H.760: Overview of multimedia apps
- H.761: Ginga-NCL
- H.762: LIME
- H.763.1: CSS for IPTV
- H.764: Script IPTV
- H.770 : IPTV Service discovery
- H.771: SIP-based discovery of IPTV services
- H.780: Digital signage: Service requirements

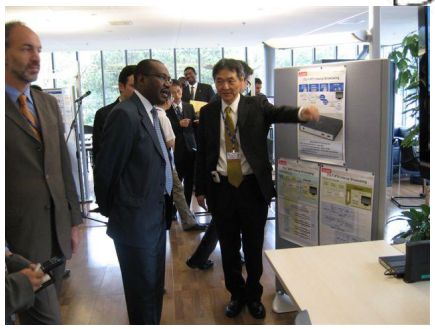
- HSTP.HRM.2 Multi-content sources
- TDES.4 Mobile
- TDES.5 Multi-device
- H.IPTV-Widget
- H.IPTV-MAFR.13 HTML
- HSTP.IPTV-SMTD Multi-TD
- ...

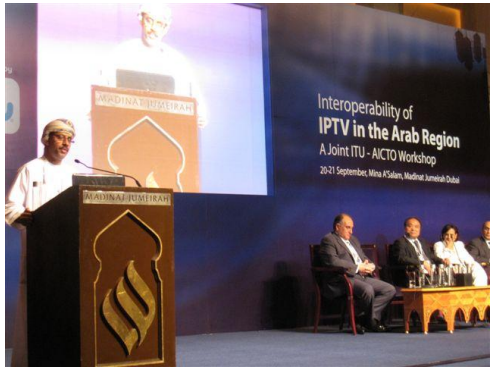
Example ITU IPTV standards based solution

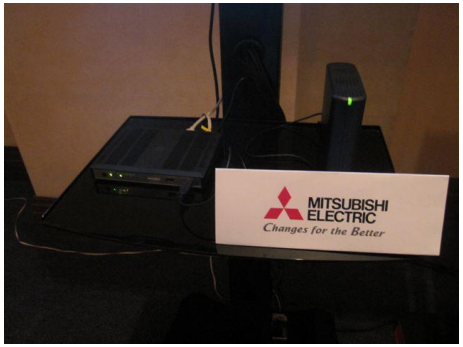


Conformance & Interoperability events









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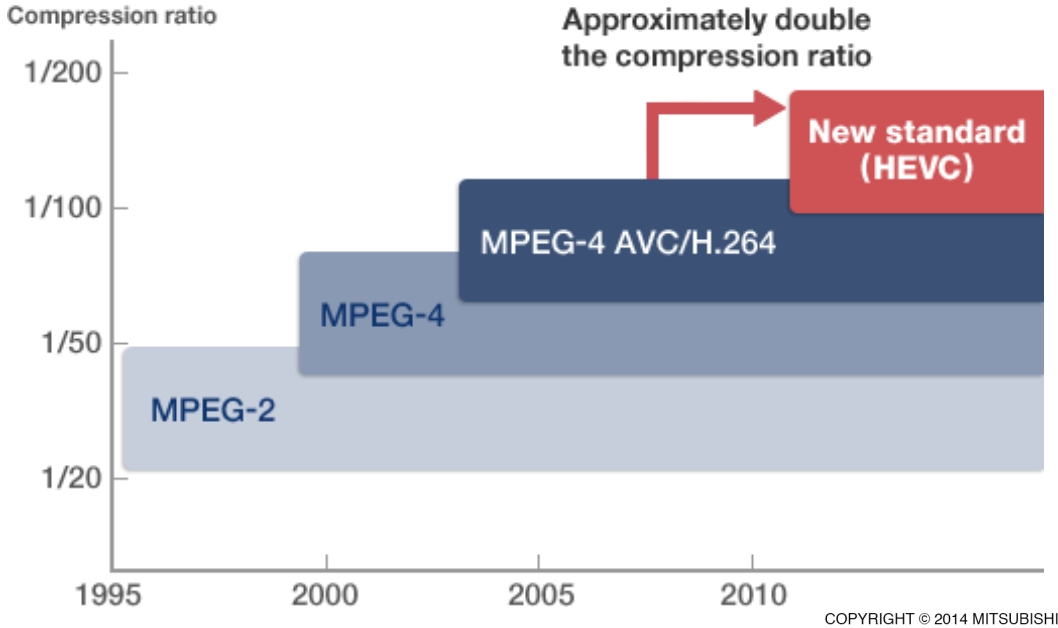
Changes for the Better

Video coding standardization

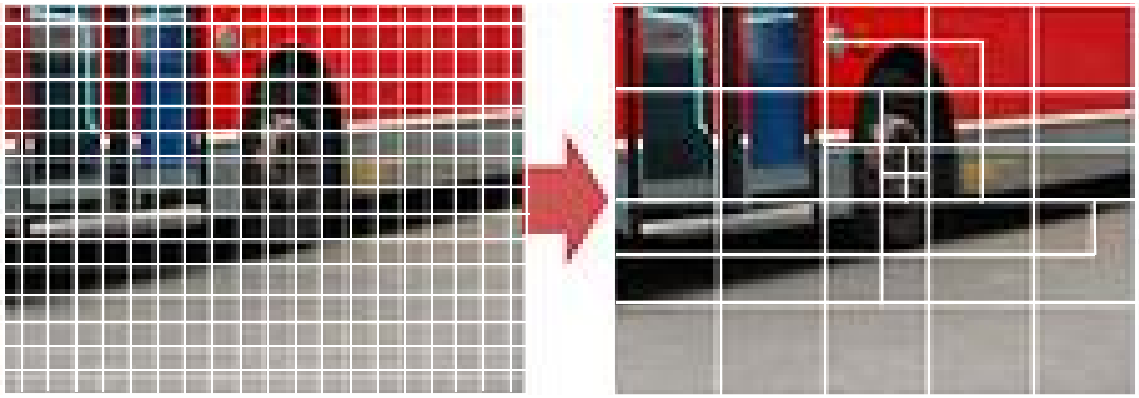
Video Compression Efficiency

Demand for higher compression efficiency
- Increasing video resolution

Migration from H.264 (AVC) to H.265 (HEVC)
- Both AVC and HEVC were jointly developed by ITU-T and ISO/IEC (MPEG)
- HEVC was finalized in Jan 2013 and offers double the compression ratio of AVC
- Will be widely supported in tablets and mobile devices

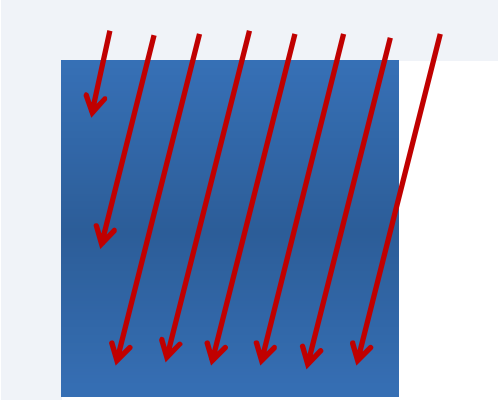


Key Features of H.265/HEVC Coding



Large Block Size with Flexible Block Partition

Group similar areas of an image into a partition

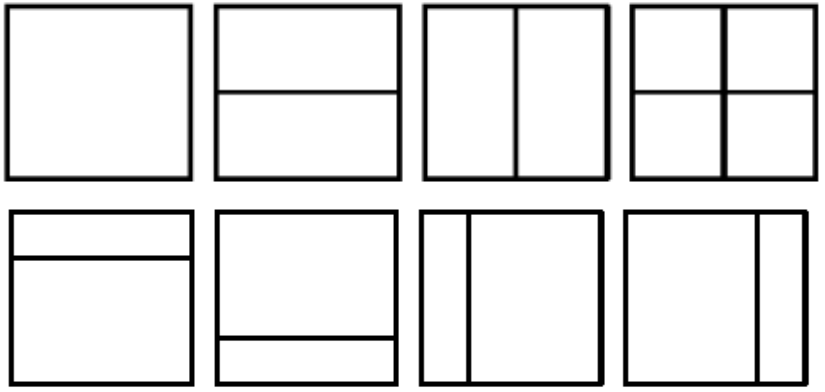


Directional Prediction

Spatial prediction of pixels within a partition

Asymmetric Motion Partitioning

More accurate representation of motion



Video Codec Comparison

HEVC has visibly better quality than AVC at the same bit rate

H.264 / AVC
@ 450 kbps

H.265 / HEVC
@ 450 kbps

Video Codec Comparison

HEVC has similar quality as AVC with half the bit rate

H.264 / AVC
@ 1800 kbps

H.265 / HEVC
@ 900 kbps

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Changes for the Better

Summary

- Collaboration with other SDOs and Fora is key to the success of ITU-T
- ITU-T Multimedia related Recommendations encourage innovation, ensure interoperability and help players remain competitive
- Open architecture of ITU IPTV standards are truly global, open standards can be deployed in horizontal market
- ITU IPTV (e.g. H.721) is widely implemented and deployed
- High Video Quality H.265, 4K, 8K made possible by the continuous collaboration of ITU-T, ISO/IEC JTC1 and other SDOs