SET eXPerience
Pilot Project for Next Generation Terrestrial TV Broadcasting in Brazil

NEC Corporation

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Pilot Project on Next-generation Digital Terrestrial Broadcasting Technology in Brazil
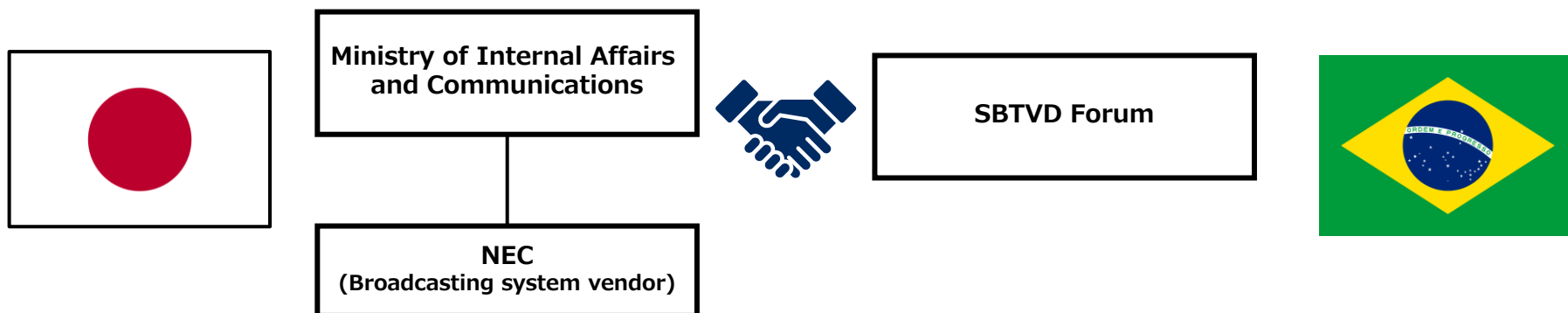
Period : Up to Mar. 2021

Place   : Rio de Janeiro, Brazil

Objectives :
- **Introducing test environment of advanced digital terrestrial broadcasting technologies developed in Japan.**

- **The advanced DTT platform for trial test will be established in Rio de Janeiro in Brazil.**

✓ **NEC support the establishment of the advanced ISDB-T transmission equipment and its testing in Rio de Janeiro.**
✓ **Transmission test of this trial equipment is expected to be started at the beginning of next year.**

Description	Month	2020				2021		
		Sep	Oct	Nov	Dec	Jan	Feb	Mar
Event					🟩 SET eXPerience			
1. Preparation of trial equipment in Japan		▮						
2.Testing at factory in Japan		▮	▮					
3.Delivery & custom clearance of trial equipment				▮				
4.Installations of the test environment in Brazil					▮			
5. Introduction of Project in SET Exhibition				▮				
6. Operation and testing by the SBTVDF.						▮	▮	
7. Joint evaluation with NEC (Expected to be done remotely)						▮		▮
8. Wrap-up Meeting								▮

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- ✓ **NEC prepared the following equipment and tested 4K program transmission with advanced ISDB-T transmission equipment.**
- ✓ **NEC confirmed 4K program reception and transmission parameter of the advanced ISDB-T system.**
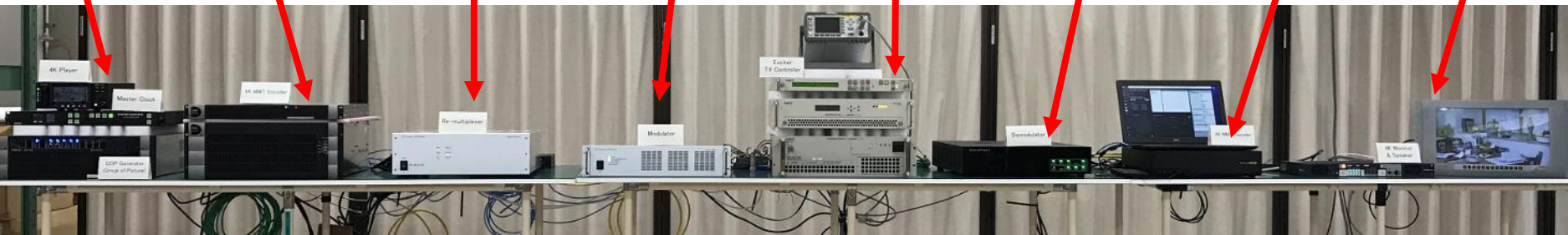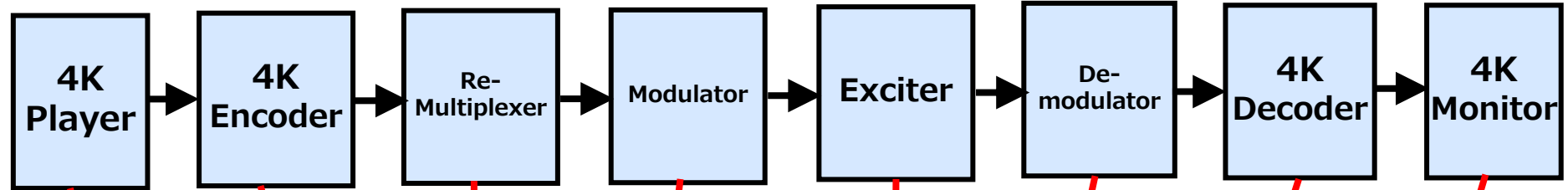
4K Player and 4K Monitor

- 4K Player : 3G-SDI x 4 output
- GPS Receiver : 10MHz, Black Burst and NTP Output
- GOP Generator : Group of Picture reference output
- 4K Monitor : 12G input
- Audio Monitor : 12G input and 32ch audio indication

4K Player

GPS Receiver

4K Monitor

GOP Generator

Audio Monitor

3.1 Explanation of Equipment

4K Encoder
  - 4K and 2K H.265 MMT Encoder module
  - Video I/O   : 4K (2,160p) and 2K (1,080p/i)
  - Audio I/O   : Embedded Audio, 32ch
  - Video Encoding   : H.265|HEVC Main10 Profile
  - Audio Encoding   : MPEG-4 AAC (ISO/IEC 14496-3)
  - 4K I/O   : 3G-SDI x 4 and 12G-SDI

4K Decoder
  - 4K H.265 TLV/MMT Decoder
  - IP Input   : MMT/IP Input
  - 4K Output   : 3G-SDI x 4 or 12G-SDI signal

YE-9300
Encoder

MF4400
Mounting Shelf

4K XJive MMT Decoder

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Re-Multiplexer
  - IP Input   : MMT/TLV input of layer-A, B, C and LLch-1 system
  - IP Output   : Two XMI packets to the Modulator
  - Multiplexing: FCE Block process, Frame process and XMI packet

Modulator
  - IP Input   : XMI/IP input
  - IF Output   : H1, H2, V1 and V2
  - Output frequency   : 37.15MHz and 10dBm±1dB/50ohm
  - Modulation : Bit-Interleaved Coded Mod and Hierarchical Synthesis
  - Interleave   : Time and Frequency Interleave

Re-multiplexer   **Modulator**

3.3 Explanation of Equipment

Exciter and TX Controller
- IF Input   : OFDM modulation signal (37.15MHz)
- RF Output   : OFDM modulation wave
- Bandwidth : 5.57MHz and 35 segments (H polarization)

Demodulator
- IF Input   : H1, H2, V1 and V2
- IP Output   : MMT/IP
- Output frequency   : 37.15MHz and 10dBm±1dB/50ohm
- Modulation : Bit-Interleaved Coded Mod and Hierarchical Synthesis
- Interleave   : Time and Frequency Interleave

TX Controller

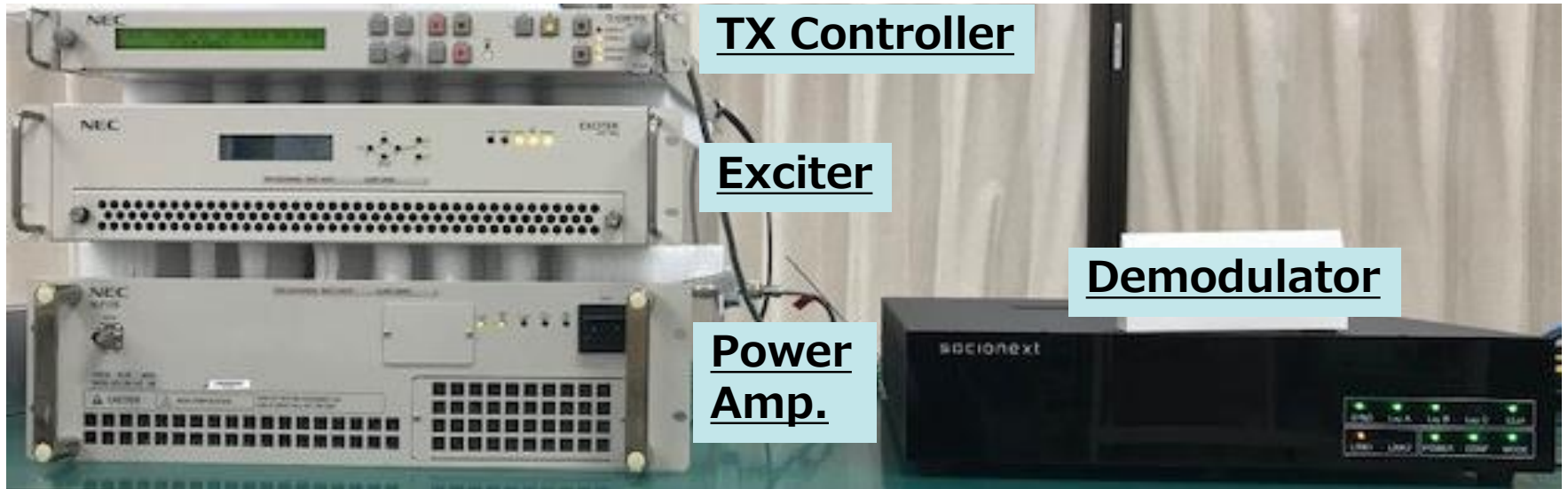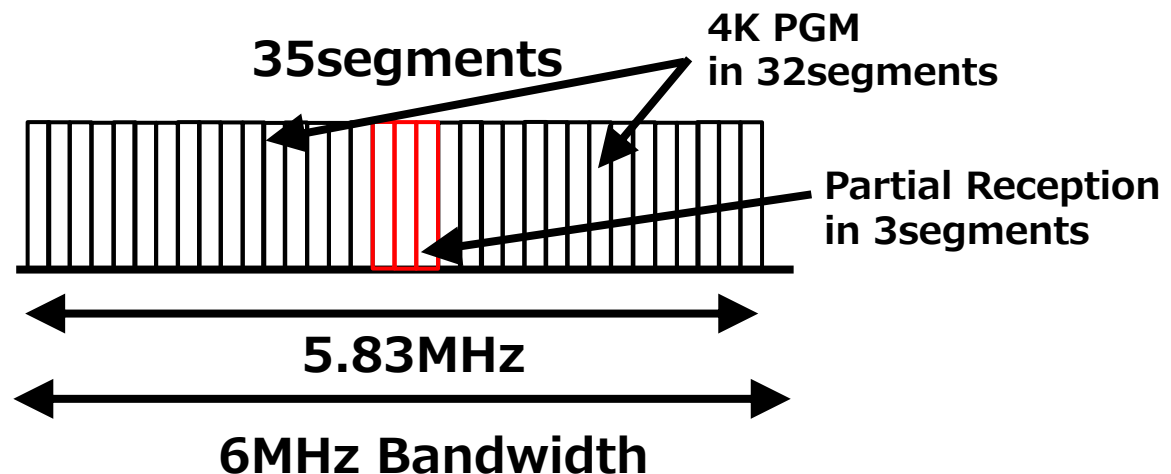**Exciter**

Demodulator

Power Amp.

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Transmission Parameter of Factory Test

The following transmission parameters in each equipment is set and 4K program reception is confirmed.

- Modulation   : Non-Uniform Constellation (NUC), **256QAM**
- Error correction : LDPC (12/16) + BCH
- FFT   : 16k
- GI ratio   : 800/16384 ≒ 1/21（126μs）
- Band width   : 5.83MHz at Exciter output
- Variable pilot insertion ratio
- System   : **SISO**

35segments

4K PGM
in 32segments

Partial Reception
in 3segments

5.83MHz

6MHz Bandwidth

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NEC also conducted Factory Test in accordance with following parameters.

- Video cording : 2K/4K, 20Mbps to 30Mbps
- Modulation : QPSK, 16QAM, 64QAM, 256QAM, 1024QAM 4096QAM
- Error correction : LDPC(2/16 to 14/16) + BCH
- FFT : 8K, 16K, 32K
- GI ratio : 126.56us to 648us

```
4K          4K          Re-                   Up                      4K          4K
Player  →  Encoder  →  Mux   →  Mod   →   Conv.  →  Demo  →  Decoder  →  Monitor
```

HUB

Each parameter is set from Configuration PC.

NTP

Master Clock → 10MHz **BB** **GOP Gen.** → **ENC**

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NEC will prepare following measuring instrument for measurement of next generation system in Brazil.

(1)Advanced signal analyzer
- Constellation, Frequency Response, Delay Profile, TMCC
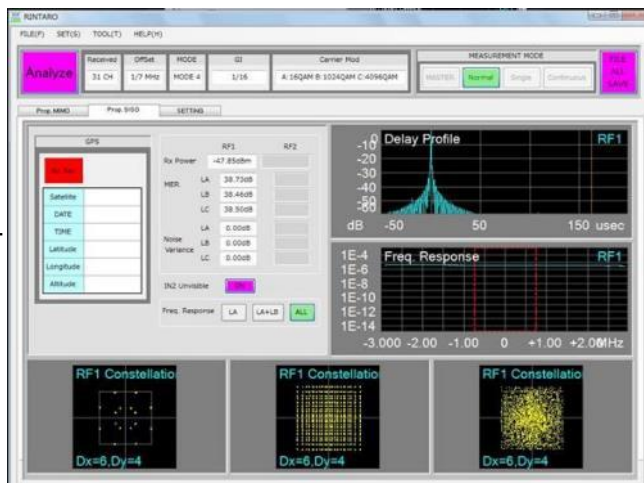- Input Level, MER

(2)TLV Packet Analyzer
- BER（PN）
- PER（TLV packet）

(3) Spectrum Analyzer
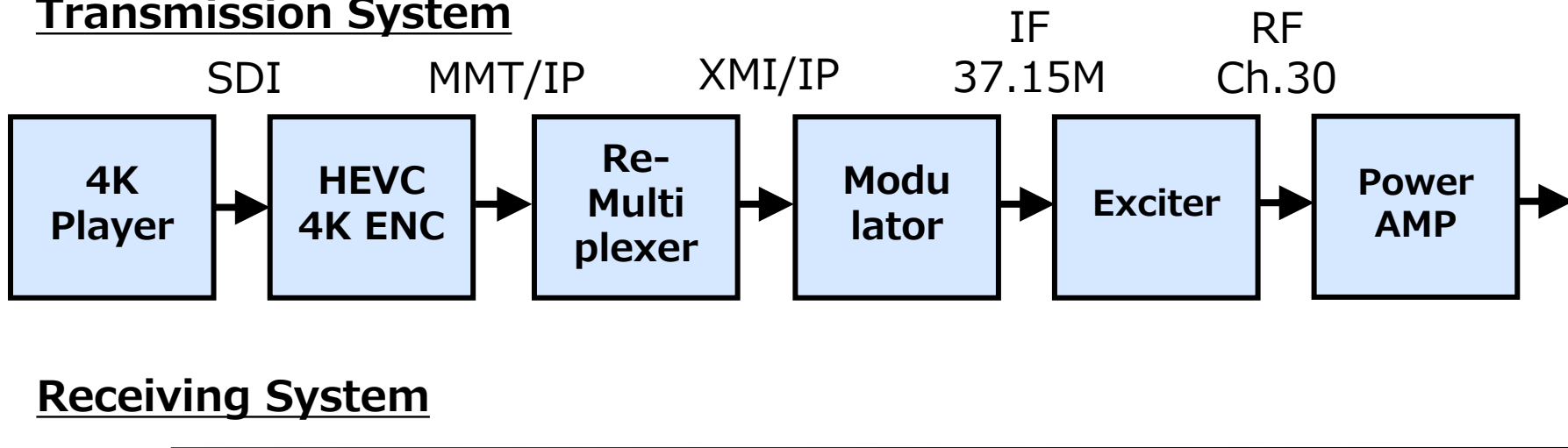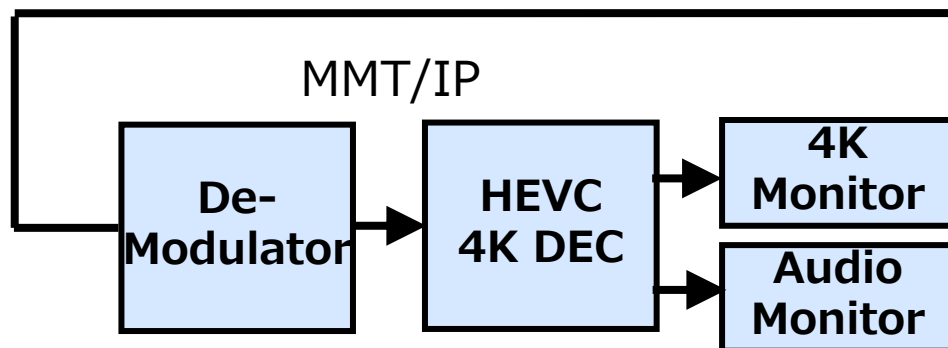- Wideband spectrum measurement such as Adjacent channels

TLV Packet Analyzer

Advanced Signal Analyzer

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5.1 Block Diagram of Factory Test

Transmission System

				IF	RF
	SDI	MMT/IP	XMI/IP	37.15M	Ch.30

4K Player → **HEVC 4K ENC** → **Re-Multi plexer** → **Modu lator** → **Exciter** → **Power AMP**

Receiving System

MMT/IP

De-Modulator → **HEVC 4K DEC** → **4K Monitor**

HEVC 4K DEC → **Audio Monitor**

Sync System

BB

Master Clock → **STC Gen. NS-G8600** → ENC (GOP)

Master Clock → MUX/MOD/EXT (10MHz)

Master Clock → HUB (NTP)

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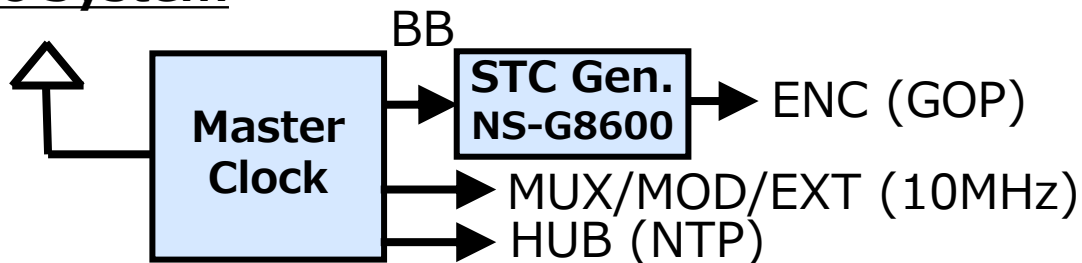
5.2 Block Diagram in Brazil

Transmission System
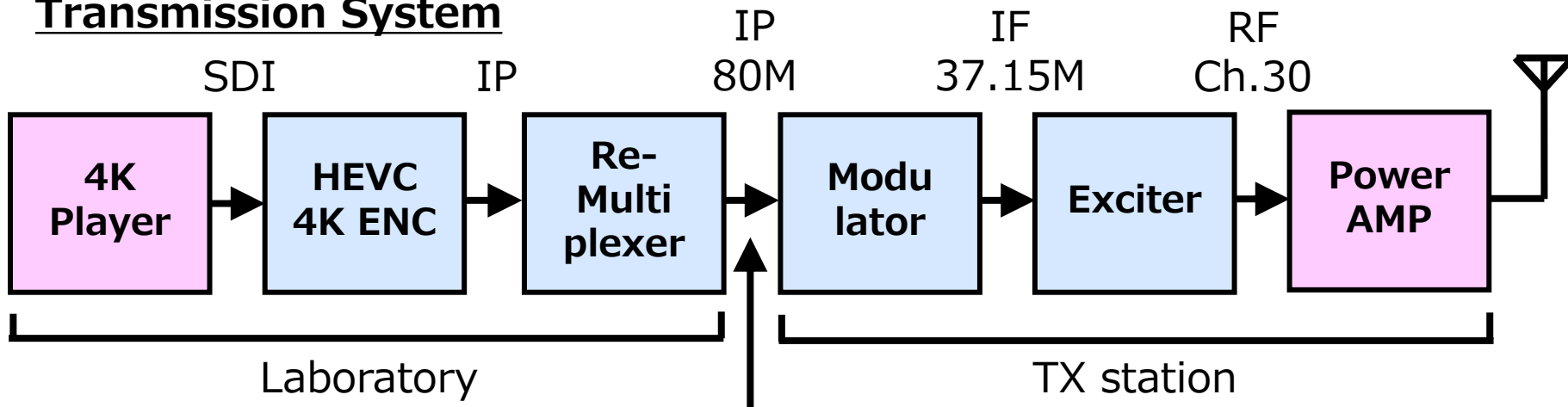
	SDI		IP		IP 80M		IF 37.15M		RF Ch.30

4K Player → HEVC 4K ENC → Re-Multiplexer → Modulator → Exciter → Power AMP → (antenna)

Laboratory ⟵ ⟶ TX station

Receiving System

(antenna) → De-Modulator → HEVC 4K DEC → 4K Monitor / Audio Monitor

Existing TX Rack

New TX Control
Exciter
PA1
PA2
PA1
PA2
COMB

Sync System

Master Clock →(BB)→ STC Gen. NS-G8600 → ENC (GOP)

Master Clock → MUX/MOD/EXT (10MHz)

Master Clock → HUB (NTP)

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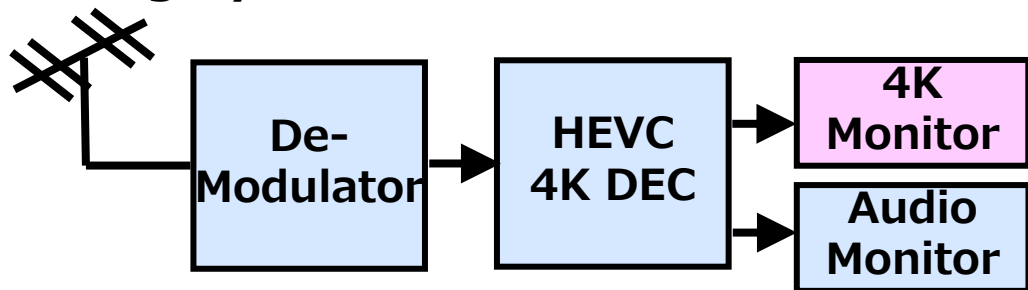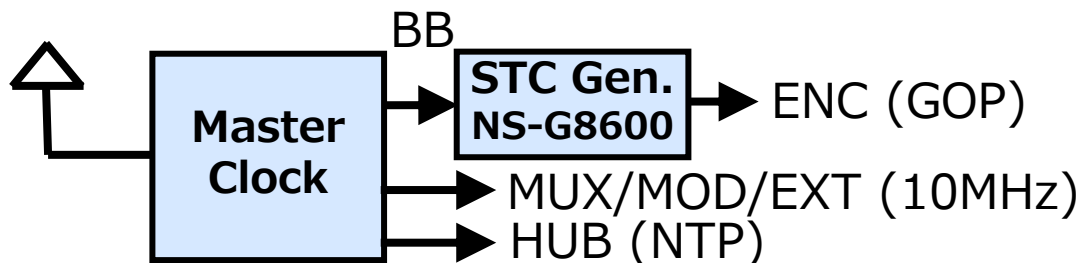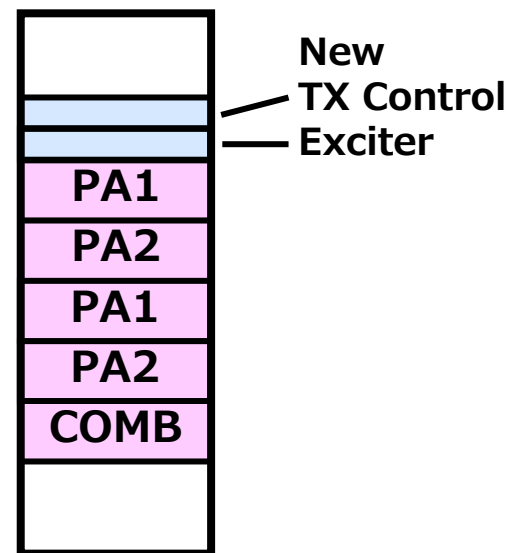
- ✓ **Encoder and Re-multiplexer will be installed in Studio Station.**
- ✓ **Transmission line between Studio and TX station will be used existing IP route.**
- ✓ **Modulator and Exciter will be installed in existing TX Rack in TX Station.**

Map of Transmission Route in Rio de Janeiro

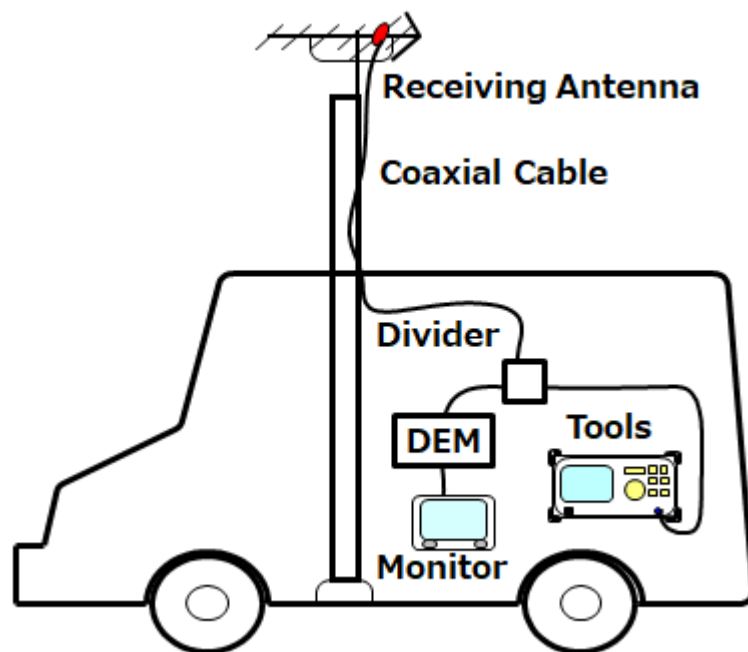## Measurement of Advance ISDB-T Transmission System

✓ **Field Transmission Test in Rio de Janeiro will be conducted.**
✓ **Following items are expected to be measured by field analyzer.**
✓ **Characteristic against ISDB-Tb reception will be compared.**

Characteristics of Signal Transmission

- **Signal Reception Level**
- **MER (Modulation Error Ratio)**
- **BER (Bits Error Rate)**
- **Chanel Spectrum**
- **Constellation**
- **Delay Profile**

Quality Check of Video and Audio

- **Bit Rate of Video Cording**
- **Bit Rate of Audio Cording**
- **Error Collection and Interleave**
- **Guard Interval and Delay Profile**
- **Carrier Modulation**

Receiving Antenna

Coaxial Cable

Divider

DEM

Tools

Monitor

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