



MIC Japan



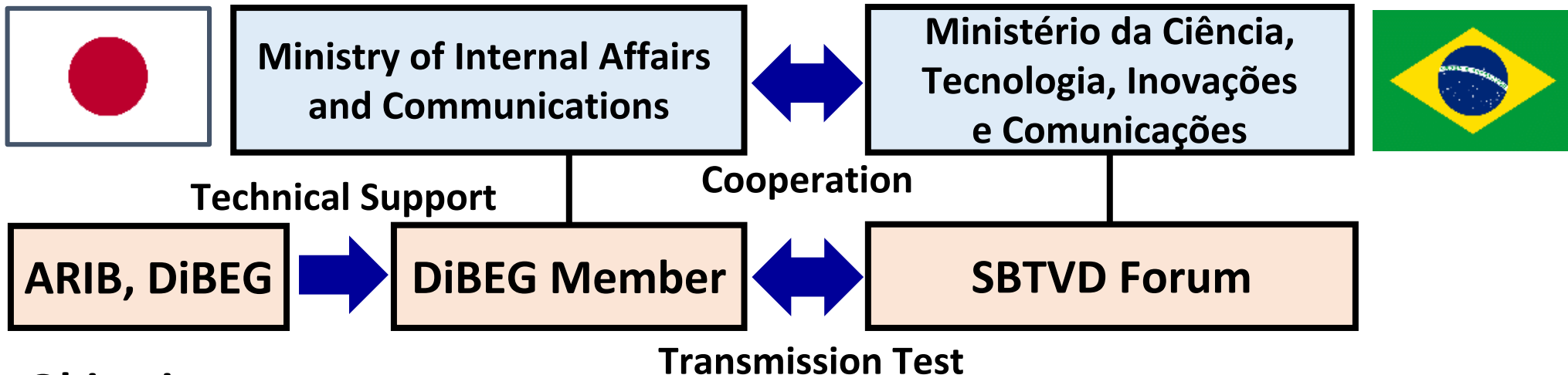
Pilot Project on the SISO Advanced ISDB-T Transmission Test and Evaluation for Brazil TV3.0

SET eXPerience 2021

1. Outline of the project

DiBEG in Japan, together with MIC, have conducted trial transmission test for the Advanced ISDB-T system in Brazil, as a part of the international standardization of the Brazilian digital terrestrial TV technology of Brazil.

Study of International Standard



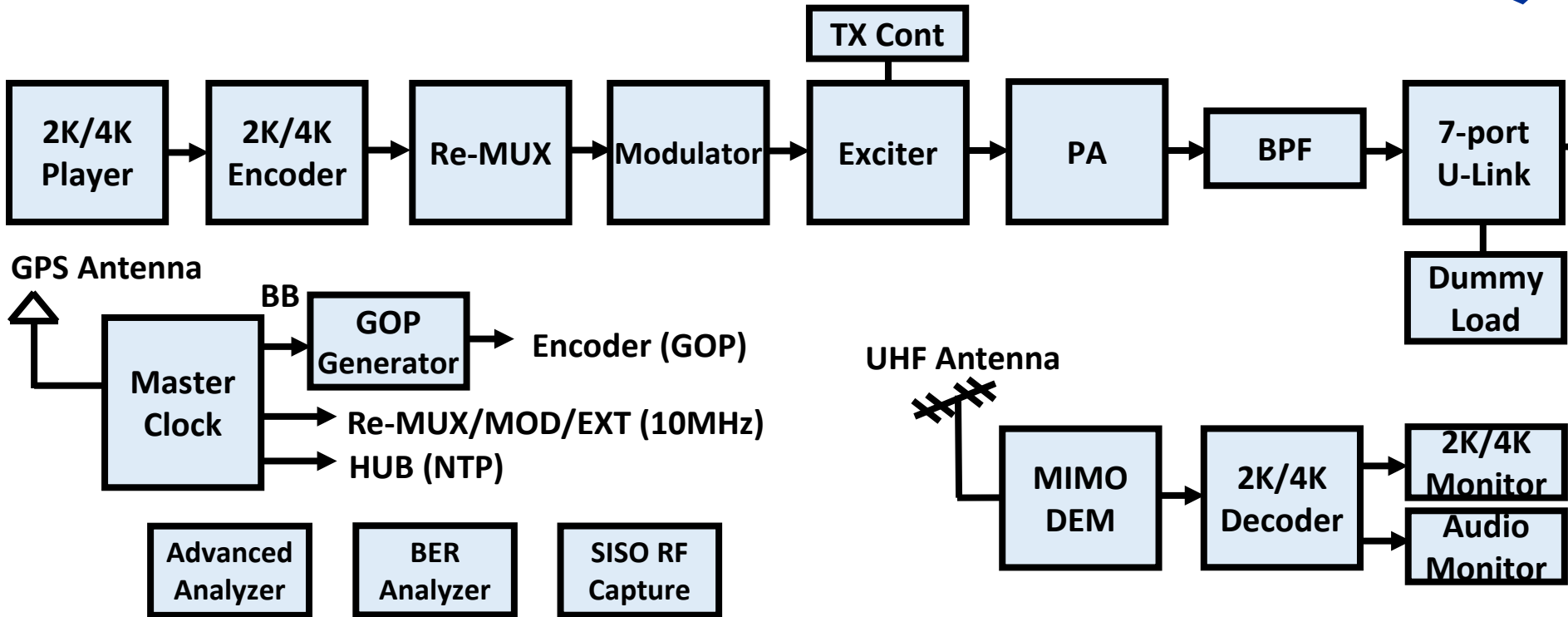
Objectives :

- Preparation of SISO Transmission Equip. of the Advanced ISDB-T System
- Factory Tests of SISO Transmission System in Japan
- Technical Support of the Field Tests in Rio de Janeiro.
- Technical Evaluation of the Advanced ISDB-T System.

2.1 TX Diagram of SISO Advanced ISDB-T System

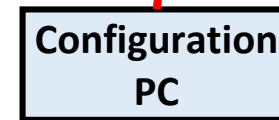
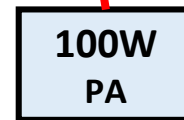
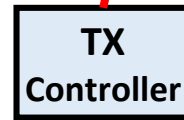
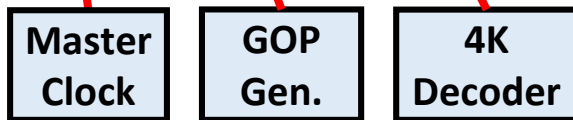
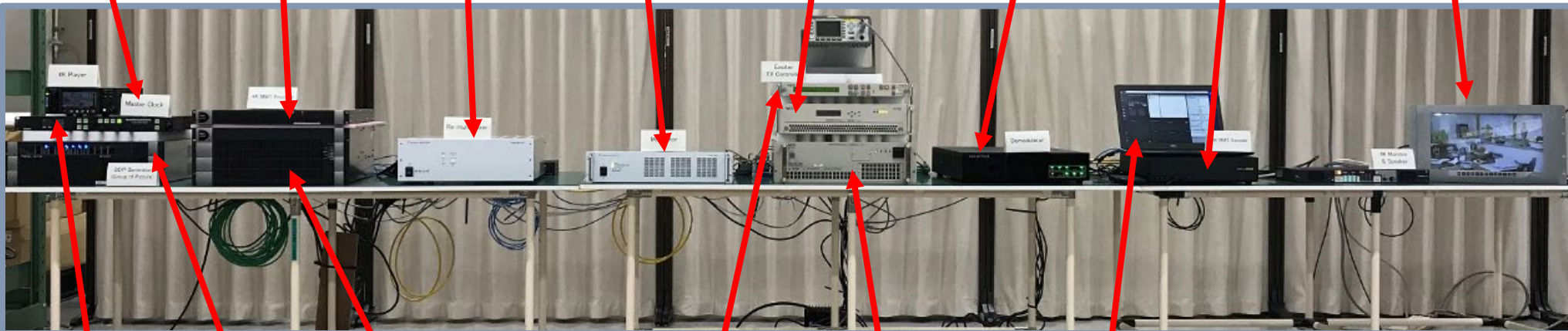
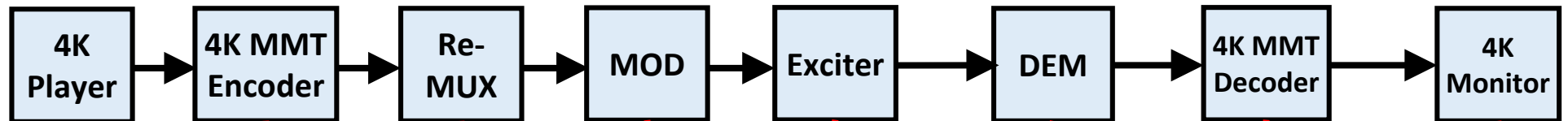
SBTVD-F and DiBEG members jointly conducted field transmission tests on the SISO Advanced ISDB-T system in March, 2021.

The block diagram of the SISO system is mentioned as follows;



2.2 External View of SISO Transmission Equipment

The SISO Advanced ISDB-T transmission system had been tested in Japan in December, 2020 before transportation to Brazil. The lineup of equipment is shown below.



2.3 Outline of Equipment

Advanced ISDB-T Equipment for digital terrestrial transmission system is shown below.

<TX Equipment>

2K/4K Encoder



HEVC Coding of 2K and 4K Program



Re-Multiplexer



Processing of Layer structure and XMI out



Modulator



IF modulation and 37.15MHz output



Exciter/TX Controller



RF modulation for Ch.30

< Reference Equipment >

Master Clock



Synchronization with GPS and BB, 10MHz, NTP out



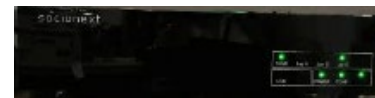
GOP Generator



Generation of Group of Picture

<RX Equipment>

Demodulator



RF demodulation for Ch.30



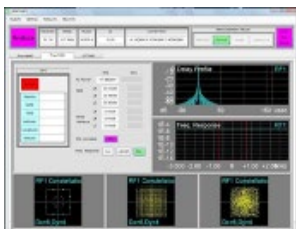
2K/4K Decoder



HEVC Decoding

<Measuring Instrument>

Advanced Analyzer



Input of RF signal
Monitor of delay profile, Constellation and MER

BER Analyzer



Input of MMT signal and BER check

RF Capture

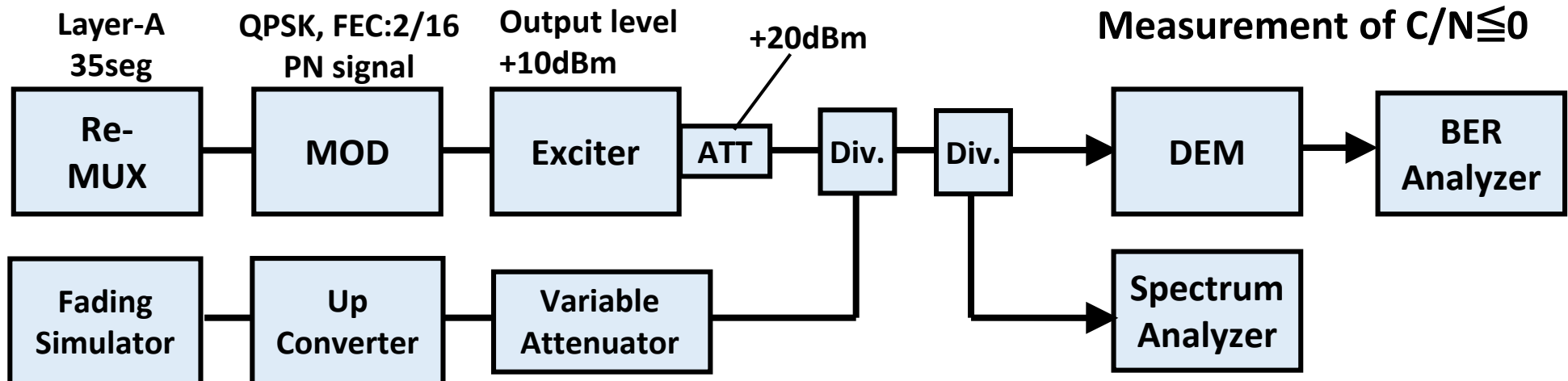


Record of RF reception signal

2.4 Outline of Laboratory Tests in Japan

In the laboratory tests in Japan, DiBEG members inspected and confirmed satisfactory performances of the transmission signal. The following diagram is configured and measured with $C/N \leq 0$ Performance in the laboratory.

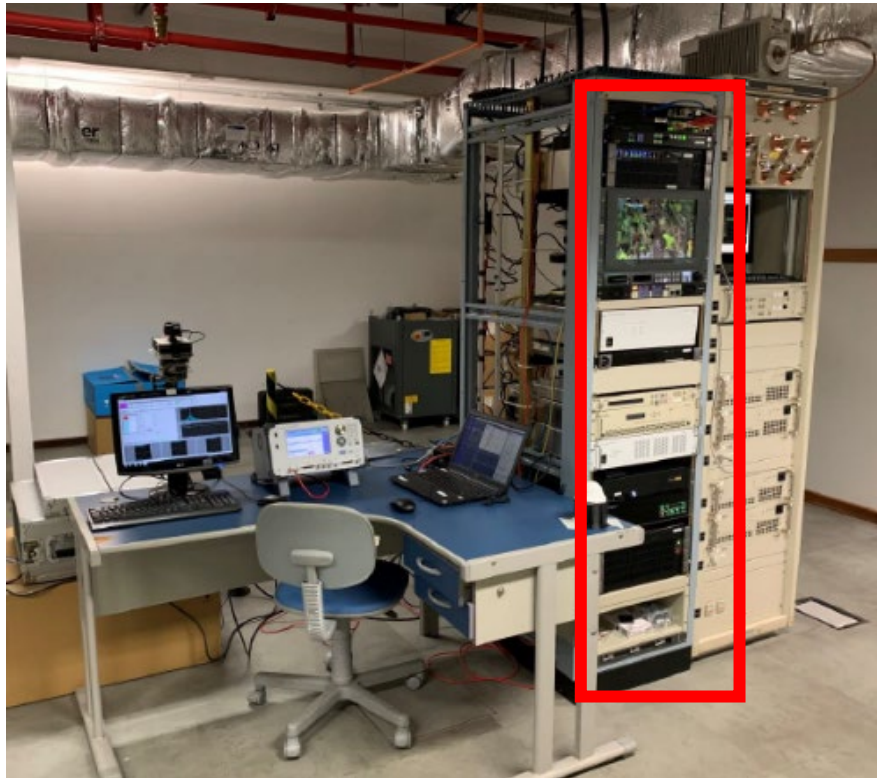
No.	MOD	Line Level	Noise Level	C/N	Remarks
1.	QPSK(2/16)	-49.1	-46.1	-3.0	Satisfy
2.	QPSK(3/16)	-49.1	-47.6	-1.5	ditto
3.	QPSK(4/16)	-49.1	-48.6	-0.5	ditto
4.	QPSK(5/16)	-49.0	-49.6	+0.6	
5.	16QAM(2/16)	-49.1	-49.6	+0.5	



3. Outline of Installation

The SISO Advanced ISDB-T transmission system was installed at the TV-Globo Sumaré TX station in Rio de Janeiro in February 2021. Layout of equipment is mentioned below.

TX Room in Sumaré Station



Adjustment work was conducted by remote work due to Covid-19.



4. Equipment Composition List

The equipment composition list of the SISO Advanced ISDB-T digital terrestrial system is shown below.

No.	Product	Q'ty	No.	Product	Q'ty
1.	2K/4K Player	1set	13.	UHF Reception Antenna	1set
2.	2K/4K Encoder	1set	14.	4K Monitor	1set
3.	Advanced Re-Multiplexer	1set	15.	Audio Monitor	1set
4.	Advanced Modulator	1set	16.	Master Clock	1set
5.	Advanced Exciter	1set	17.	GOP Generator	1set
6.	TX Controller	1set	18.	L2 Switch	1set
7.	Power Amplifier	2sets	19.	Personal Computer	1set
8.	Band Pass Filter	1set	20.	Advanced Analyzer	1set
9.	U-link Panel	1set	21.	BER Analyzer	1set
10.	Dummy Load	1set	22.	SISO RF Capture	1set
11.	Demodulator	1set	23.	Spectrum Analyzer	1set
12.	2K/4K Decoder	1set	24.	Test Signal Generator	1set

5. Comparison Table

Comparison table between ISDB-T and SISO Advanced ISDB-T system.

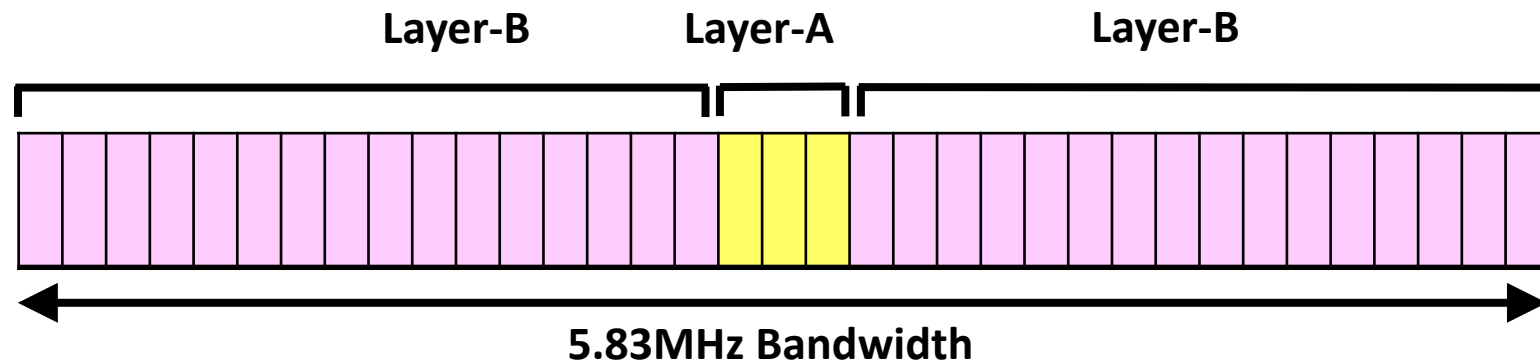
Description	ISDB-T	SISO Advanced ISDB-T
Video Coding	MPEG-2, MPEG-4	VVC*
Speed (Bit rate)	16.0Mbps	28.5Mbps
Program	2K	4K
Segment Number	13	35
Bandwidth	5.57MHz	5.83MHz
Layer	Layer-A, B, C	Layer-A, B, C, LLch
FFT Size	1,024, 4096, 8,192	8,192, 16,384, 32,768
Guard Interval	1/4, 1/8, 1/16, 1/32	1/4, 1/8, 1/16, 1/32, 1/256, 800/FFT size
Modulation	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM 256, 1024, 4096QAM
Error Correction	RS + convolutional code	BCH + LDPC

* VVC is under study and evaluation.

6.1 Transmission Parameter for 4K

256QAM and 25Mbps of 4K program were applied as the transmission parameters. The detailed parameter is as follows.

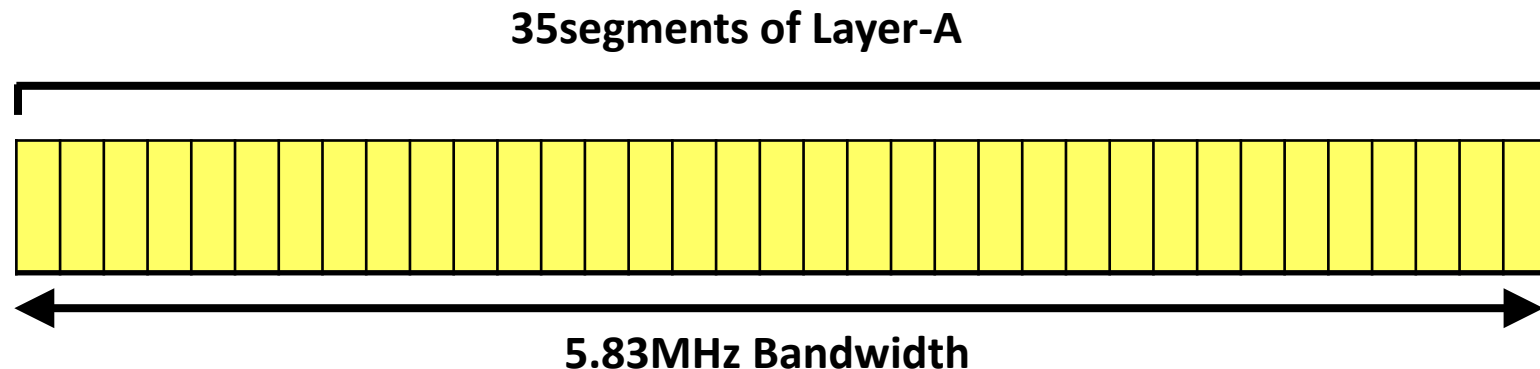
- Modulation : 256QAM
- Constellation : Non-Uniform Constellation
- Error correction : LDPC (12/16) + BCH
- FFT : 16k
- GI ratio : 800/16384
- Pilot : Dx=6, Dy=4
- Time Interleave : I=2
- Layer : Layer-B, 32segments
- Program : 4K (2160p), 25Mbps



6.2 Transmission Parameter for 2K

QPSK and 1.7Mbps of 2K program were applied as the transmission parameters. Detailed parameter is as follows.

- Modulation : QPSK
- Constellation : Uniform Constellation
- Error correction : LDPC (3/16) + BCH
- FFT : 8k
- GI ratio : 1/8
- Pilot : Dx=6, Dy=4
- Time Interleave : I=2
- Layer : Layer-A, 35segments
- Program : 2K (1080p), 1.7Mbps



7.1 Field Tests in Rio

Field tests were conducted by TV-Globo. The supervisor from Japan could not visit Rio due to Covid-19. We discussed the field test results after the measurement.

Vehicle was prepared by Globo and the Advanced measuring instruments were prepared in Japan.



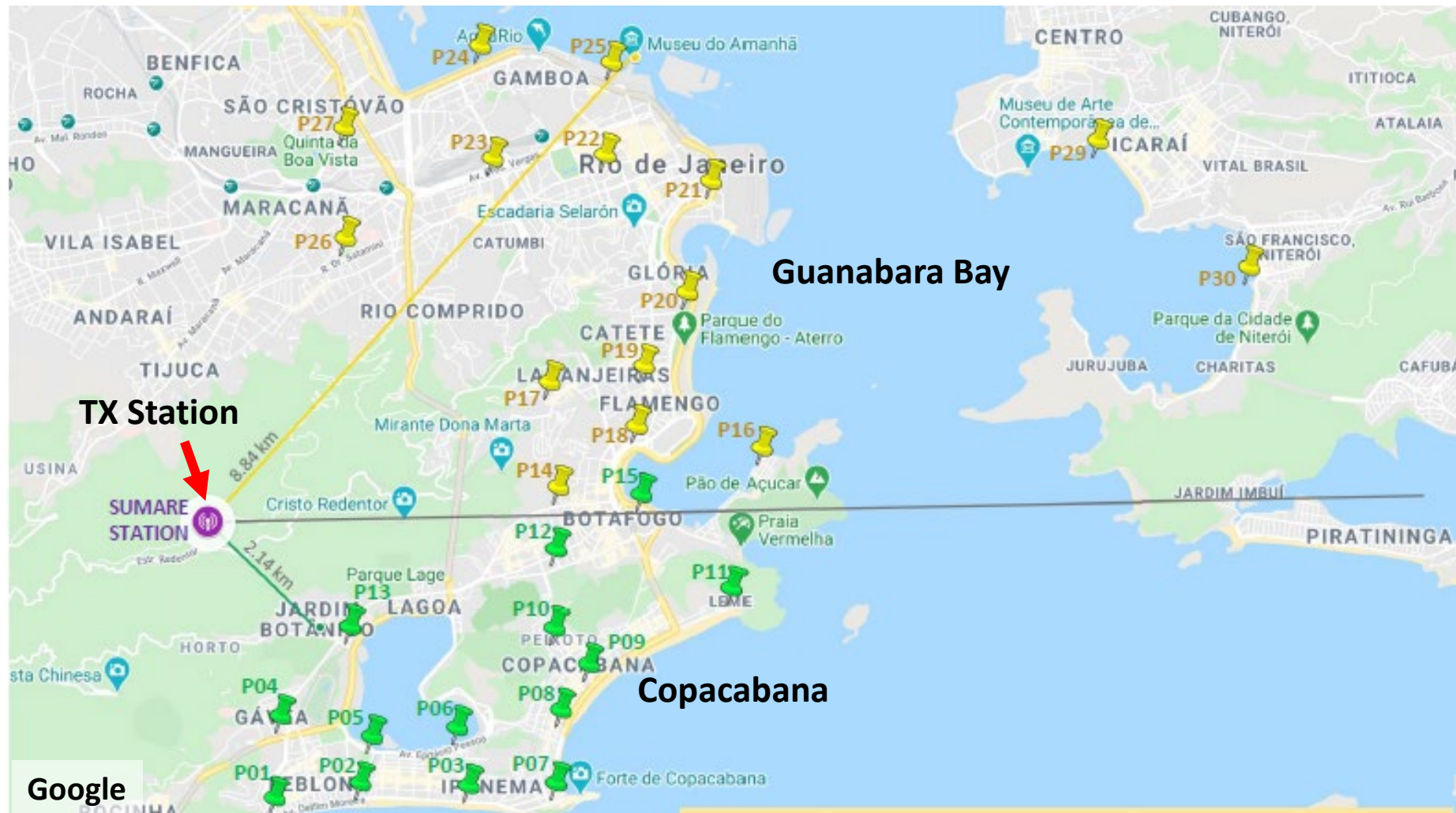
Inside of Vehicle

- Spectrum
- Divider
- Attenuator
- Test signal
- RF Capture Analyzer
- BER Analyzer
- Config. PC



7.2 Location of Field Tests in Rio

The field tests were conducted in Rio de Janeiro, Brazil. Thirty measuring points were selected; 15 yellow points are in Downtown, and 15 green points are in the south.



7.3 Interference check of Field Tests in Rio

Transmission Frequency is 569MHz of Ch-30 in 6MHz bandwidth and the output power is 100W. We checked the interference to adjacent channel of Ch-29 and Ch-31. We confirmed no interference to adjacent program.

Confirmation of no interference to adjacent channel

TX Antenna
for Field tests



Ch-29
Globo

Ch-30
Test

Ch-31
Univ.



7.3 Interference check of Field Tests in Rio

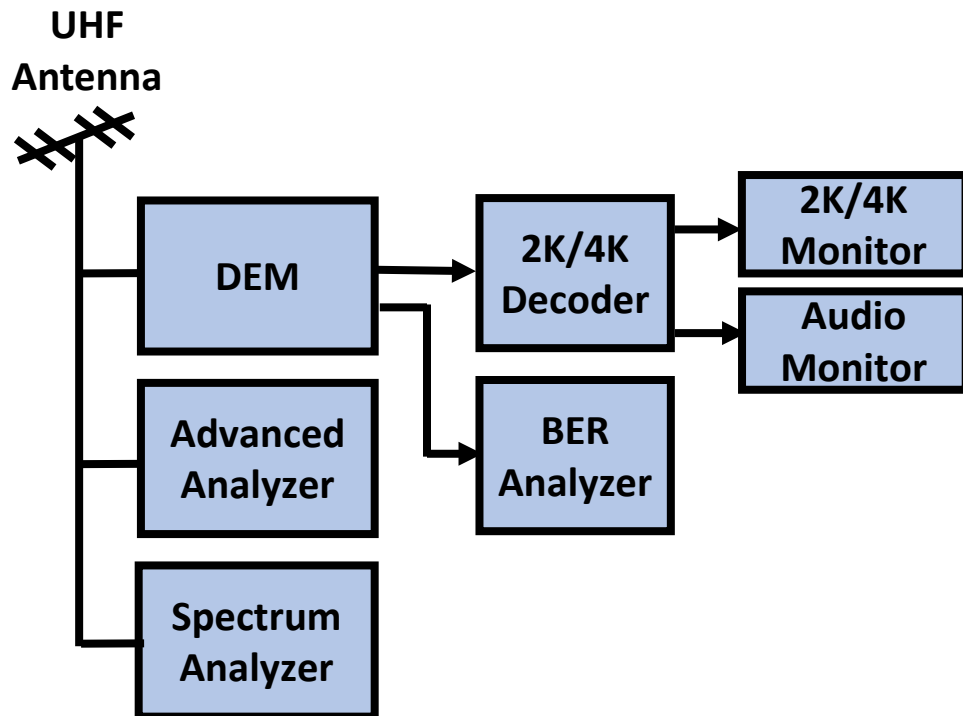
Field Test Data of 4K Transmission is below.

Point	Desired Latitude (degree)	Desired Longitude (degree)	Demodulator Measurements				CNR Limiar Measurement: Spectrum Analyzer + Demodulator									Date
			RSSI-1 (dBm)	Reception quality_1 (dB)	"Normal" RX PRINT SCREEN?	PER after 2 min	6 Mhz CH. POWER RECEIVED C (dBm)	6 Mhz CH. POWER INJECTED N (dBm)	Calculated C/N (dB)	RSSI-1 (dBm)	PER after 2 min	Reception quality_1 (dB)	Calculated Margin (dB)	"Degrad" RX PRINT SCREEN?		
1	-22.98809	-43.22714	-56	36.1	yes	0	-55.5	-76.5	21.0	-55	0	20.0	16.1	yes	2021/3/19	
2	-22.98623	-43.21545	-45	36.1	yes	0	-45.9	-68.0	22.1	-46	0	21.4	14.7	yes	2021/3/19	
3	-22.98658	-43.20056	-70	28.1	yes	0	-70.4	-89.5	19.1	-70	0	23.1	5.0	yes	2021/3/19	
4	-22.97789	-43.22616	-54	34.3	yes	0	-54.1	-75.0	20.9	-52	0	22.8	11.5	yes	2021/3/19	
5	-22.9804	-43.21389	-52	36.1	yes	0	-51.7	-71.8	20.1	-50	0	21.7	14.4	yes	2021/3/19	
6	-22.9792	-43.2022	-47	35.1	yes	0	-46.9	-68.0	21.1	-46	0	21.3	13.8	yes	2021/3/19	
7	-22.98616	-43.18873	-74	26.3	yes	0	-74.4	-90.4	16.0	-74	0	24.1	2.2	yes	2021/3/19	
8	-22.97696	-43.18817	-87	13.1	yes	-	-86.4	-	-	-	-	-	-	no	2021/3/23	
9	-22.97138	-43.18429	-83	15.5	yes	-	-83.2	-	-	-	-	-	-	no	2021/3/23	
10	-22.96676	-43.18896	-87	13.3	yes	-	-86.4	-	-	-	-	-	-	no	2021/3/23	
11	-22.96187	-43.1649	-86	14.5	yes	-	-85.4	-	-	-	-	-	-	no	2021/3/23	
12	-22.95694	-43.18886	-54	33.8	yes	0	-53.3	-75.4	22.1	-54	0	21.0	12.8	yes	2021/3/23	
13	-22.96667	-43.21678	-54	35.4	yes	0	-54.9	-78.4	23.5	-55	0	22.7	12.7	yes	2021/3/19	
14	-22.94916	-43.1885	-93	5.2	yes	-	-89.3	-	-	-	-	-	-	no	2021/3/24	
15	-22.95009	-43.17719	-84	1.9	yes	-	-83.5	-	-	-	-	-	-	no	2021/3/23	
16	-22.94426	-43.16106	-62	28.5	yes	0	-62.2	-83.7	21.5	-62	0	20.8	7.7	yes	2021/3/24	
17	-22.93603	-43.1897	-75	24.7	yes	3.79E-01	-75.6	-	-	-	-	-	-	no	2021/3/24	
18	-22.94171	-43.17782	-90	9.3	yes	-	-87.7	-	-	-	-	-	-	no	2021/3/24	
19	-22.93404	-43.17682	-71	20.7	yes	2.67E-01	-71.7	-	-	-	-	-	-	no	2021/3/24	
20	-22.92486	-43.17091	-64	32.7	yes	0	-64.1	-84.7	20.6	-64	0	21.0	11.7	yes	2021/3/24	
21	-22.91099	-43.16767	-61	31.3	yes	0	-61.7	-82.7	21.0	-61	0	20.8	10.5	yes	2021/3/25	
22	-22.90761	-43.18213	-65	30.9	yes	0	-65.6	-90.5	24.9	-65	0	24.1	6.8	yes	2021/3/25	
23	-22.90811	-43.19736	-65	20.5	yes	2.79E-02	-67.2	-	-	-	-	-	-	no	2021/3/25	
24	-22.894	-43.19909	-71	20.1	yes	7.36E-01	-70.1	-	-	-	-	-	-	no	2021/3/25	
25	-22.89615	-43.18123	-79	20.2	yes	8.84E-01	-78.1	-	-	-	-	-	-	no	2021/3/25	
26	-22.91811	-43.21746	-63	31.3	yes	0	-64.1	-84.5	20.4	-64	0	20.5	10.8	yes	2021/3/25	
27	-22.90437	-43.21765	-66	31.7	yes	0	-66.1	-87.9	21.8	-65	0	23.9	7.8	yes	2021/3/25	
28	-22.87835	-43.10914	-69	20.6	yes	4.33E-02	-70.2	-	-	-	-	-	-	no	2021/3/26	
29	-22.90583	-43.11527	-57	30.5	yes	0	-57.6	-79.2	21.6	-58	0	20.8	9.7	yes	2021/3/26	
30	-22.92167	-43.09466	-66	25.2	yes	0	-66.1	-88.8	22.7	-68	0	21.5	3.7	yes	2021/3/26	

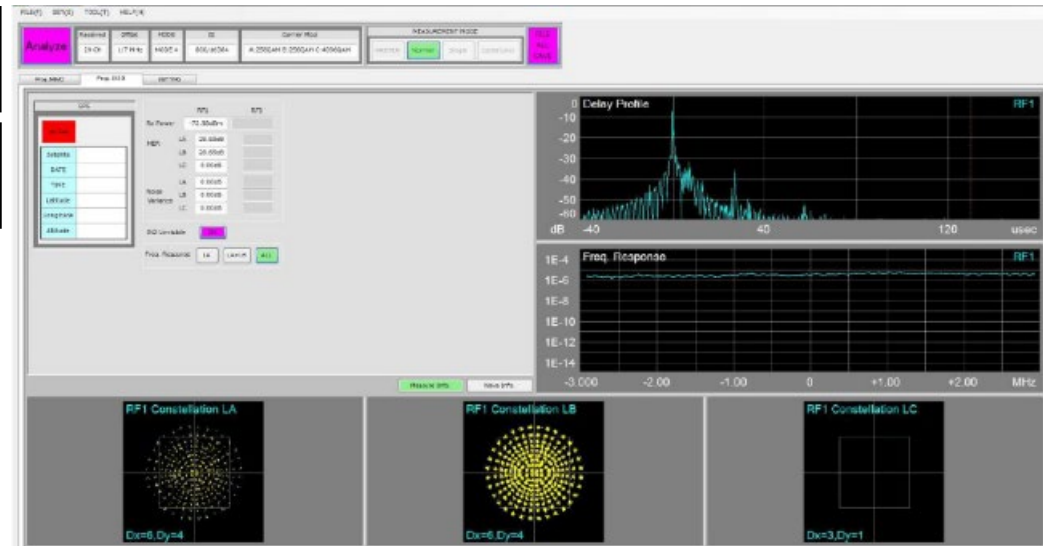
7.5 Comment of Field Test result for 4K transmission

The measuring diagram in the vehicle is mentioned as follows.

- (1) The test results at most of all measured points show good performance, although some points registered some amount of packet error.
- (2) Due to terrain obstructions, the points 8, 9, 10, 11, 14, and 15 presented not enough signal strength to perform a 256 QAM demodulation.



Advanced Analyzer in Point-3



7.6 Field Test result of 2K transmission

Field Test Data of 2K Transmission for $C/N \leq 0$ measurement is below.

Point	Desired Latitude (degree)	Desired Longitude (degree)	Demodulator Measurements				CNR Limiar Measurement: Spectrum Analyzer + Demodulator									Date
			RSSI-1 (dBm)	Reception quality_1 (dB)	"Normal" RX PRINT SCREEN?	PER after 2 min	6 Mhz CH. POWER RECEIVED C (dBm)	6 Mhz CH. POWER INJECTED N (dBm)	Calculated C/N (dB)	RSSI-1 (dBm)	PER after 2 min	Reception quality_1 (dB)	Calculated Margin (dB)	"Degrad" RX PRINT SCREEN?		
1	-22.98809	-43.22714	-52	35.1	yes	0	-53.0	-52.5	-0.5	-49	0	1.3	33.8	yes	2021/3/8	
2	-22.98623	-43.21545	-47	35.1	yes	0	-46.8	-46.0	-0.8	-44	0	1.1	34.0	yes	2021/3/8	
3	-22.98658	-43.20056	-72	27.0	yes	0	-72.5	-71.2	-1.3	-68	0	1.2	25.8	yes	2021/3/8	
4	-22.97789	-43.22616	-45	35.1	yes	0	-45.6	-44.4	-1.2	-42	0	1.2	33.9	yes	2021/3/10	
5	-22.9804	-43.21389	-45	35.1	yes	0	-46.4	-46.5	0.1	-43	0	1.9	33.2	yes	2021/3/9	
6	-22.9792	-43.2022	-45	35.1	yes	0	-45.9	-45.0	-0.9	-42	0	1.3	33.8	yes	2021/3/9	
7	-22.98616	-43.18873	-77	22.5	yes	0	-76.6	-76.0	-0.6	-73	0	1.3	21.2	yes	2021/3/9	
8	-22.97696	-43.18817	-89	10.6	yes	0	-88.3	-90.7	2.4	-94	0	3.0	7.6	yes	2021/3/10	
9	-22.97138	-43.18429	-84	9.5	yes	0	-85.0	-86.9	1.9	-83	0	3.7	5.8	yes	2021/3/9	
10	-22.96676	-43.18896	-92	6.9	yes	0	-89.9	-90.7	0.8	-95	0	3.8	3.1	yes	2021/3/18	
11	-22.96187	-43.1649	-84	15.3	yes	0	-83.2	-83.2	0.0	-80	0	2.0	13.3	yes	2021/3/9	
12	-22.95694	-43.18886	-52	31.9	yes	0	-52.2	-50.9	-1.3	-48	0	1.2	30.7	yes	2021/3/10	
13	-22.96667	-43.21678	-48	36.1	yes	0	-50.0	-49.4	-0.6	-47	0	1.2	34.9	yes	2021/3/8	
14	-22.94916	-43.1885	-88	11.4	yes	0	-86.1	-84.0	-2.1	-84	0	1.7	9.7	yes	2021/3/11	
15	-22.95009	-43.17719	-85	12.7	yes	0	-85.5	-87.0	1.5	-84	0	3.2	9.5	yes	2021/3/10	
16	-22.94426	-43.16106	-57	27.7	yes	0	-57.1	-58.6	1.5	-55	0	1.6	26.1	yes	2021/3/11	
17	-22.93603	-43.1897	-76	20.5	yes	0	-76.6	-75.7	-0.9	-73	0	1.2	19.3	yes	2021/3/12	
18	-22.94171	-43.17782	-95	4.9	yes	0	-84.8	-85.3	0.5	-94	0	2.8	2.1	yes	2021/3/11	
19	-22.93404	-43.17682	-77	22.0	yes	0	-77.5	-76.9	-0.6	-74	0	1.3	20.7	yes	2021/3/12	
20	-22.92486	-43.17091	-62	33.1	yes	0	-62.5	-61.5	-1.0	-59	0	1.0	32.1	yes	2021/3/12	
21	-22.91099	-43.16767	-52	32.1	yes	0	-52.3	-51.9	-0.4	-49	0	1.5	30.6	yes	2021/3/12	
22	-22.90761	-43.18213	-63	32.8	yes	0	-64.3	-64.0	-0.3	-60	0	1.4	31.4	yes	2021/3/12	
23	-22.90811	-43.19736	-62	31.0	yes	0	-62.0	-61.2	-0.8	-58	0	1.3	29.7	yes	2021/3/12	
24	-22.894	-43.19909	-69	21.1	yes	0	-70.0	-70.5	0.5	-67	0	2.2	18.9	yes	2021/3/17	
25	-22.89615	-43.18123	-80	17.7	yes	0	-80.6	-81.5	0.9	-78	0	1.4	16.3	yes	2021/3/17	
26	-22.91811	-43.21746	-63	32.2	yes	0	-64.0	-63.0	-1.0	-59	0	1.5	30.7	yes	2021/3/17	
27	-22.90437	-43.21765	-49	33.2	yes	0	-48.4	-49.5	1.1	-47	0	1.4	31.8	yes	2021/3/17	
28	-22.87835	-43.10914	-58	29.6	yes	0	-58.9	-58.1	-0.8	-55	0	1.2	28.4	yes	2021/3/18	
29	-22.90583	-43.11527	-58	31.6	yes	0	-57.6	-57.1	-0.5	-54	0	1.4	30.2	yes	2021/3/18	
30	-22.92167	-43.09466	-63	33.0	yes	0	-67.1	-65.9	-1.2	-62	0	2.1	30.9	yes	2021/3/18	

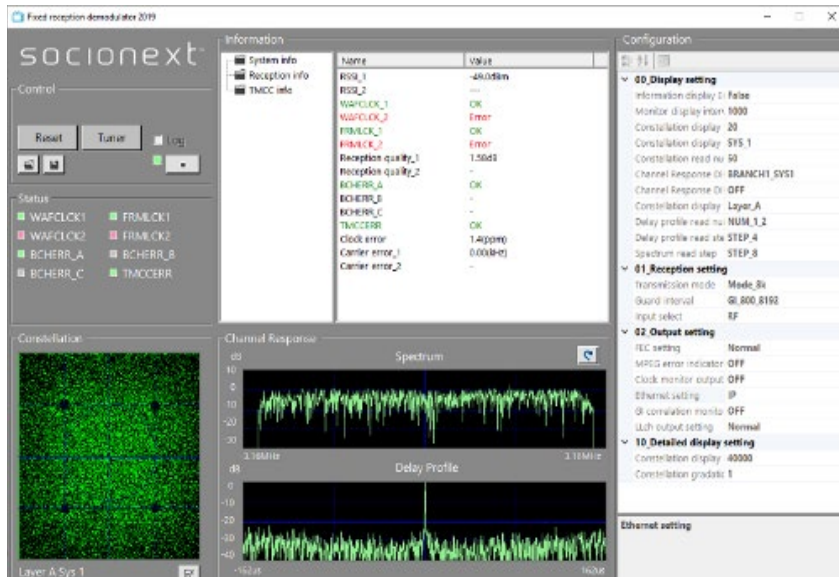
7.7 Comment of Field Test result for 2K transmission

2K transmission test was for the purpose of $C/N \leq 0$ measuring under QPSK.

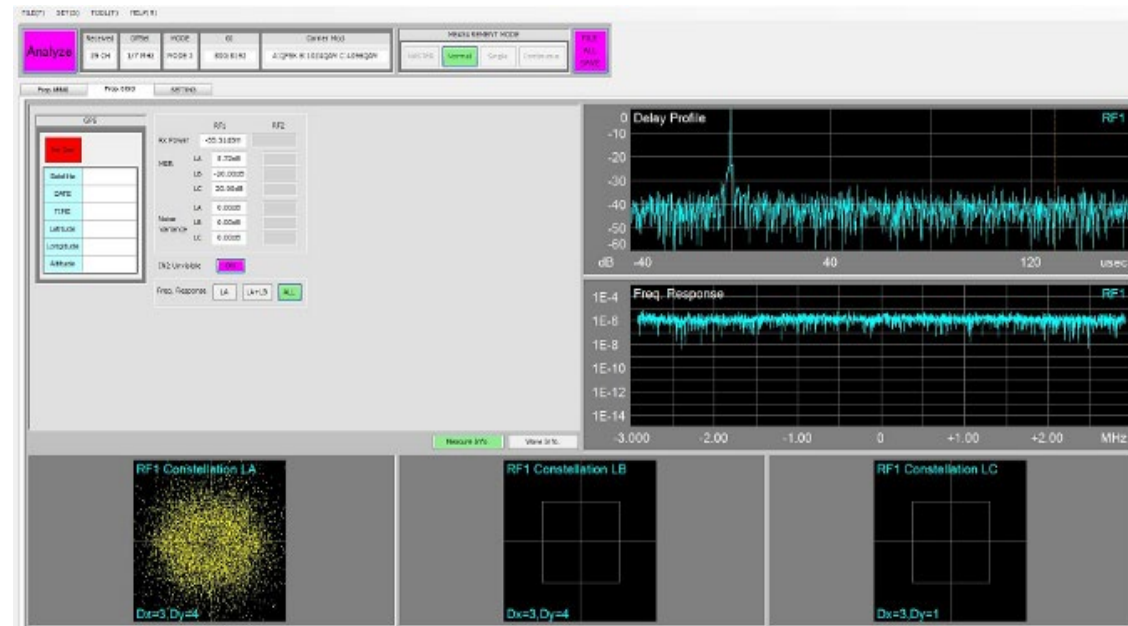
(1) $C/N \leq 0$ is measured at more than 60% of the measuring points in the field.

(2) At other test points, we believe other interference factors not displayed in the spectrum or delay profile affected the results. In the Japanese field test experience, we found that some locations showed degraded receiving level of few dB.

Output of Demodulator in Point-21



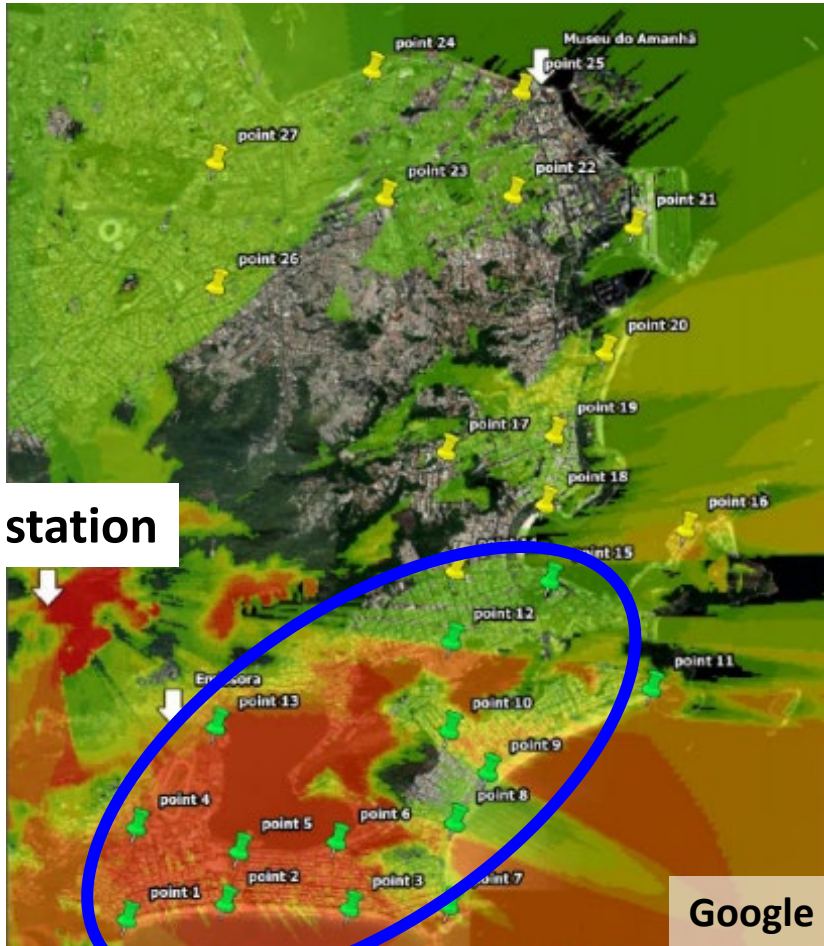
Output of Advanced Analyzer in Point-21



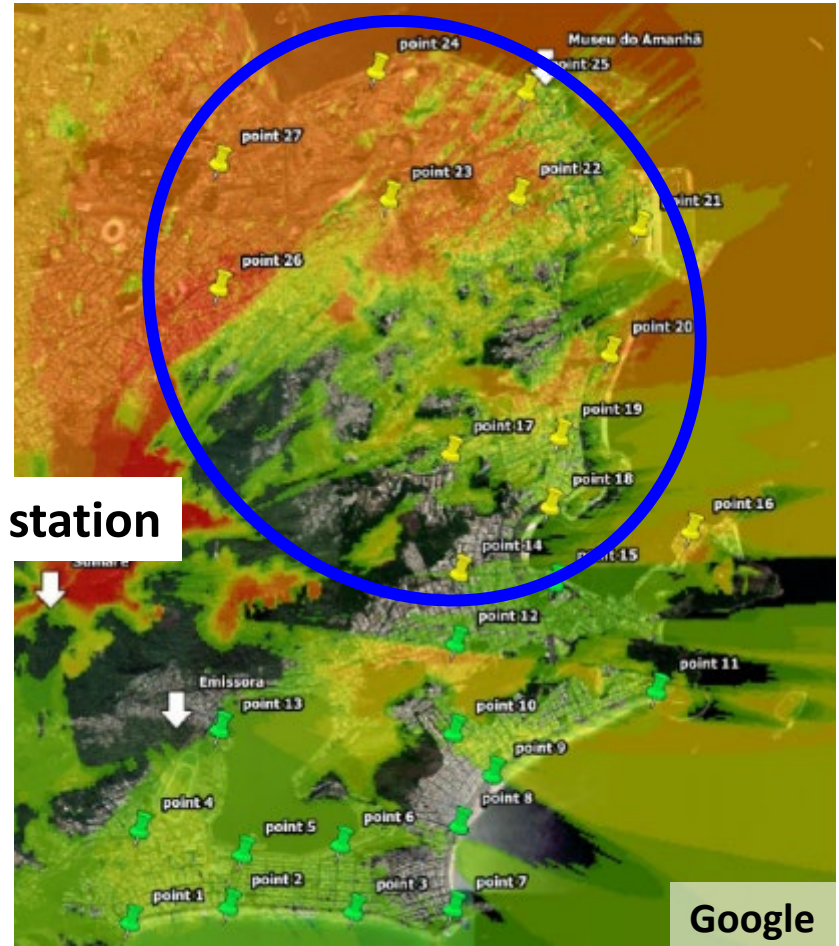
7.8 Field Tests in Rio

The field strength measurements in the southern and the downtown area are shown as follows.

Field strength of South area



Field strength of Downtown



Green: 53 to 70, Yellow: 70 to 80
Red: 80 to 100 (dBuV/m)

8. Summary of the Field Tests in Rio

(1) Investigation of technical subjects and requirements

As technical subject, based on CfP and interviews with Brazilian broadcasters, $C/N \leq 0$ in 2K reception and co-channel interference with own system, etc. were checked.

(2) Examination of countermeasures and sharing of test results

We examined the parameters to achieve $C/N \leq 0$. And we almost measured satisfactory results of $C/N \leq 0$, using the proposed parameters. We discussed the 2K/4K field test results with SBTVD-F.

(3) Feedback to DiBEG and Japanese members

The process and results of the pilot project were reported at DiBEG and Task Force member meetings. Some experts commented that measurements of $C/N \leq 0$ in the field tests were highly satisfactory.

(4) International standardization in collaboration with Brazil

The 4K and 8K transmission, Integrated Broadcast-Broadband, and robustness and flexibility of transmission are the major goals to be achieved by the Japanese next-generation broadcasting technology, and are common to Brazil. These goals are to be achieved through collaborations between Japan and Brazil.

9. Gratitude

Regarding the transmission tests in Rio de Janeiro, SBTVD-F made strenuous efforts in the installation, adjustments and field testing even under the Covid-19 influence in February and March, 2021. They conducted the measurements of 2K and 4K transmission programs at 30 locations in the city of Rio. We were able to obtain very useful data for the next-generation digital terrestrial broadcasting.

We, team of Japan, are sincerely grateful for SBTVD Forum's cooperation even under the Covid-19 pandemic situation.

We will continue to extend our support and cooperation for the development of the next-generation digital terrestrial broadcasting in Brazil.



Muito Obrigado!

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