Seminar #8

Transmission Network & Hardware

31th March, 2005

Digital Broadcasting Expert Group (DiBEG)

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(Toshiba)

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1. Infrastructure of Broadcaster for digital broadcasting

1.1 How analog to digital?

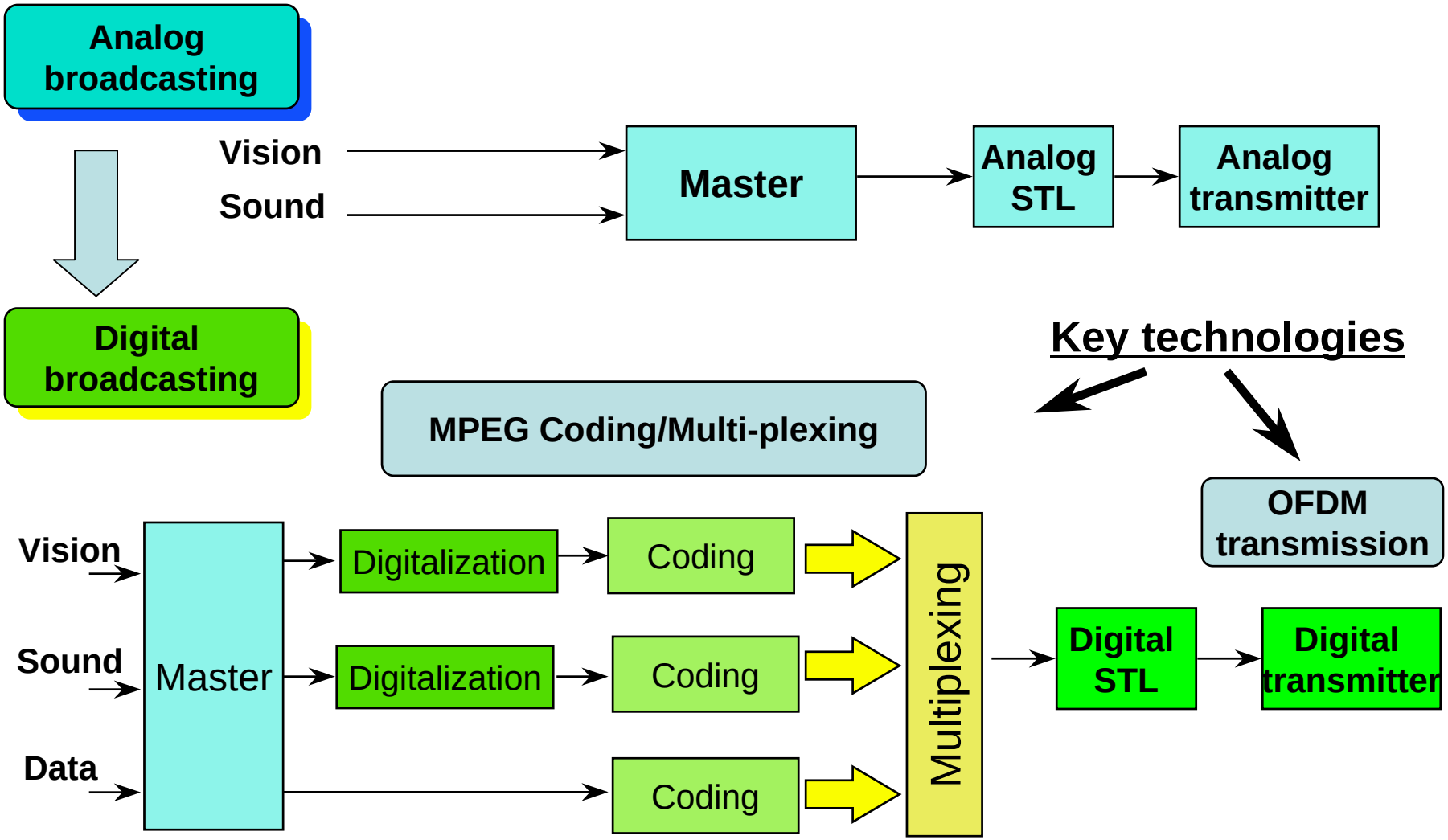
1.2 Example of Broadcaster's Infrastructure

(a) Master system

(b) transmitter system

(c) antenna system (Tokyo tower)

Differences Between Analog and Digital Broadcasting



Examples of Broadcasterer's equipment

Master system: During analog simulcast period, Master system should treat both analog TV program and Digital TV program simultaneously. -Show the outline of TV Tokyo master system as an example

Transmitter : Digital Transmitter should be separately prepared. - Show the block-diagram and out-of-view of Tokyo tower transmitter as an example

Antenna: 3 area starting at Dec. 2003, analog TV channels are mainly located in VHF Band, therefore, antenna for Digital Broadcasting should be prepared separately. -Show the out-of-view of Tokyo tower as an example

Equipment design concept(TV Tokyo)

- Total system correspondent to both terrestrial digital and analog broadcasting service

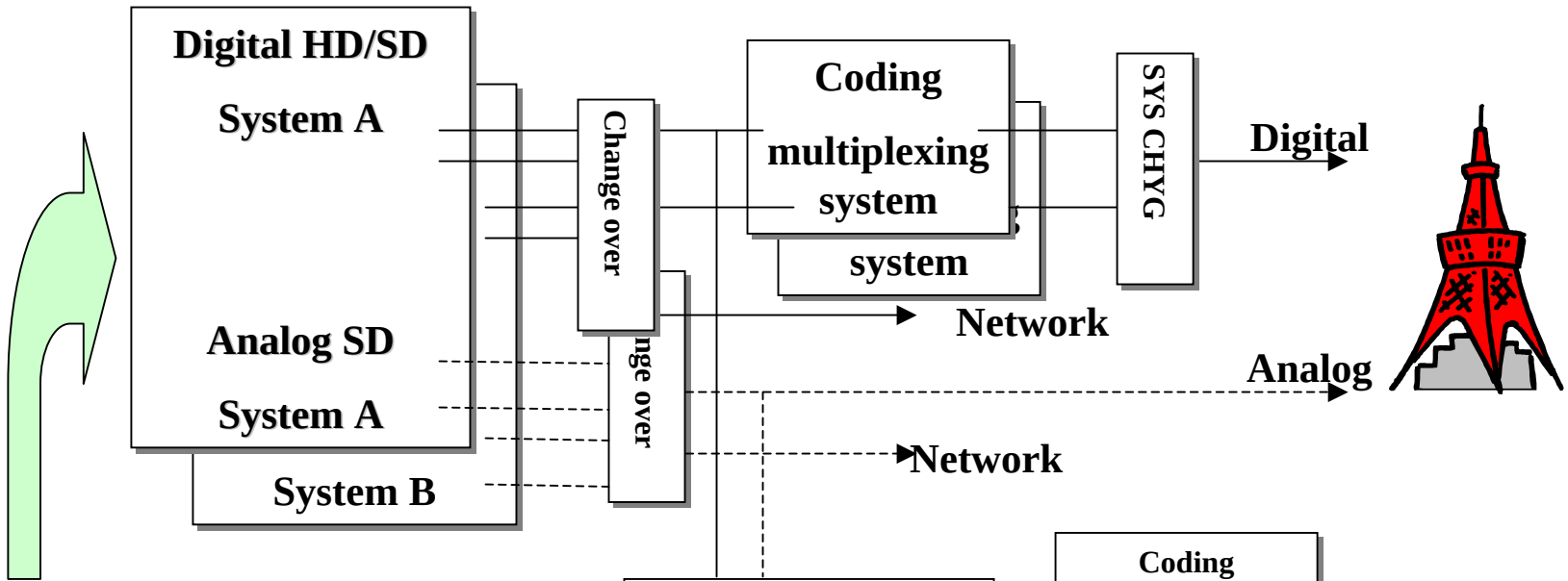
-Correspondent to variety of service and flexible program

-Correspondent to variety of many kind of program

-Network operation with group broadcasters

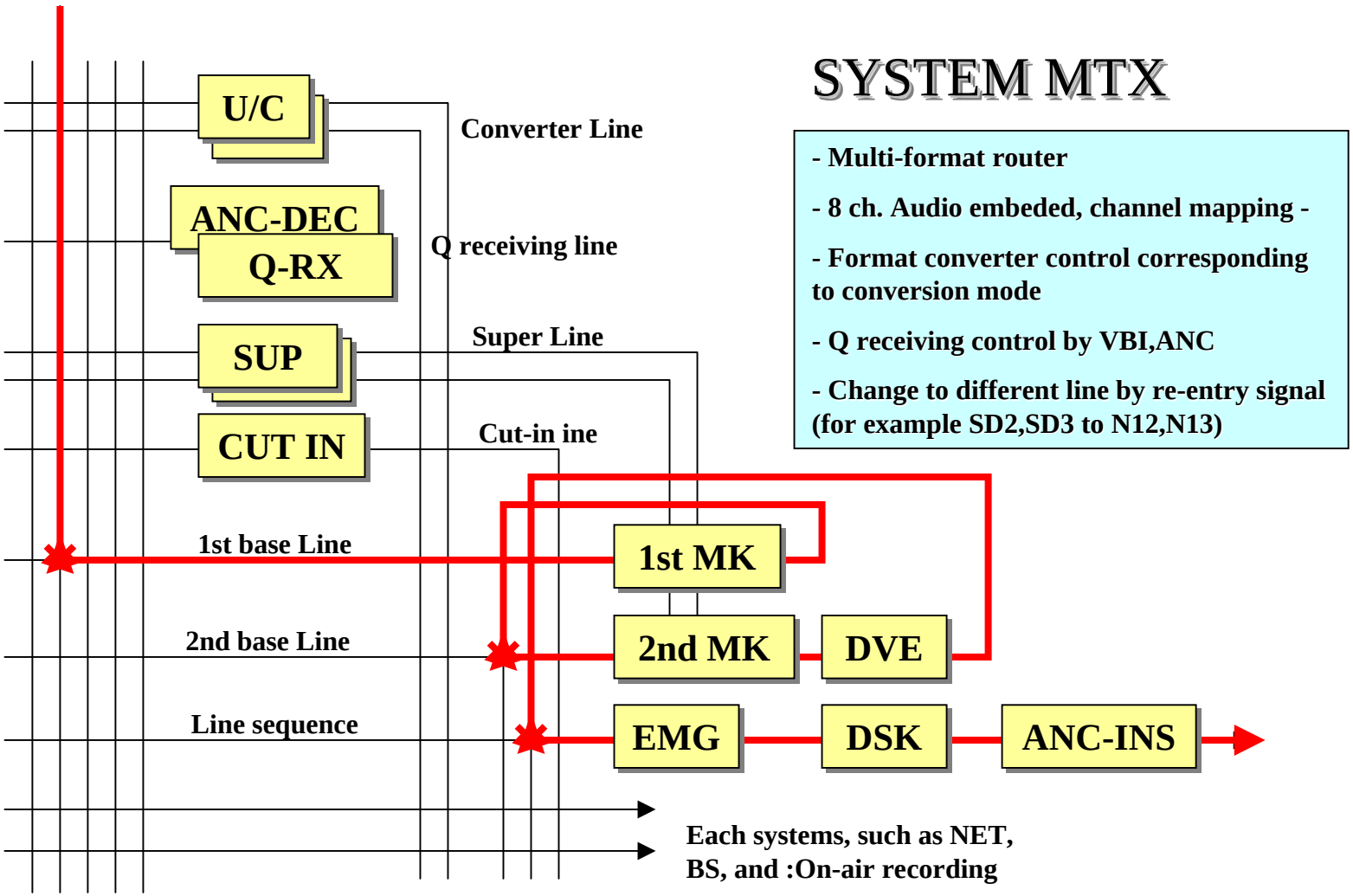
-High cost performance

Concept master system(TV Tokyo)



- HD studio, Tennozu studio
- -OB van for HD, FPU,SNG
- -WDM multiplex and distribution(controlled by APS)
- -Master equipment, such as, Program Bank,CM Bank,VAF VTR

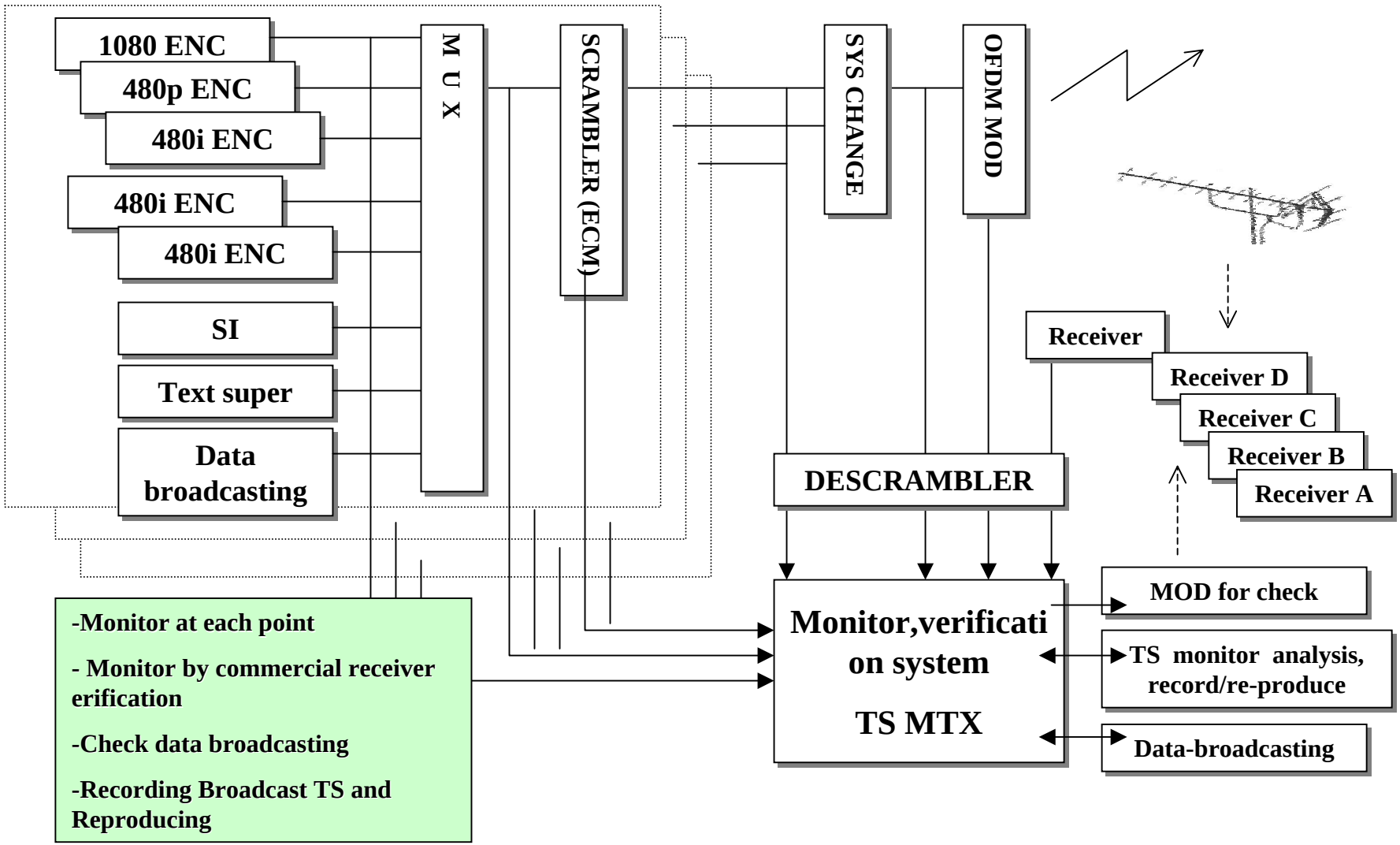
Master baseband system construct (TV Tokyo)



SYSTEM MTX

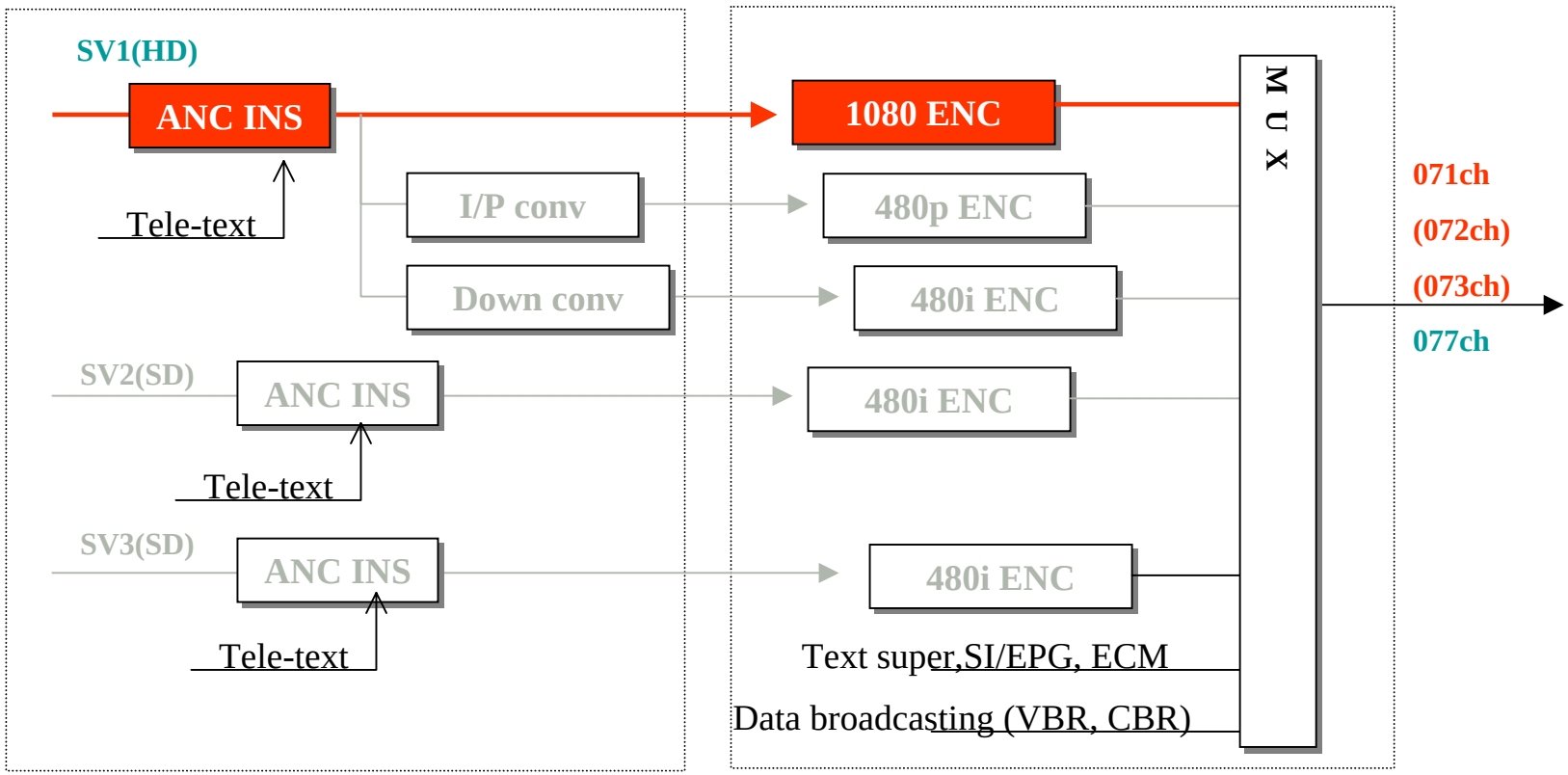
- Multi-format router
- 8 ch. Audio embeded, channel mapping -
- Format converter control corresponding to conversion mode
- Q receiving control by VBI,ANC
- Change to different line by re-entry signal (for example SD2,SD3 to N12,N13)

The example of coding and multiplexing service form(TV Tokyo)



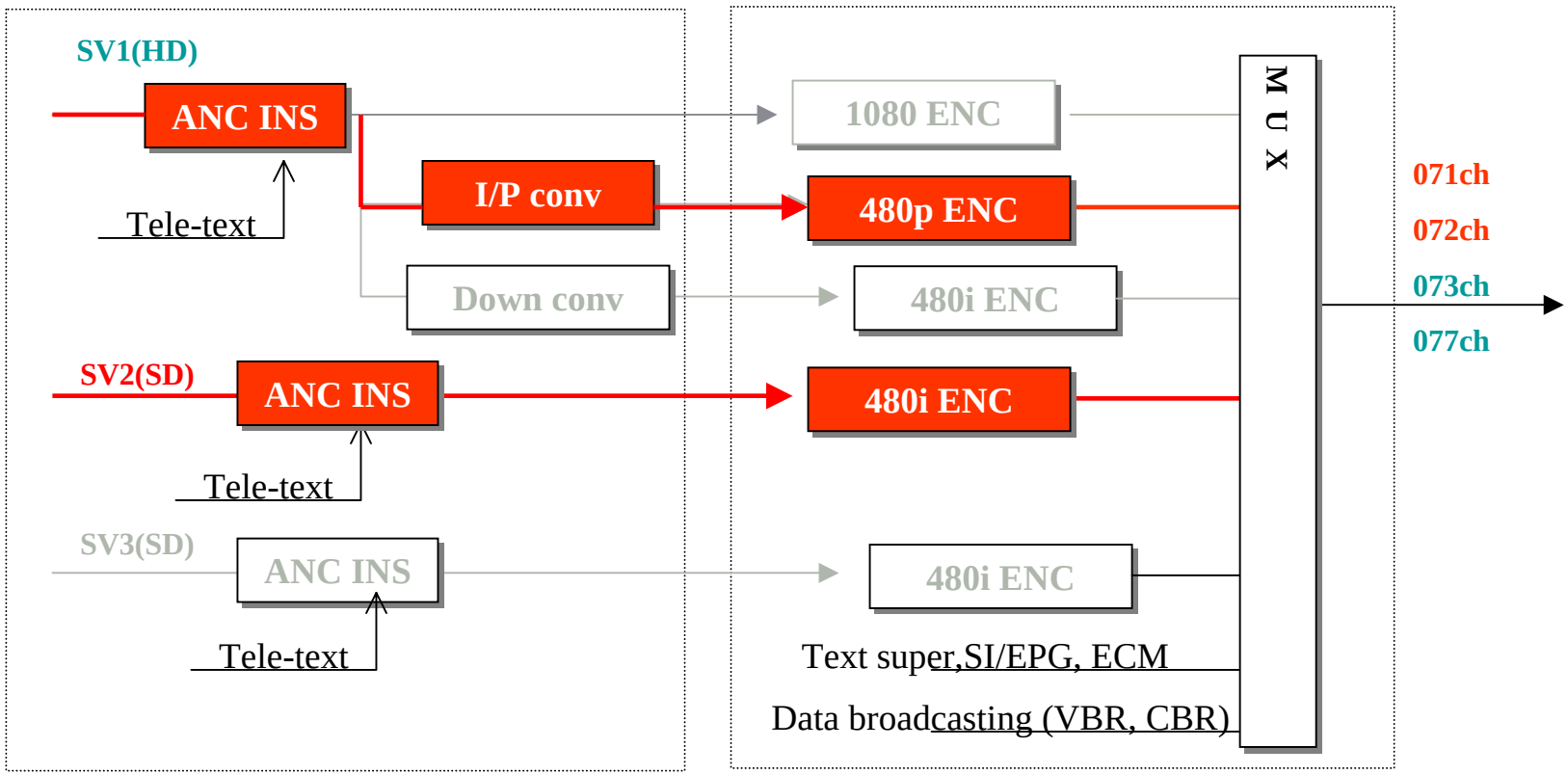
The example of service configuration(ex. 1)

HD, SD muliti-CH, Multi-view, Extraordinary service Data broadcasting, Tele-text, Character super-impose, Portable receiving service



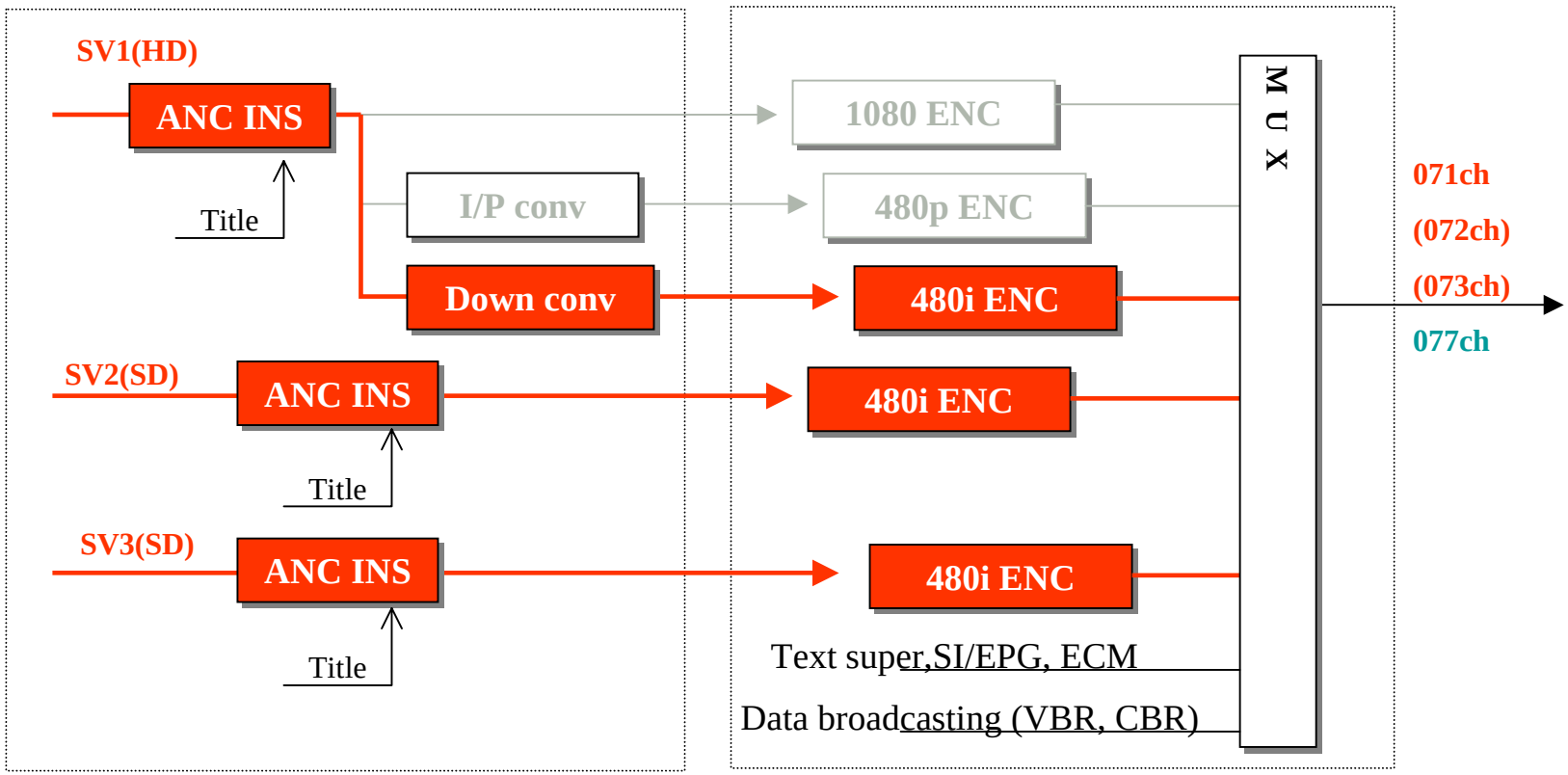
The example of service configuration(ex. 2)

HD, SD 2-CH, Multi-view, Extraordinary service Data broadcasting, Tele-text, Character super-impose, Portable receiving service

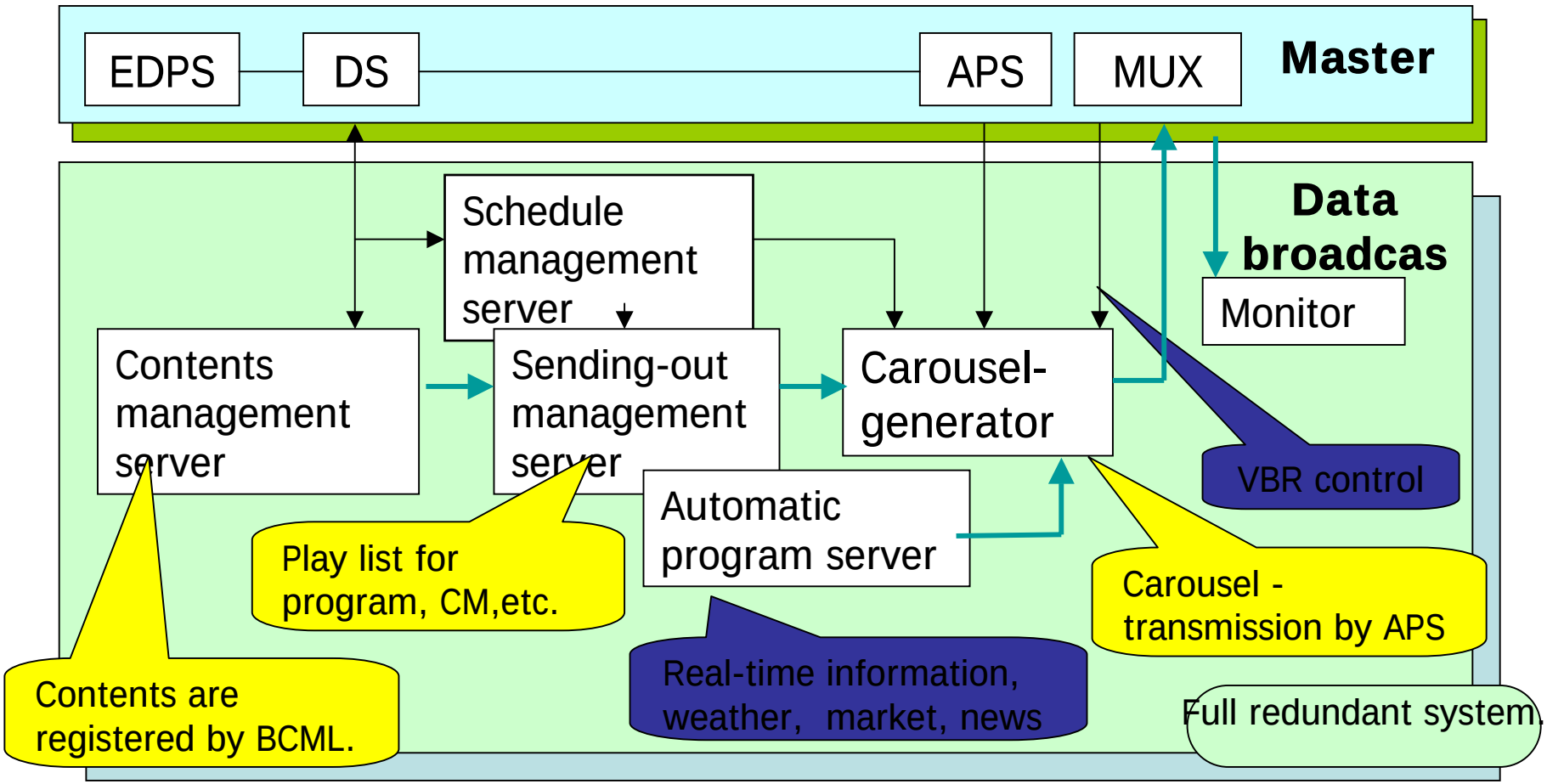


The example of service configuration

HD, SD muliti-CH, Multi-view, Extraordinary service Data broadcasting, Tele-text, Character super-impose, Portable receiving service



Concept of Data-broadcasting equipment



Example of Master system (TV Tokyo)

-Operation by few clues

-Efficient positioning

-Multi-view and/or selection on wide screen LCD,PDP

-Use touch panel for operation

-monitoring another line at monitoring booth

Example of Master system (TV-asahi)

Example of Video Server

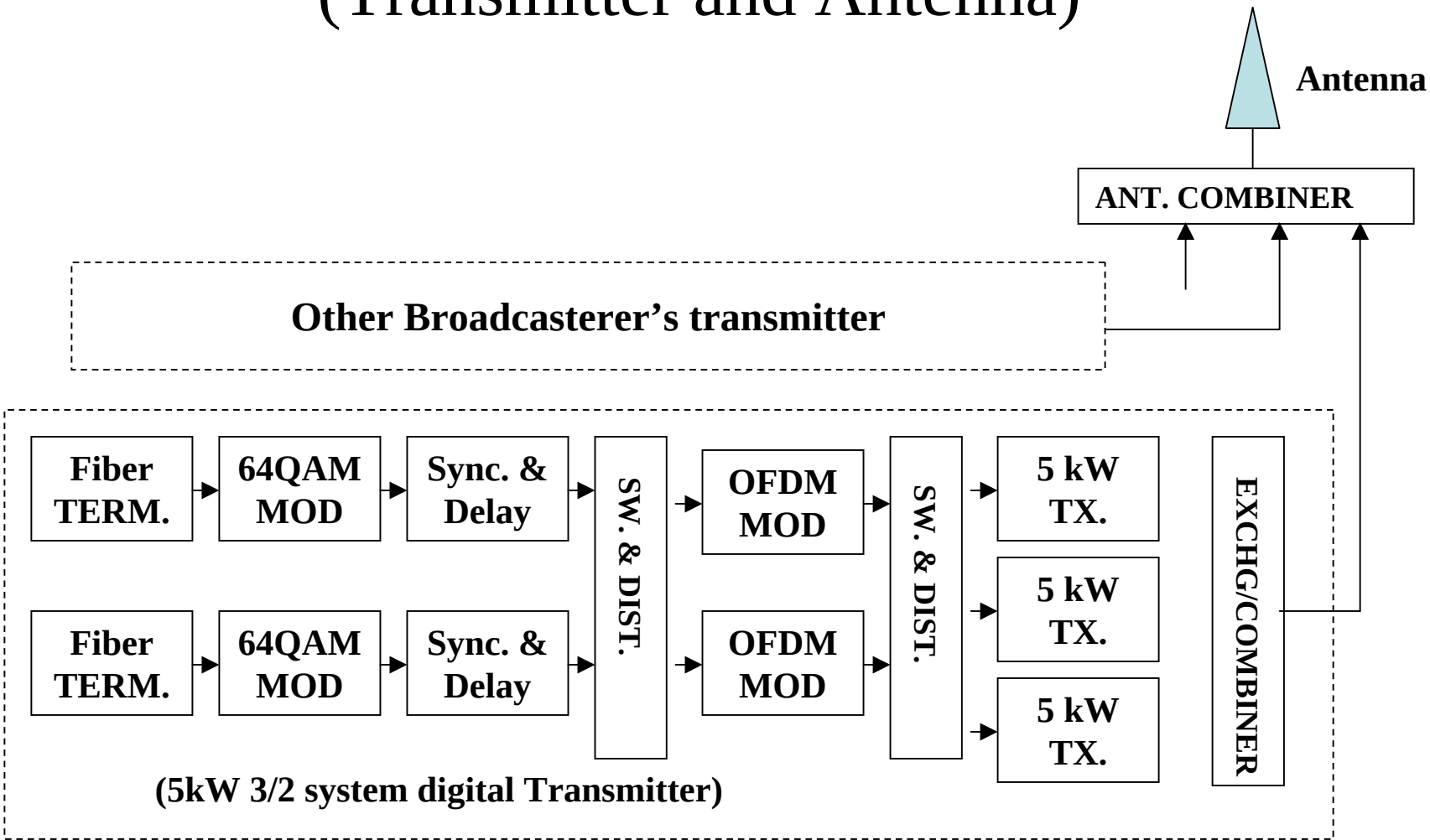
VIDEOS™(note)

Console

Equipment Racks

(note)Flash memory video server(Toshiba commercial model)

Example of Broadcasterer's equipment (Transmitter and Antenna)



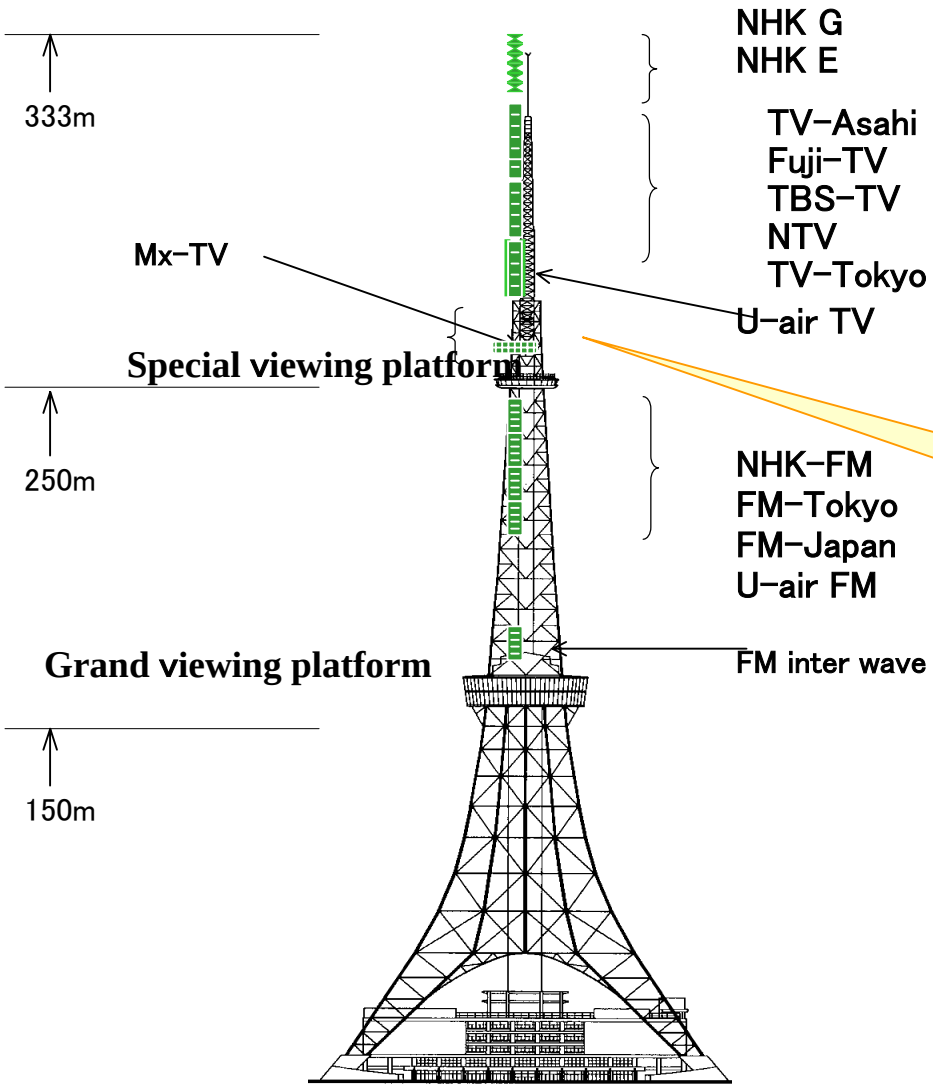
Example of Tokyo Tower Transmitter/Antenna System

Example of digital terrestrial transmitter

5kW, 3/2 system(10kW output) in Tokyo Tower

(Toshiba)

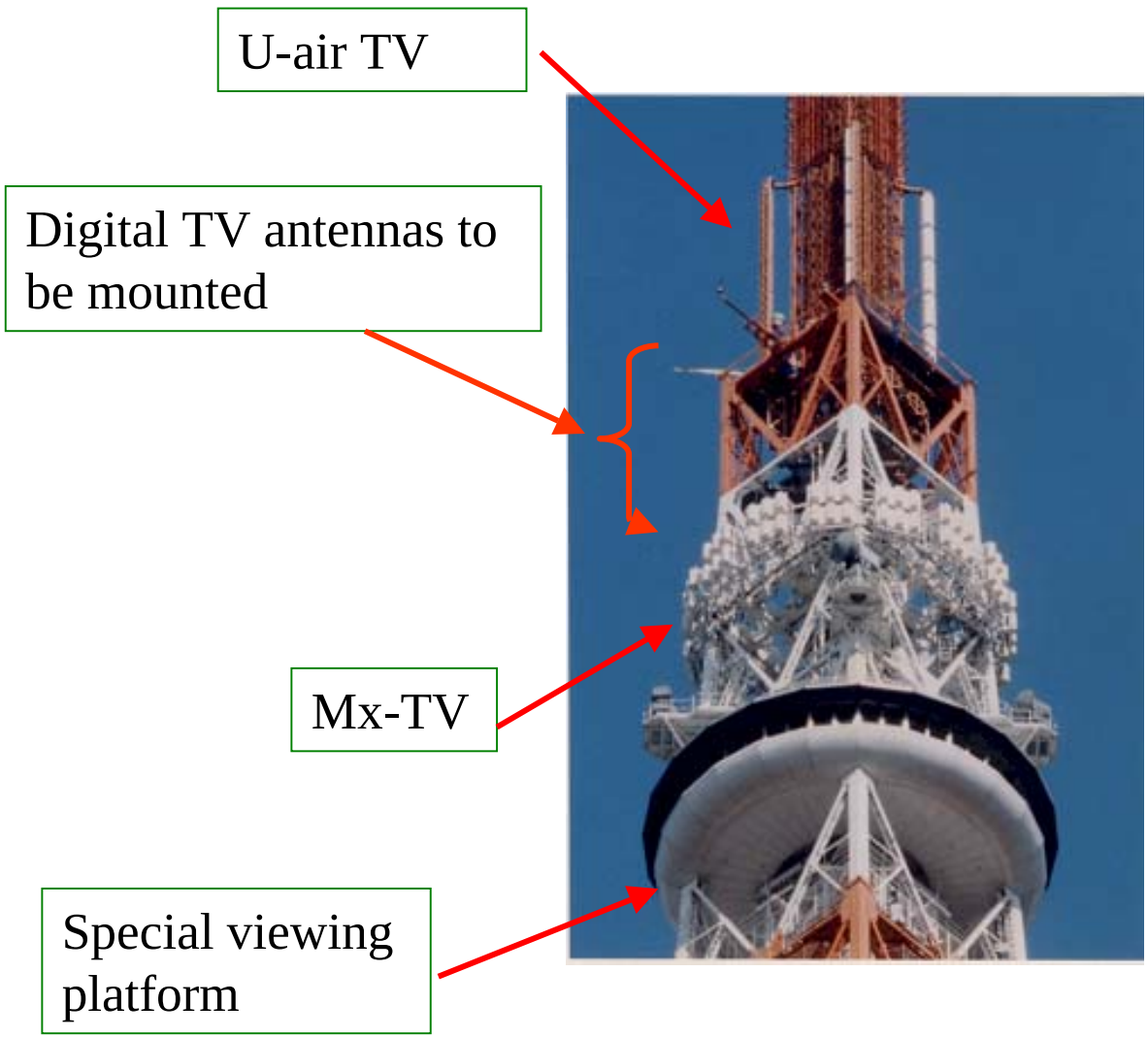
TV Broadcasting Antennas Installed on the Tokyo Tower



- A number of analogue TV broadcasting antennas are already installed on the Tokyo Tower, leaving only a limited space for mounting of digital broadcasting antennas

Digital TV antennas to be mounted here

Mounting Space for Digital TV Antennas on the Tokyo Tower



•The mounting space for the digital TV antennas is limited to a small space of 6 meters in width and 12 meters in height on the tower structure.

• A pattern synthesis technology is required to realize an omnidirectional radiation pattern using such a difficult space for mounting

2. Transmission network system for DTTB

2.1 transmission network system for DTTB

(1) SFN? or MFN?

(a) To save frequency resource, SFN is better

(b) For wideband network for mobile service, SFN is better

(c) For SFN, network design and management should be done carefully compare to MFN (details are explained in chapter 3)

Note;

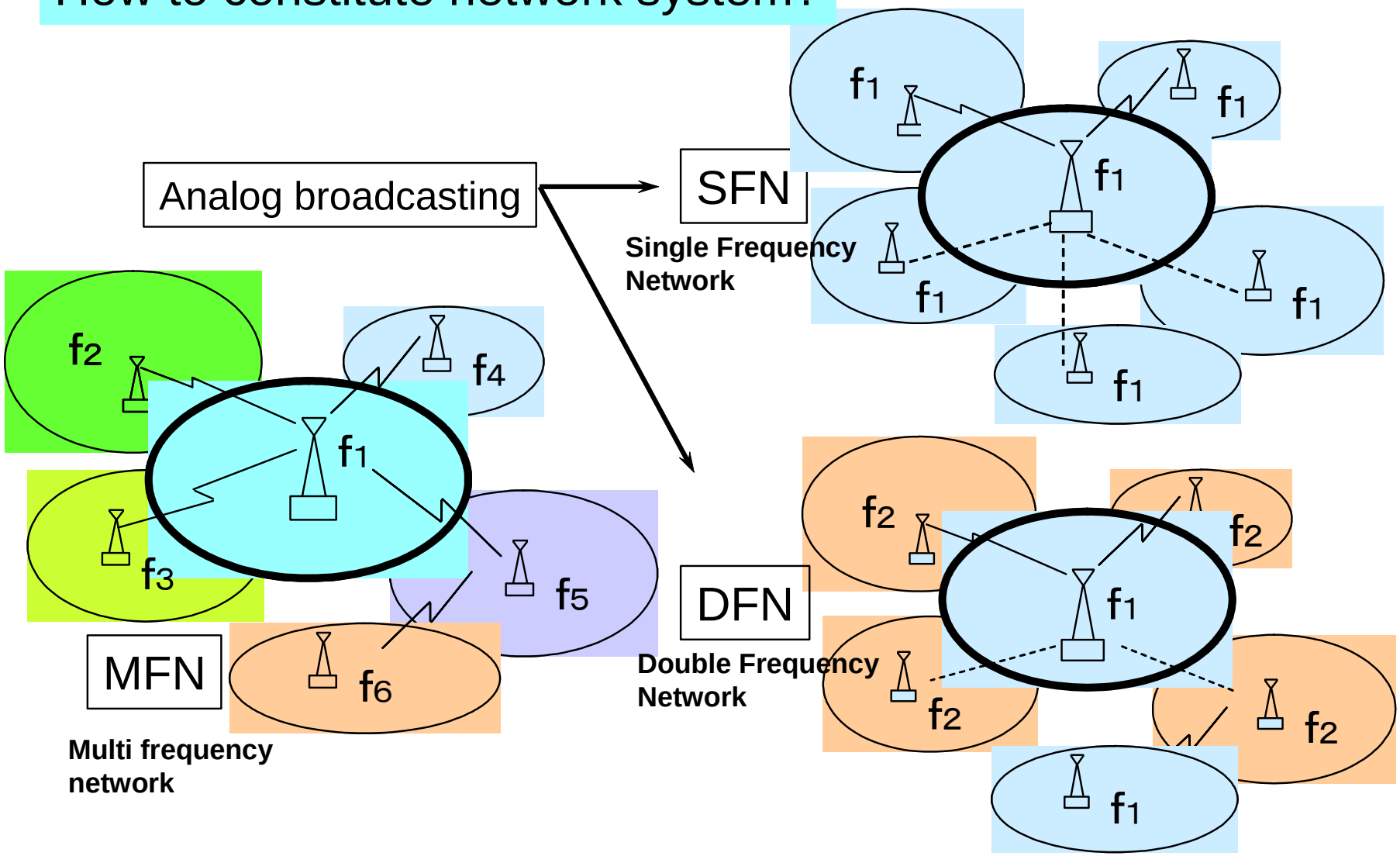
SFN; Single frequency network,

MFN; Multi Frequency Network, popular system for analog TV network

DFN; Double Frequency Network, special case of MFN.

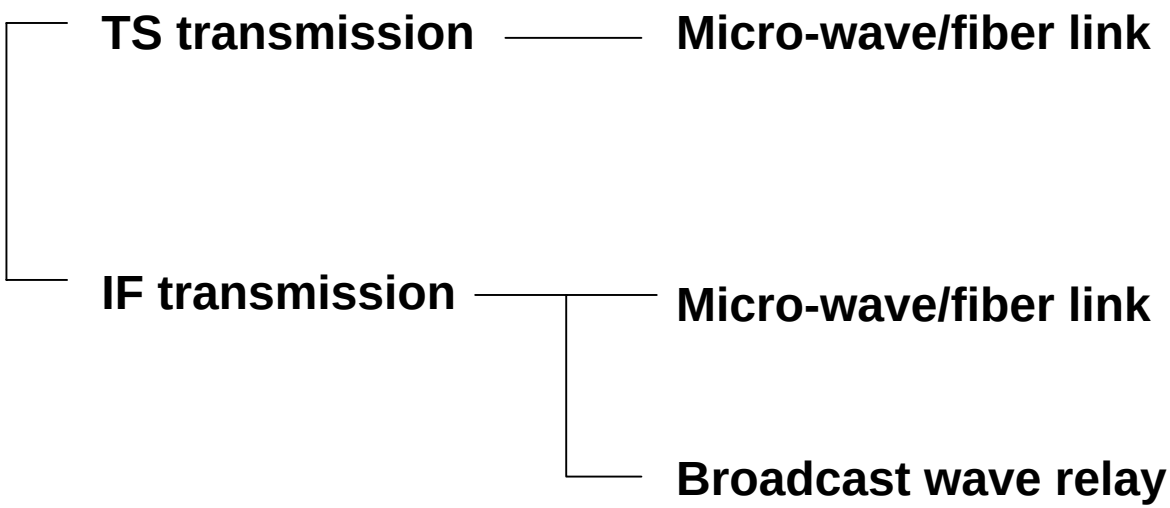
Image of SFN/DFN/MFN

How to constitute network system?



2.1 transmission network system for DTTB

(2) Classification of network system



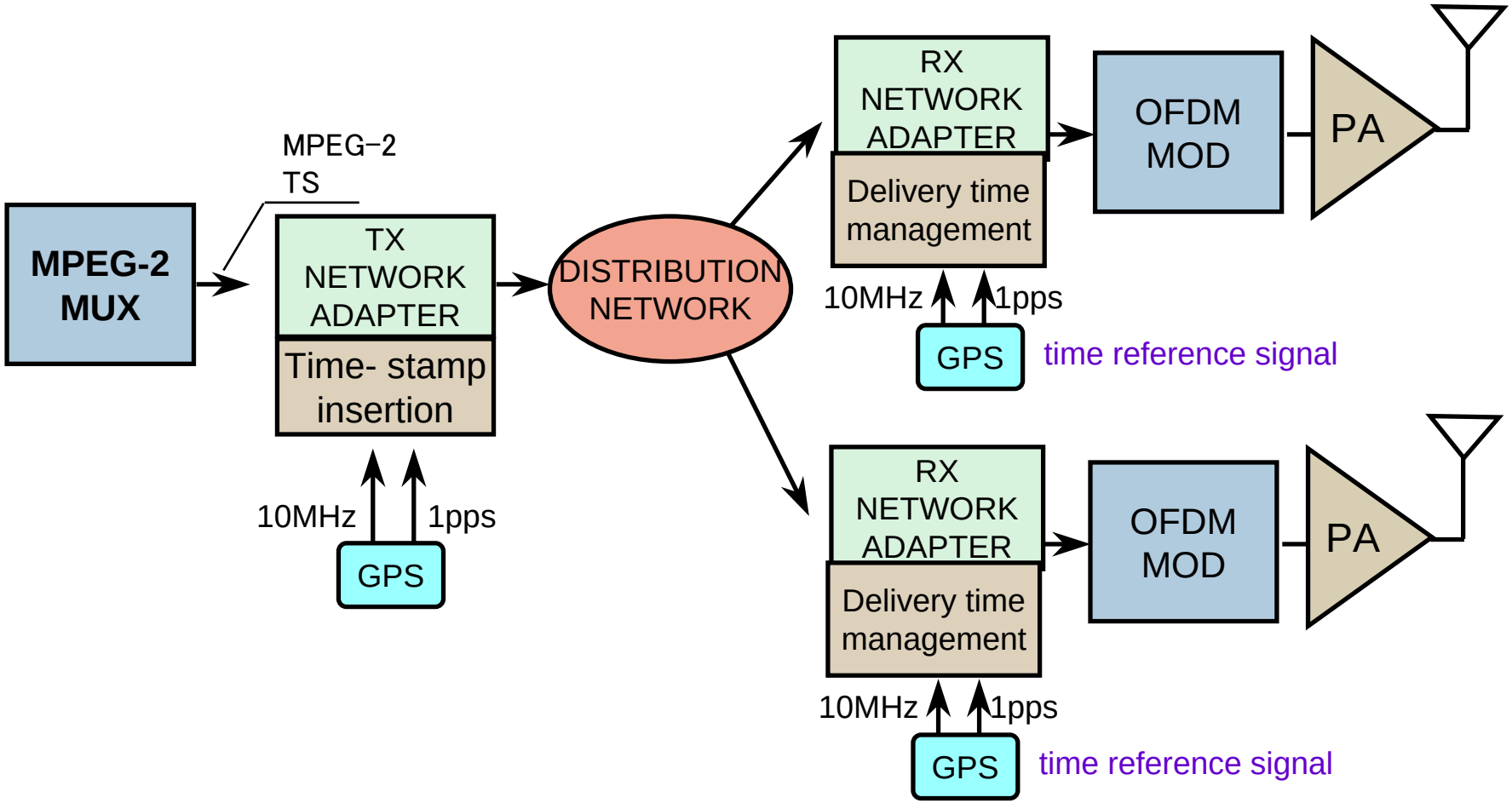
Comparison of network system

Network type	Infra & maintenance cost	Signal quality	SFN timing adjustment	Save micro-wave frequency resource
TS transmission-microwave/fiber	**3**	**1**	**1**	**2**
IF transmission-micro wave/fiber	**2**	**2**	**1**	**2**
Broadcast- wave relay station	**1**	**3**	**2** (note1)	**1** (note2)

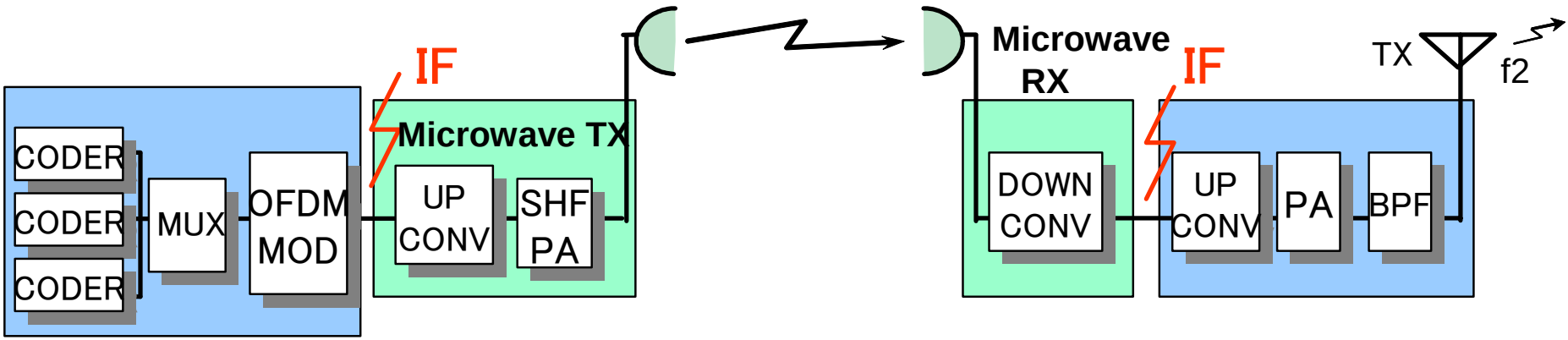
(note1) for Broadcast wave relay system, transmission the range of transmission timing is limited.

(note 2) Broadcast wave relay system dose not need micro wave frequency.

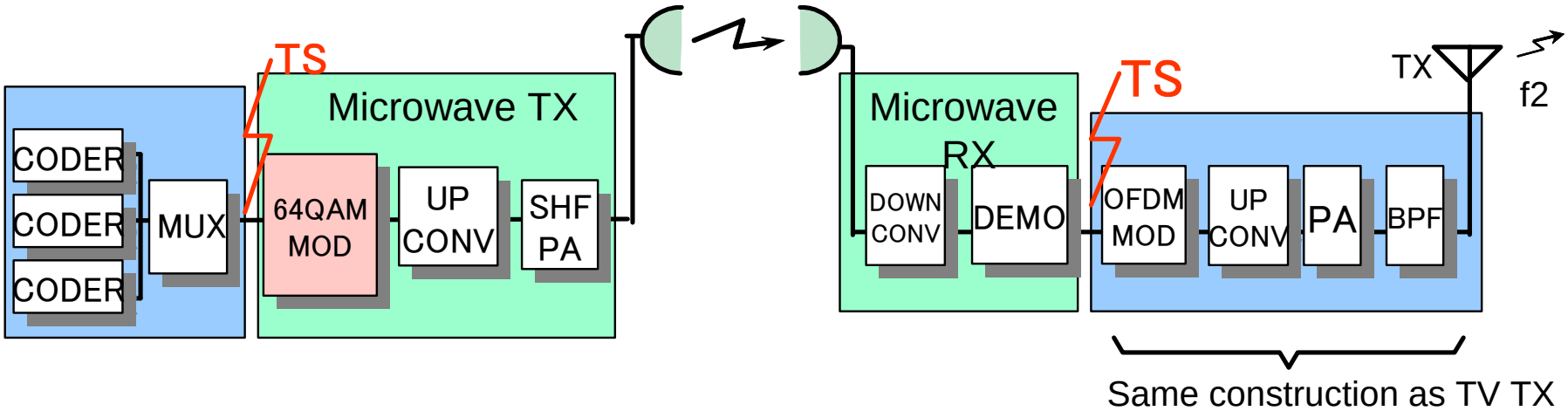
Image of Network timing adjustment by GPS



Example of IF transmission system by micro wave link



Example of TS transmission system by micro wave link



3. Transmission network design for digital broadcasting

3.1 Link budget for transmission network chain

3.2 Network synchronization in SFN

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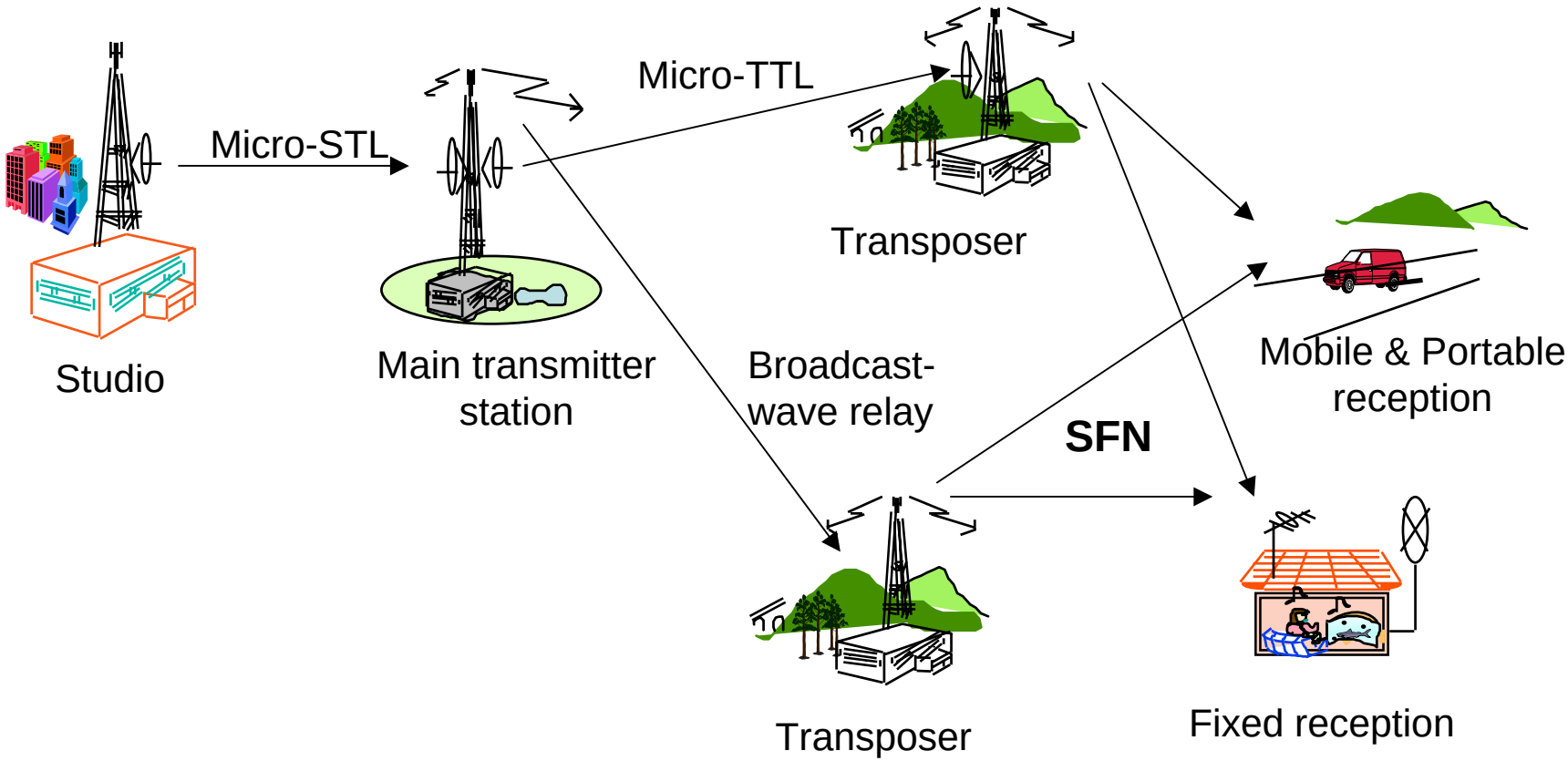
An Image of transmission network chain



Key points of transmission network for DTTB

For DTTB transmission network design, two important factor should be considered

(1) Link budget;

In digital transmission, threshold C/N is important. Under threshold C/N, receiver does not operate well. On the other hand, in analog system, under required C/N, only picture quality degrade. The C/N degradation is caused not only by thermal noise but also by another causes such as equipment degradation, etc. Therefore, link budget is important especially for multi-stage transmission chain.

(2) Network synchronization

SFN technology is the feature of DTTB to save frequency resource. For SFN system, plural path should be within guard interval at receiving point. For this reason, the transmission timing of plural transmitter in same network should be managed to achieve SFN condition

3.1 Link budget for transmission network chain

Key Factor ;Equivalent C/N

Keep required Equivalent C/N ratio at the receiver front end

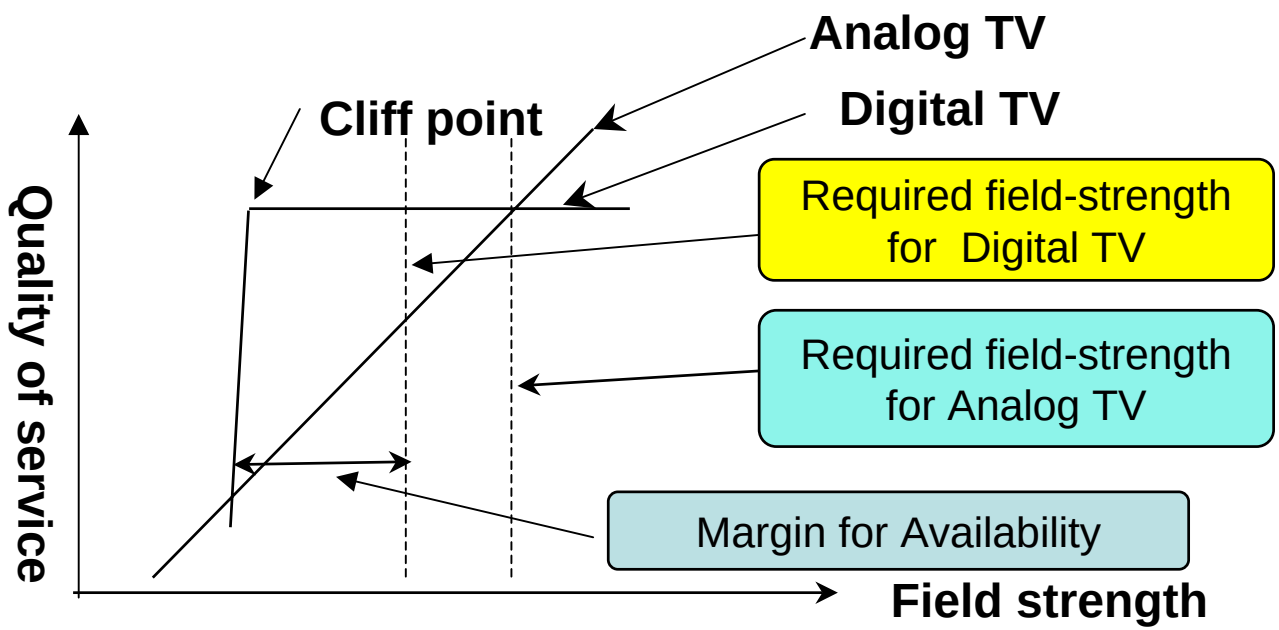
[1] In the digital system, "cliff effect" shall be considered

[2] Set the receiver model for link budget

[3] Check link budget parameters

[1] “Cliff Effect”

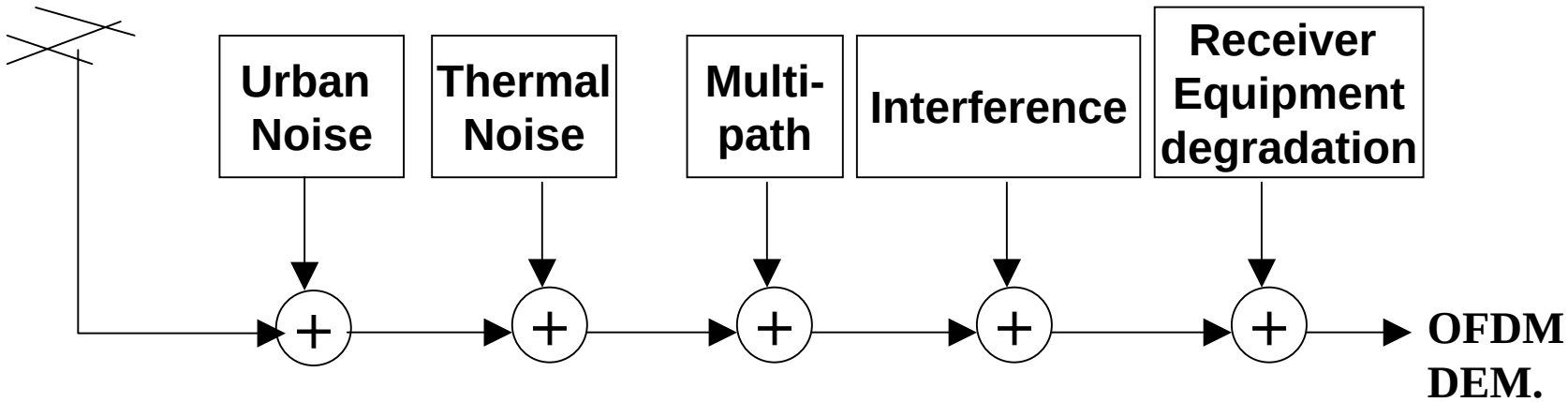
In digital system, Quality of service is not proportional to input signal strength. At the lower level of cliff point, the fatal disturbances will happen, such as large block noise, moving picture frozen, and picture black out.



[2] Receiver model for link budget

Minimum required field strength= 60 dBuV/m

7 element Yagi



(note) required C/N depends on transmission parameters

In Japan, considering most serious parameter set, 64QAM r=1/2, is base of link budget . In this case, equivalent C/N for receiver is as much as 28dB. (see details ARIB STD-B31 reference A.3.2.3

[3] Link budget parameters

(a) Transmitter model

3 types are considered; TS transmission, IF transmission, broadcast relay station

(b) Propagation loss and fading margin

Fading margin is different according to propagation distance. See details ARIB STD-B31 reference A.3.2

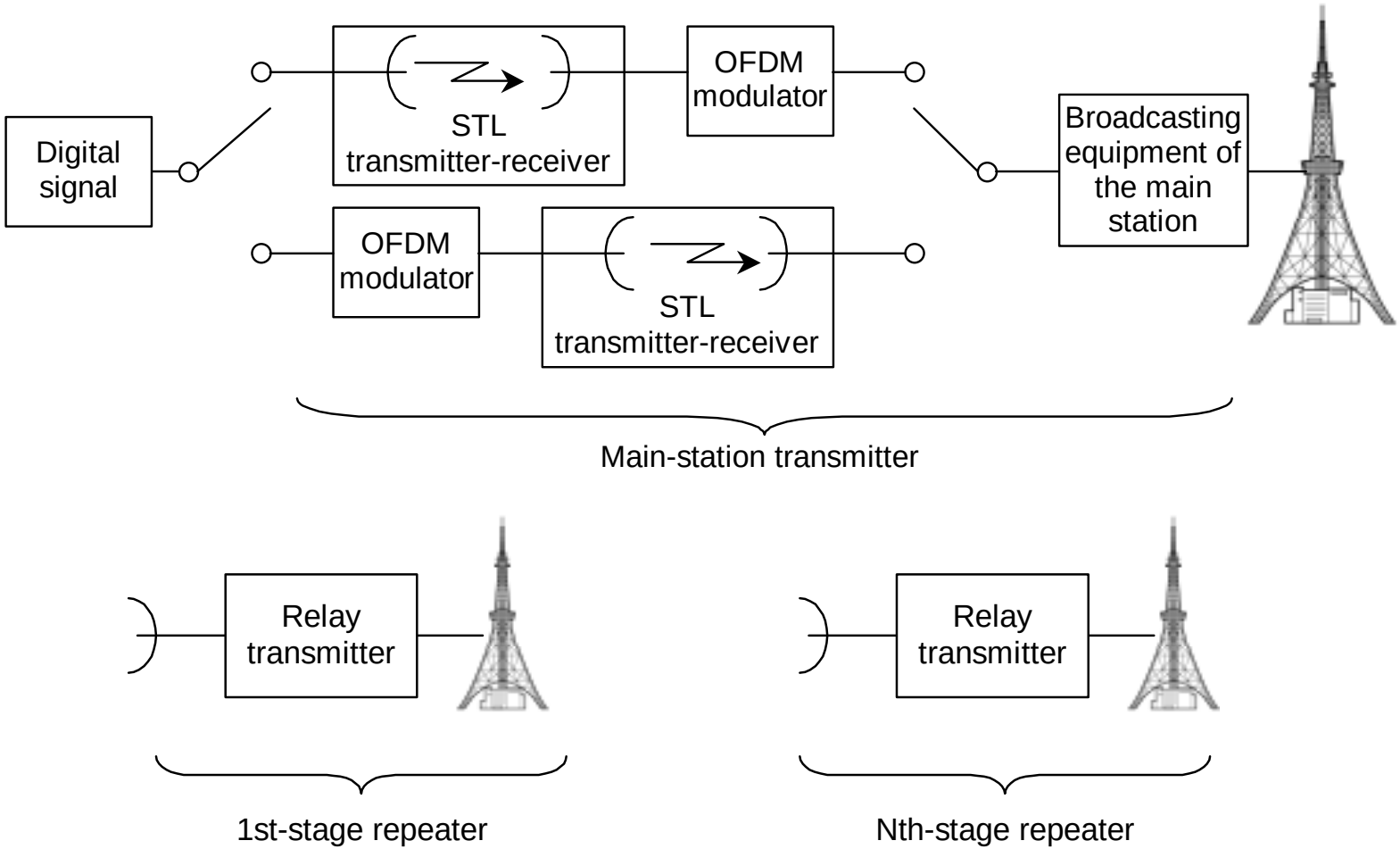
(c) Equipment degradation and transmission distortion

Equivalent C/N is degraded by equipment degradation, especially in multi-stage transmitter chain, these degradation are accumulated. See details next section 2.3

(d) Number of transmitter stage

Degradation of each stage are accumulated, therefore , equivalent C/N of final stage should be considered in network design (as a reference, see ARIB STD-B31 A.3.2.4)

(a) Transmitter model



(b) Propagation loss and fading margin

-For design transmission network, at first, present analog network was surveyed (ARIB STD-B31 reference A.3.2.1 (1) table A3.2-1)

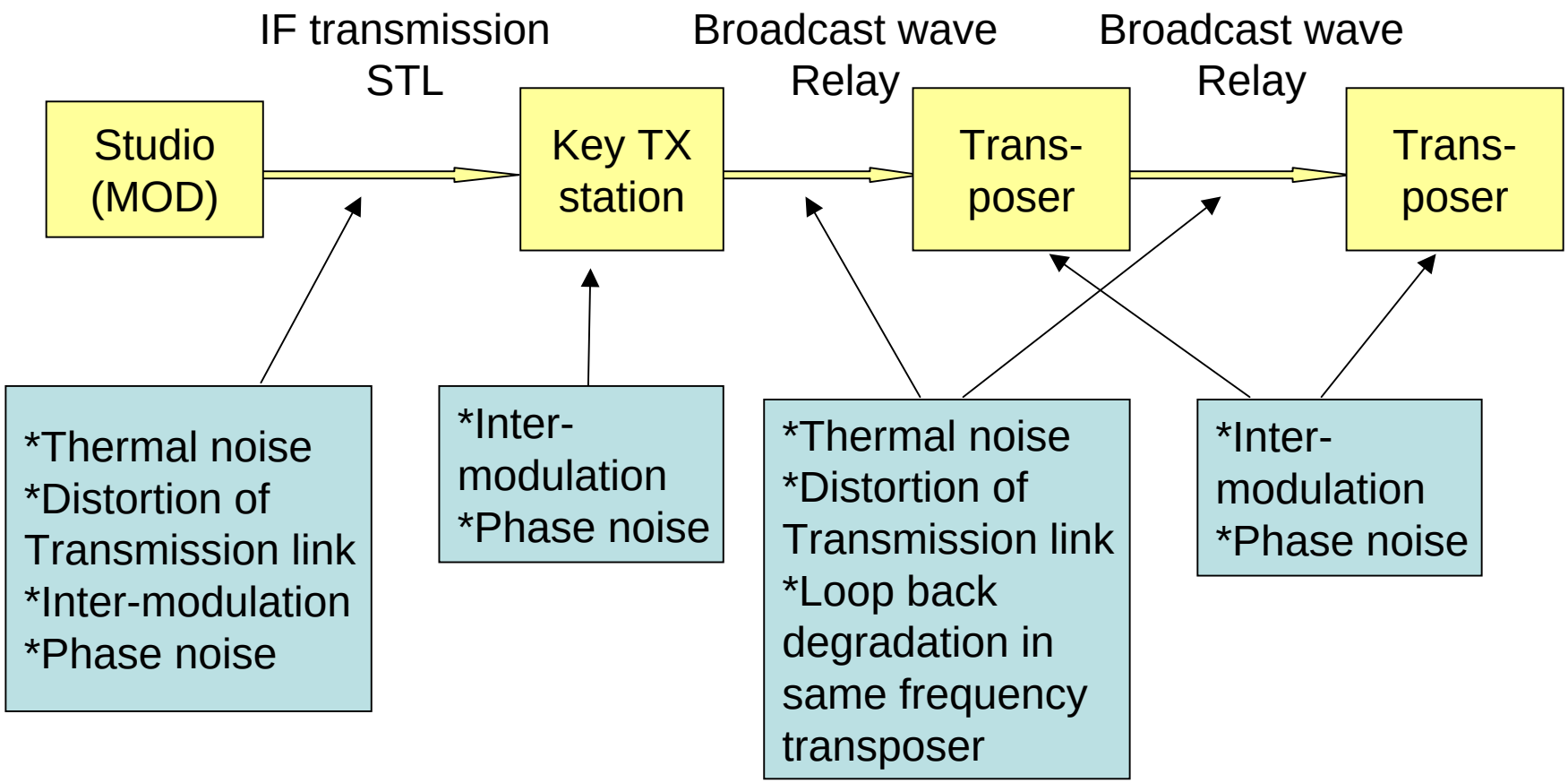
-assume the fading margin according to each stage-to-stage distance (value that includes 80% of all stations selected in (1)) under the assumption that 99.9% fading margin will be available.

Table A3.2-2: 99.9% Fading Margin Selected Based on a Stage-to-Stage Distance Acceptable for 80% of All Stations

Relay station	To 1st Stage	To 2nd Stage	To 3rd Stage	To 4th Stage	To 5th Stage	To 6th Stage	To 7th Stage
Stage-to-stage distance	52.5 km	25.1 km	23.1 km	16.3 km	23.7 km	9.5 km	5.8 km
Fading loss	13.1 dB	8.7 dB	8.4 dB	7.3 dB	8.5 dB	6.7 dB	4.1 dB

[3] causes of signal degradation in transmission network

(details will be explained in chapter 4. of seminar #8)



(note) all these degradation are evaluated as END (Equivalent Noise Degradation) in transmission link budget

(d) Number of transmitter stage

As explained before, equivalent noise degradation of each stage are accumulated. For this reason, equivalent C/N of final stage should be carefully checked, and decide number of transmitter stage and these required C/N. As an example, relation ship between number of stage and required C/N is shown below.

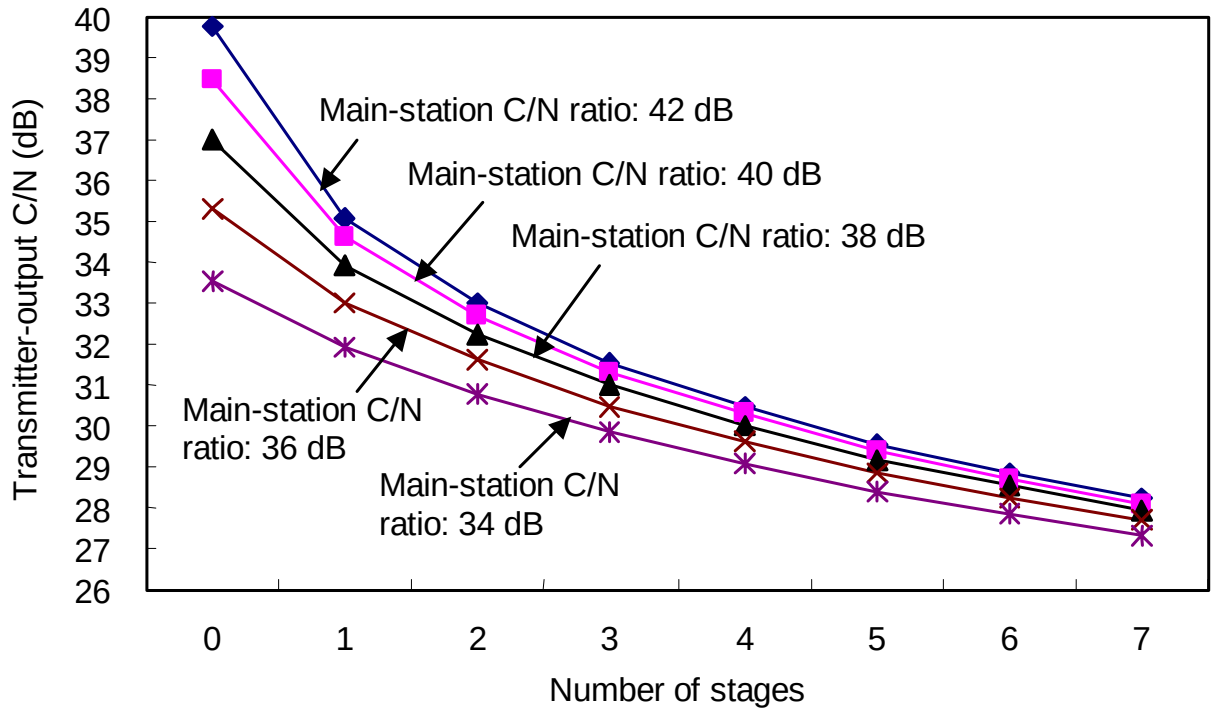


Fig. A3.4-2: Impact of Changes to the Equivalent C/N Ratio of the Main Station's Transmitter on the Transmitter-Output C/N Ratio

3.2 Network synchronization for SFN

(1) Network synchronization system

3 types of synchronization system are explained in ARIB STD-B31 Appendix 5.2

(a) Complete synchronization system; not used in actual system

(b) Slave synchronization system; most popular

(c) Reference synchronization system; considering to use

(2) Information for Network synchronization control

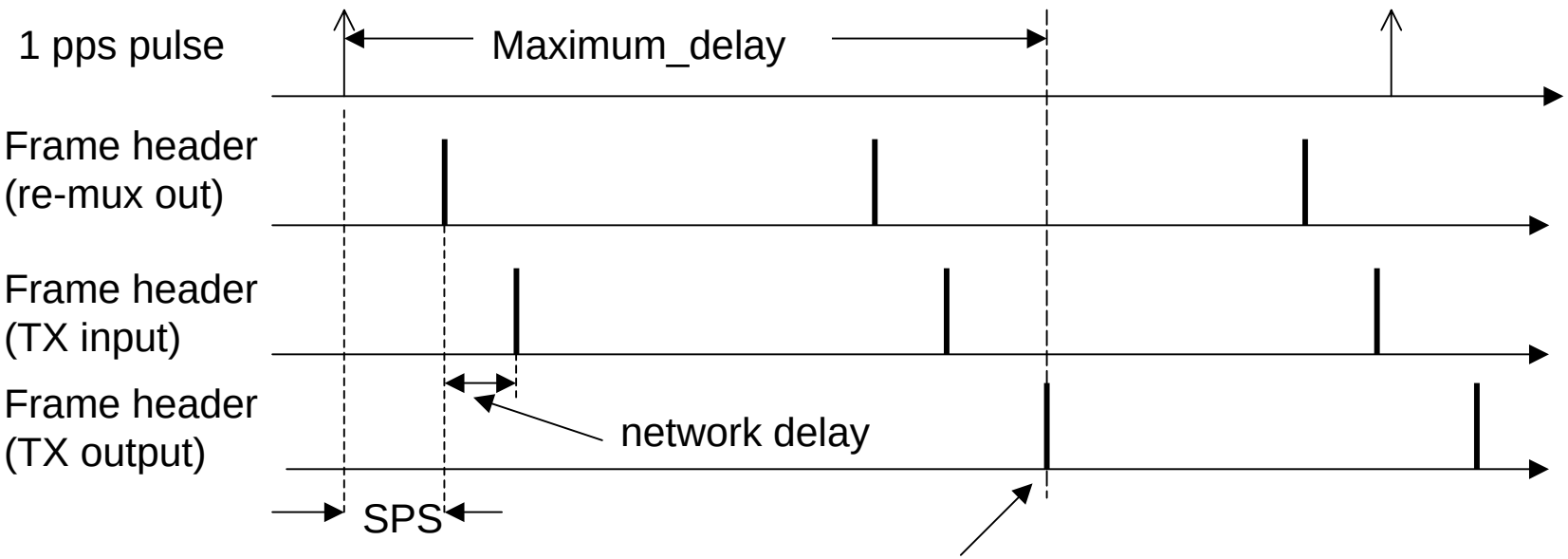
In ISDB-T system, network_synchronization_information is multi-plexed into broadcasting TS at RE-MUX. This information is useful not only for network synchronization but also for measure the transmission timing of each transmitter.

(3) What is “IIP” ?

IIP(ISDB-T Information Packet) is multi-plexed into Broadcast TS at Re-Multiplexer. Broadcasting network control informations are included in IIP, and are used for transmission network control at transmitter station.(see details ARIB STD-B31 Appendix 5.5)

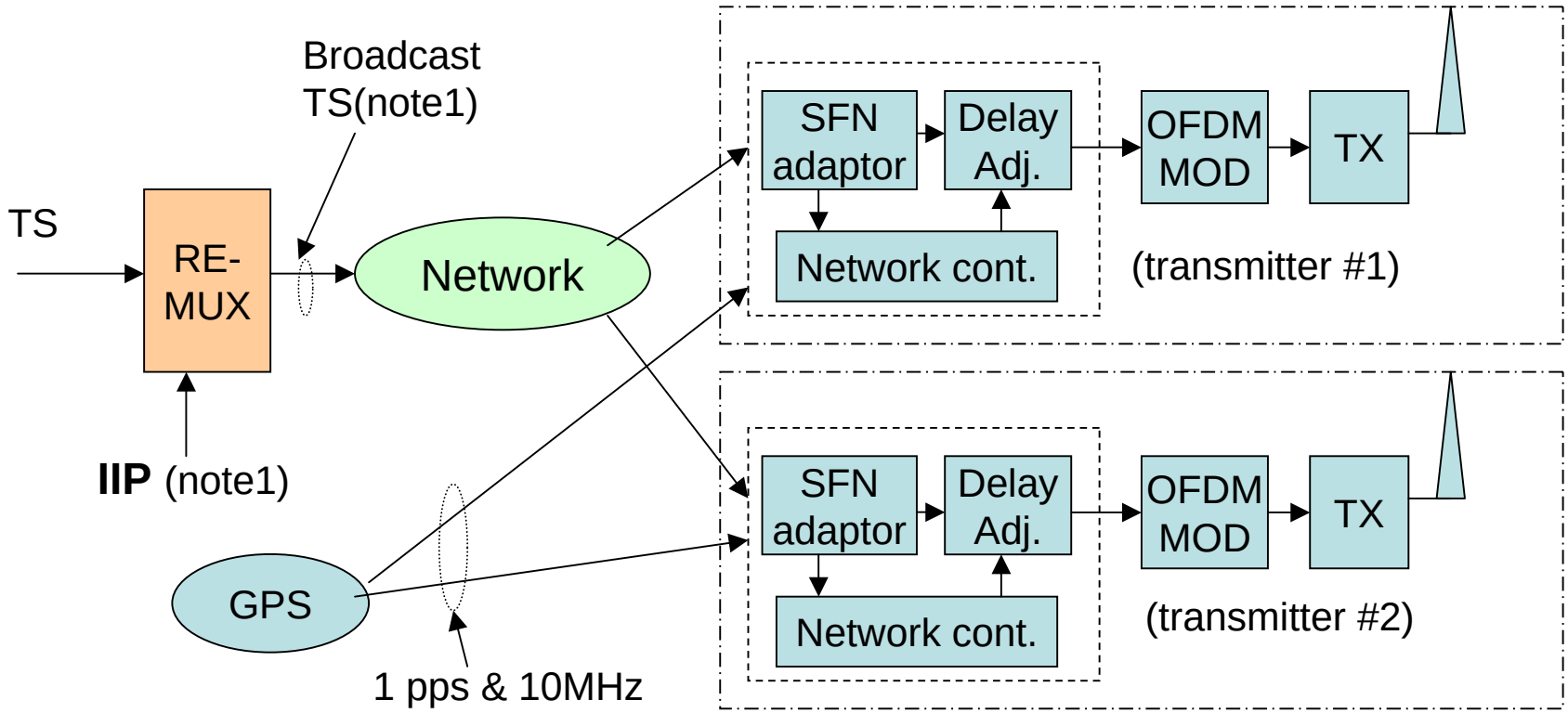
Network_synchronization_information is useful for network synchronization. Details are shown in table 5-12, and table 5-13 of ARIB STD-B31 Appendix.

Example of Network_synchronization_information



Example of network synchronization by GPS

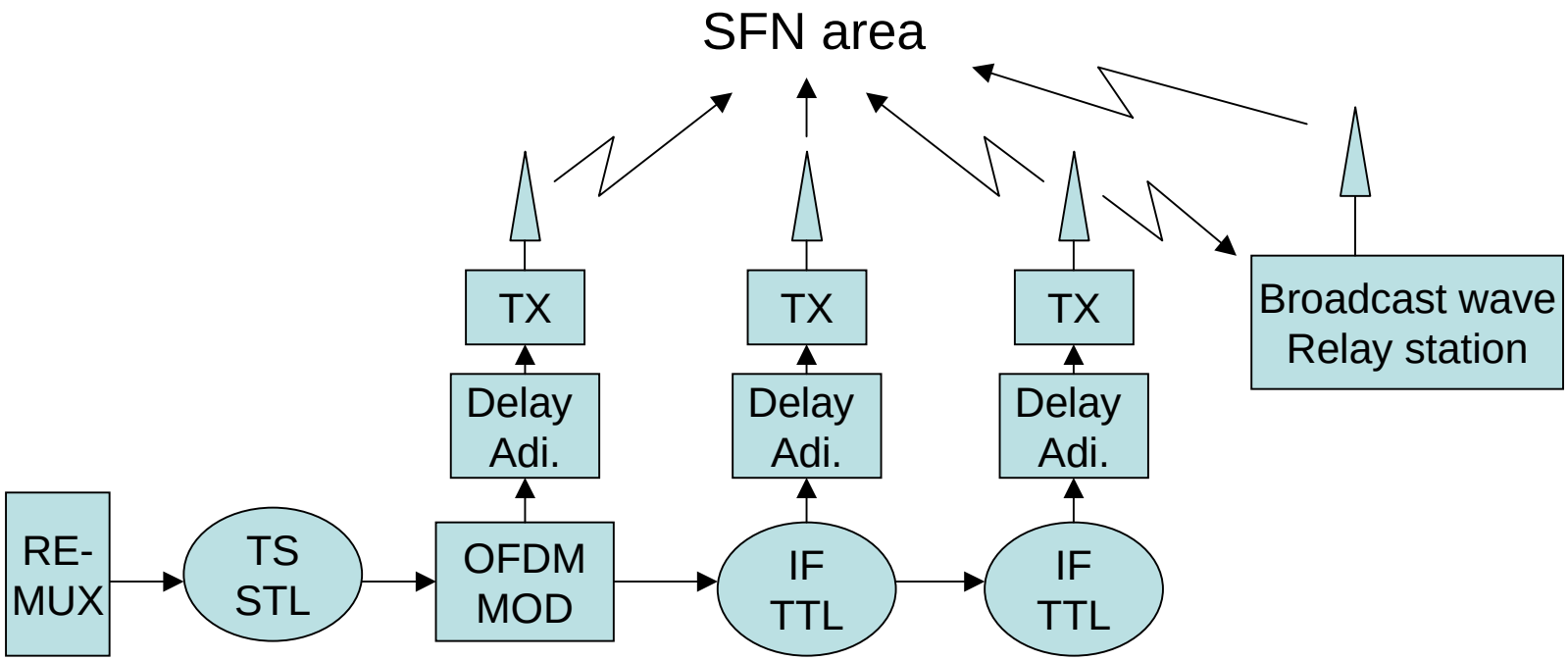
(TS transmission type)



(note 1) Broadcast TS; transport stream for broadcasting, OFDM framed.

IIP data is decode at SFN adaptor and measure the frame header timing then adjust signal delay.

Transmitting adjustment for transmitter chain



Each transmitter output timing is adjusted by “Delay Adi.”, but for broadcast wave transmitter , output timing adjustment is difficult. Therefore, signal delay of broadcast wave relay station should be considered in SFN design.

Future development for network synchronization

Followings are desired

(a) Method of distribution of IIP to IF transmission relay station and broadcast wave relay station

→ New system is proposed recently, that is, transmit IIP information through AC channel

(b) Method of measurement of OFDM frame timing at OFDM signal directly

→ New technology is proposed recently, that is, to measure time difference of FFT window and OFDM signal by Delay profile technology

(reference)

JEITA(Japan Electronics and Information Technology Industries Association) started new project, the purposes of this project is to issue “handbook of method of measurement for digital terrestrial broadcasting transmission network. This project will be finalized by mid this year.

In this handbook, following items will be included

(a) measurement for signal delay and time difference of plural transmitter

(b) Signal quality improvement and measurement technology of compensator which are mainly used in broadcast wave relay station.

(c) Method of measurement for received signal quality.

4. New technology for transmission network

3.1 Degradation factors in transmission network

3.2 Improvement technology

3.1 Degradation factors in transmission network

3.1.1 Classification of degradation

(a) Equipment degradation

(a) **Non-linear distortion**; non-linear of amplifier causes ICI (inter carrier interference between OFDM carriers.

(b) **Phase noise**; phase noise causes CPE(common phase error) and ICI. Especially critical for micro-wave IF transmission link.

(c) **Coupling loop interference (CLI);** CLI occurs in same frequency broadcast wave transposer, coupling from TX antenna to RX antenna

(b) Transmission distortion

(a) **Multi-path distortion**; Multi-path distortion causes frequency characteristics distortion , especially, long delay multi-path causes inter symbol interference(ISI)

(b) **fading**; fading is caused by transmission path variation.

3.2 Outline improvement technology

Many improvement technologies has been developed and on developing. Representative technologies are introduced here

(1) Improvement of transmitter non-linear distortion

-Feedback Pre-distortion correction technologies; adopted for high power transmitter

- Feed forward type amplifier; mainly adopted for middle power multi-channel power amplifier used as trans-poser

(2) Improvement of phase noise in IF transmission micro-wave link

(3) Improvement of transmission distortion

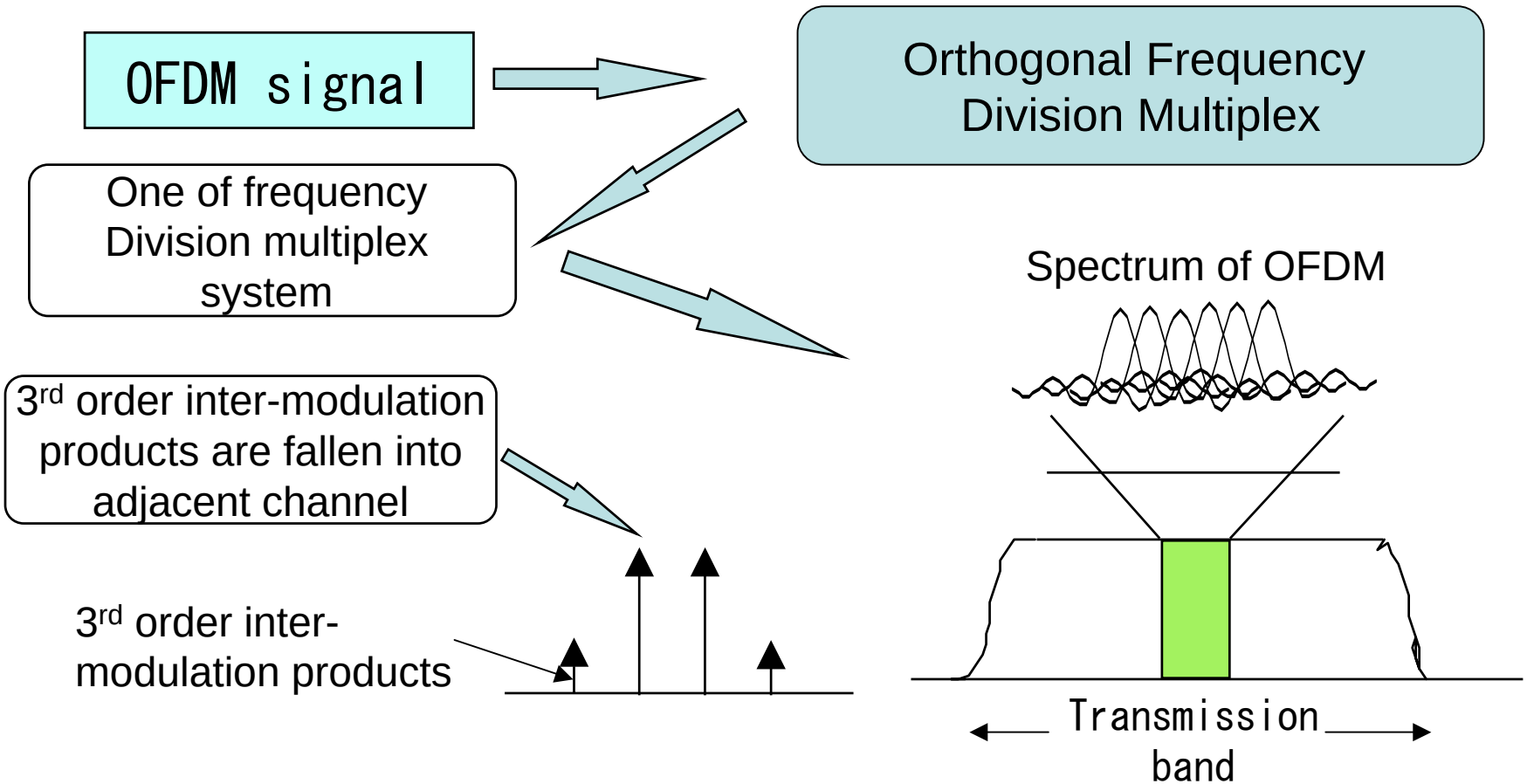
-Multi-path canceller; especially compensate the multi-path distortion on transmission link.

-Coupling loop interference(CLI) canceller; compensate the coupling loop between TX antenna and RX antenna in SFN

-**Diversity receiving technology**; Improve the degradation caused by fading. This technology is useful not only transmission network but also mobile reception.

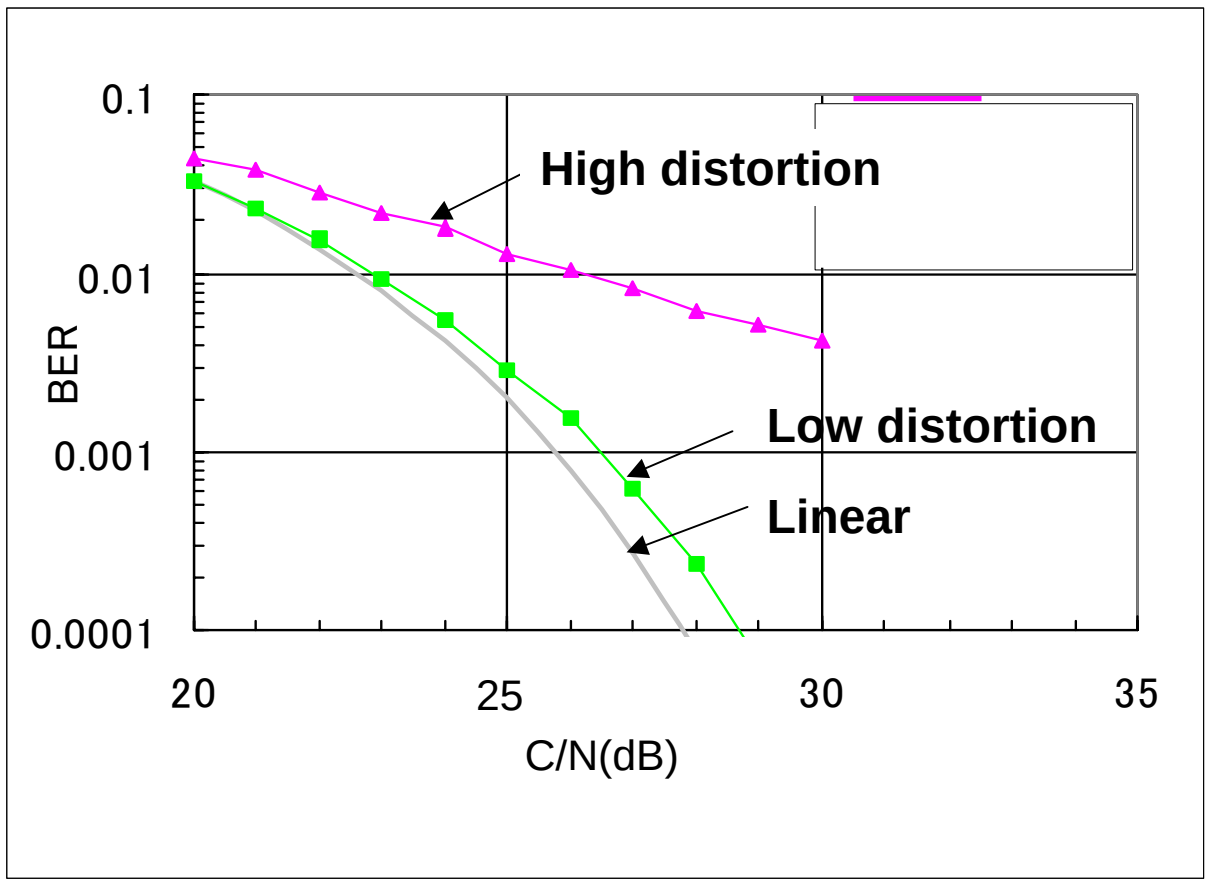
(1) Non-linear distortion

In digital system Non-linear distortion of transmitter causes the inter-modulation products, and these products are fallen into the adjacent sub-channels. Therefore signal quality is degraded by the Inter-carrier interference.

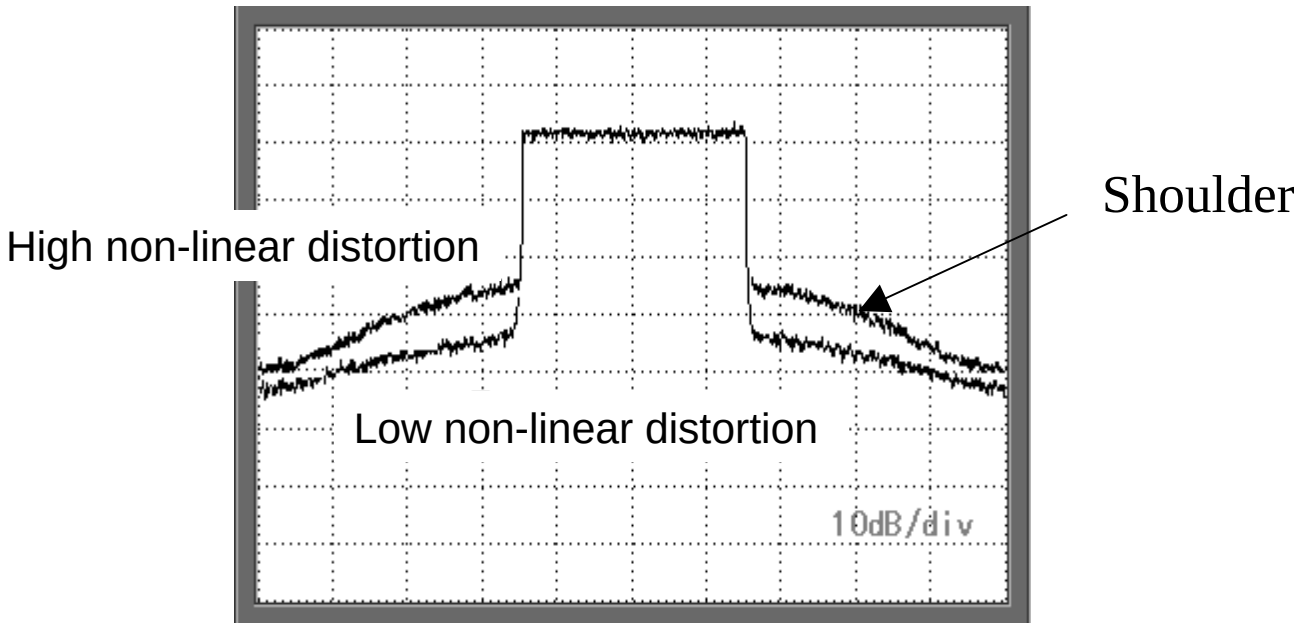


Signal degradation caused by non-linear distortion

Inter-modulation products are fallen into adjacent sub-channels. These products behave as thermal noise, therefore BER characteristics are degraded.



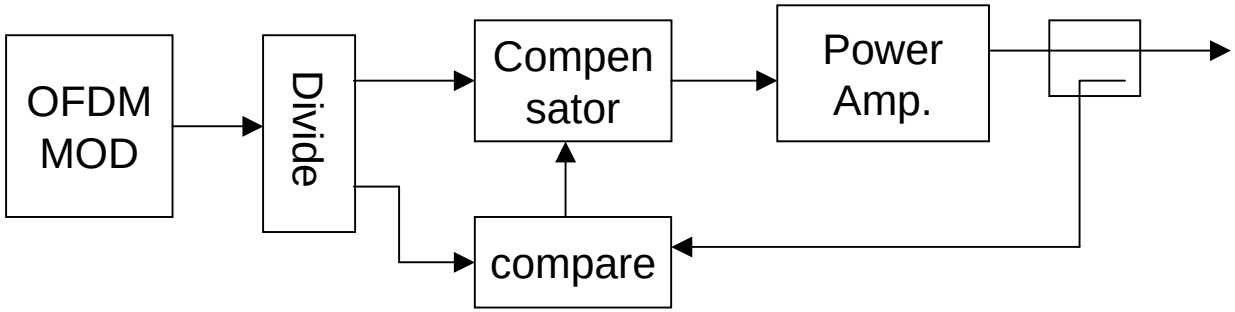
An example of output spectrum



The 3rd-order inter-modulation products appeared on the outside of signal bandwidth. These products are coaled “Shoulder”, and used for measurement parameter of transmitter

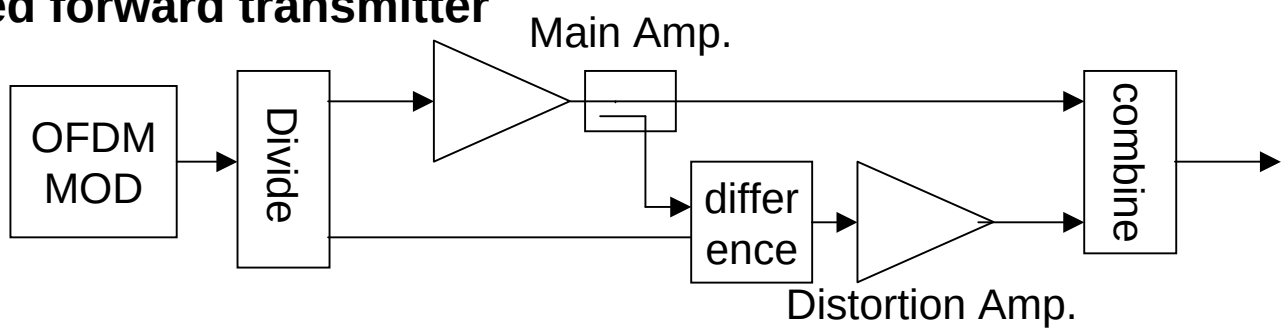
Examples

Feedback pre-distortion transmitter



This technology is used for high power transmitter. Inter-modulation level is decreased -45 dB or less.

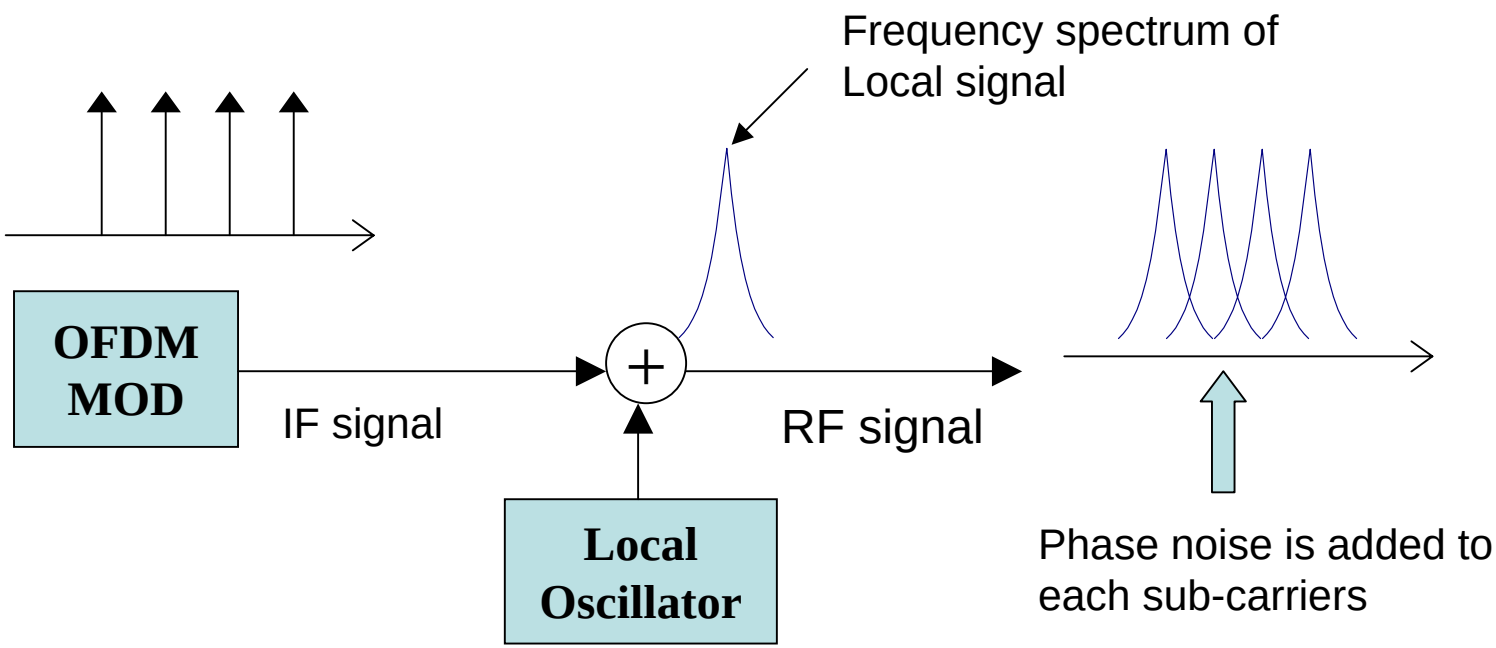
Feed forward transmitter



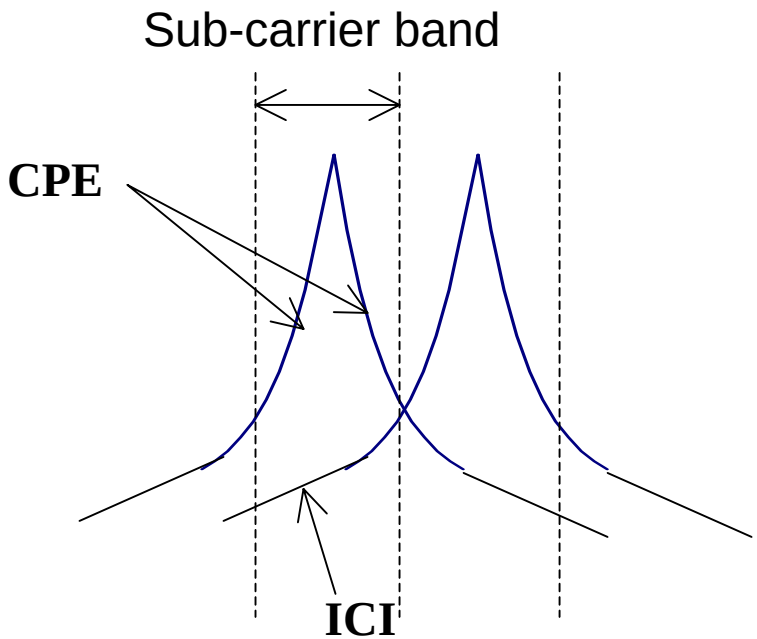
This technology is used for low to medium power transmitter. This type amplifier covers wideband, so used for multi channel amplifier. Inter-modulation level is decrease to -50 dB or less.

(2) Phase Noise

The phase noise is mainly generated from local oscillator, and is added to each sub-carriers of OFDM signal(See below)



The Influences of Phase Noise



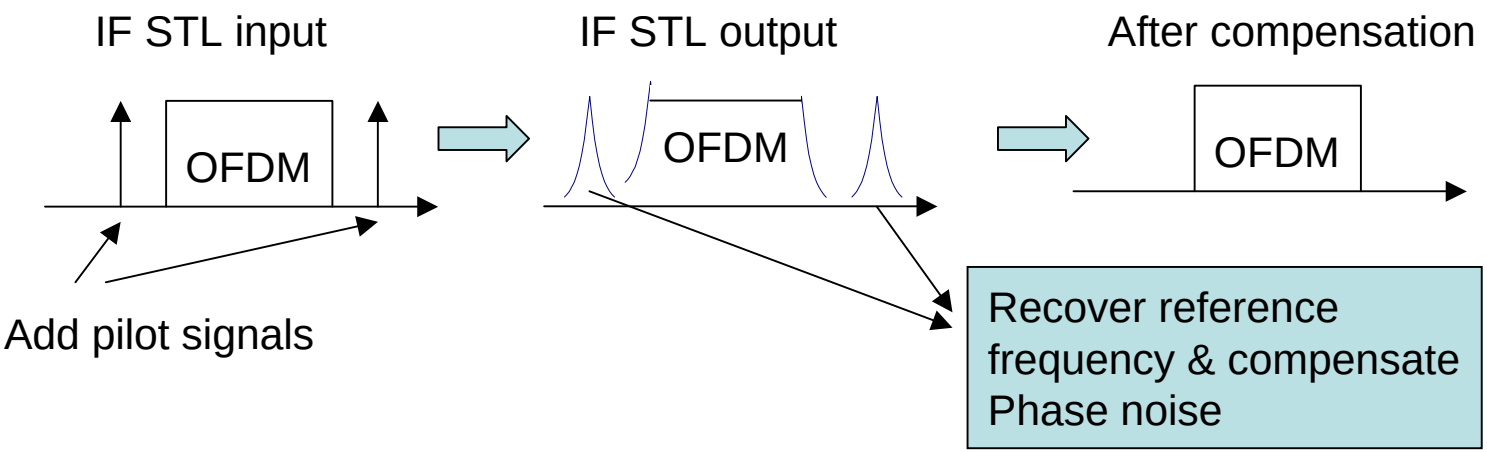
CPE: **Common Phase Error. The in-band components of Phase Noise. This causes circular shift of signal constellation. As a result, causes the C/N degradation.**

ICI: **Inter-Carrier Interference. The out-band components of Phase Noise. This components behave as a thermal noise. As a result, causes the C/N degradation**.

example

(1) Use high stable oscillator for local signal (ex. GPs controlled crystal oscillator)

(2) 2 pilot carrier transmission system for IF transmission micro-wave link



(3) Improvement of transmission distortion

-Multi-path canceller; especially compensate the multi-path distortion on transmission link.

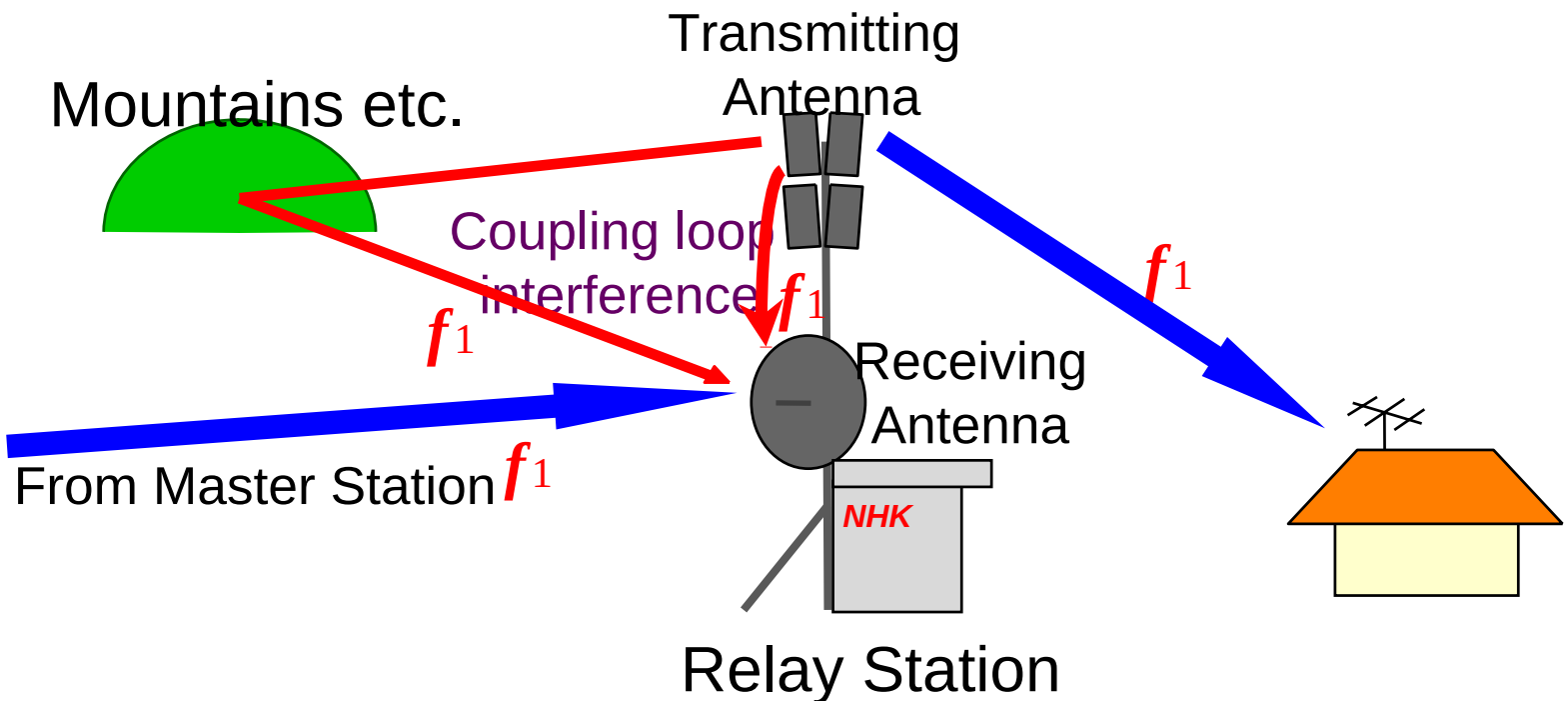
-Coupling loop interference(CLI) canceller; compensate the coupling loop between TX antenna and RX antenna in SFN

-**Diversity receiving technology**; Improve the degradation caused by fading. This technology is useful not only transmission network but also mobile reception.

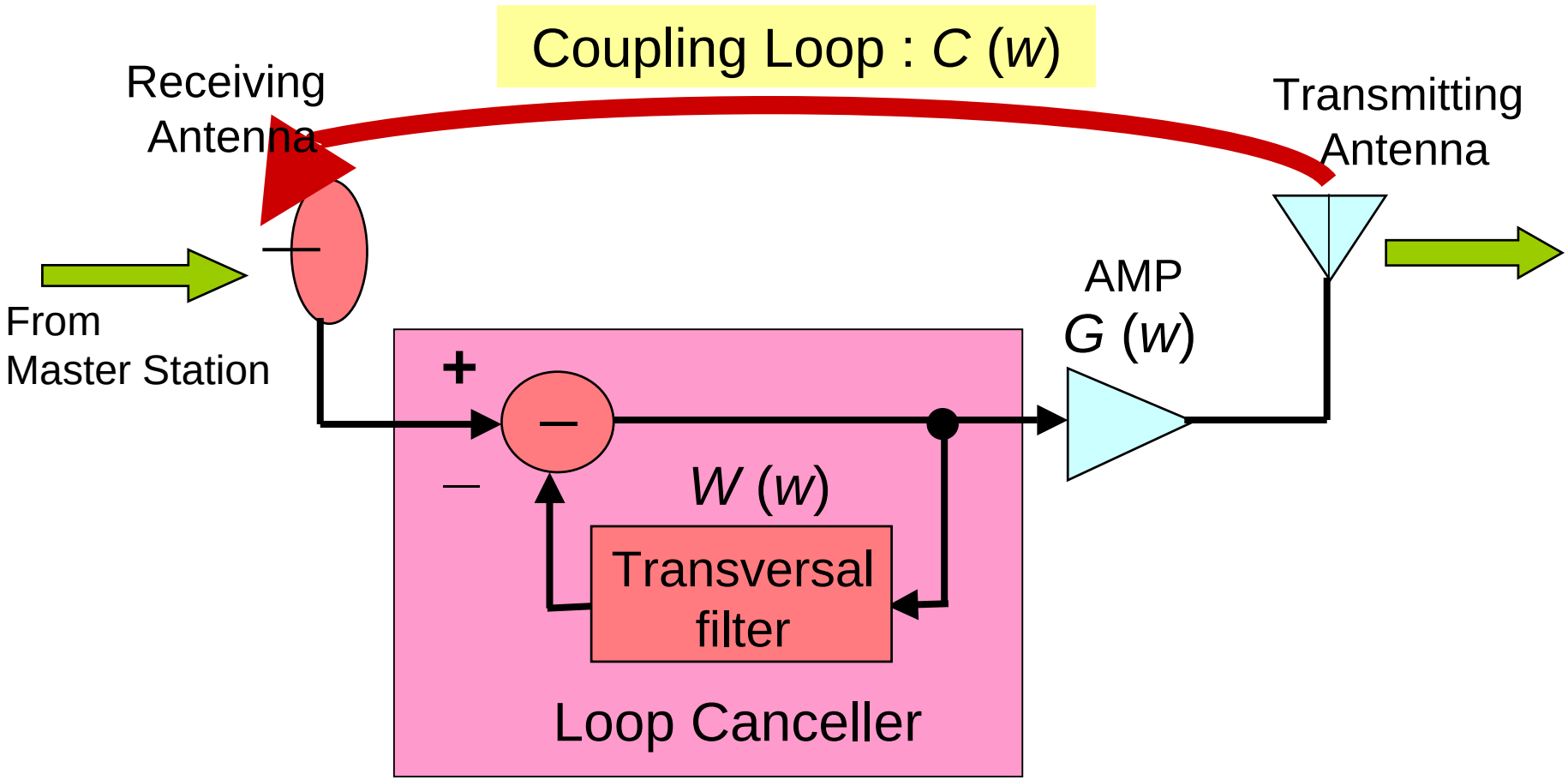
Above technologies was explained in seminar #5

What is CLI (coupling loop interference) ?

- Frequency of transmitting signal is the same as frequency of receiving signal.
- If the output of transmitting signal comes to the input receiving antenna, receiving signal is interfered. This is CLI.
- It is generally said that more than 90dB isolation is needed between transmitting antenna and receiving antenna.

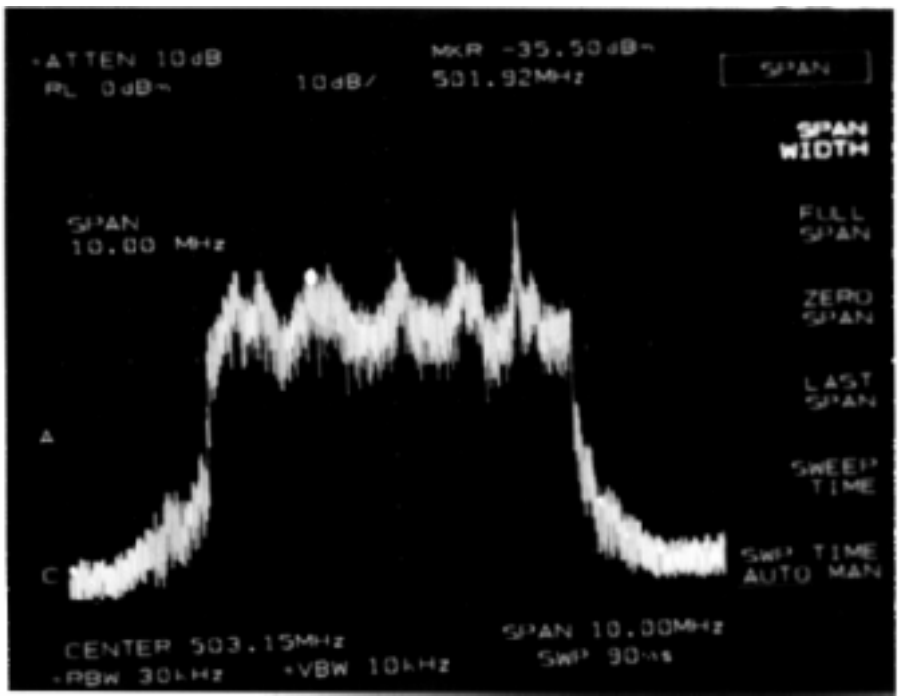


Principle of CLI canceller

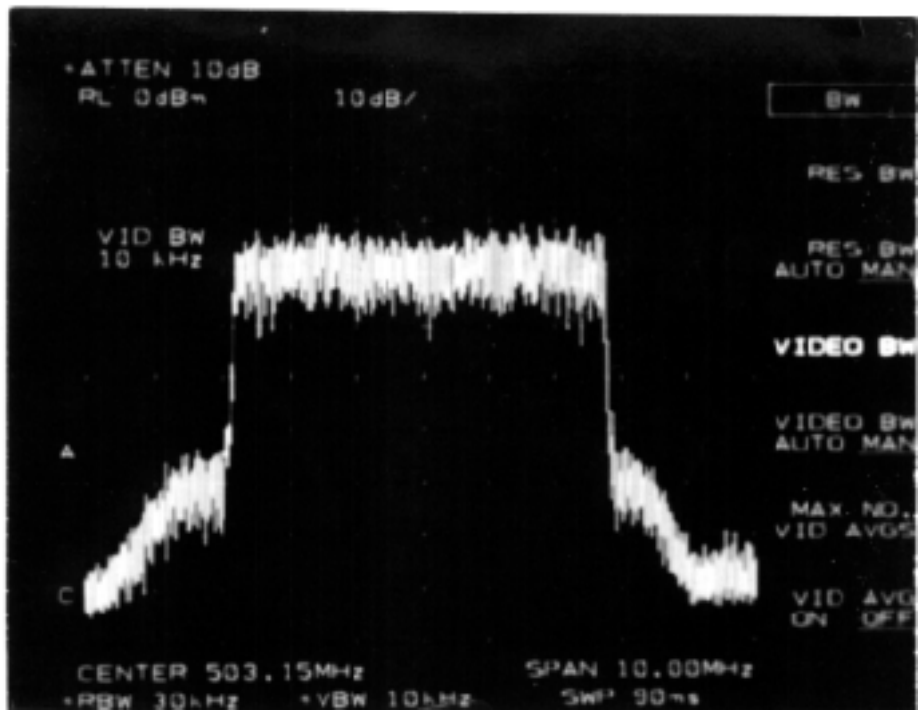


Condition for canceling : $W(w) = G(w)\,C(w)$

Effect of CLI canceller



Transmission signal
without CLI canceller

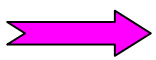


Transmission signal
with CLI canceller

Merits / demerits of SFN

- Merit of SFN
  - Frequency effective use (Frequency is limited)
- Demerits of SFN
  - CLI at broadcast-wave relay station
    - solve by CLI canceller
  - Appearance of long delay multipath
    - solve by guard interval of OFDM

How about long delay multipath over guard interval

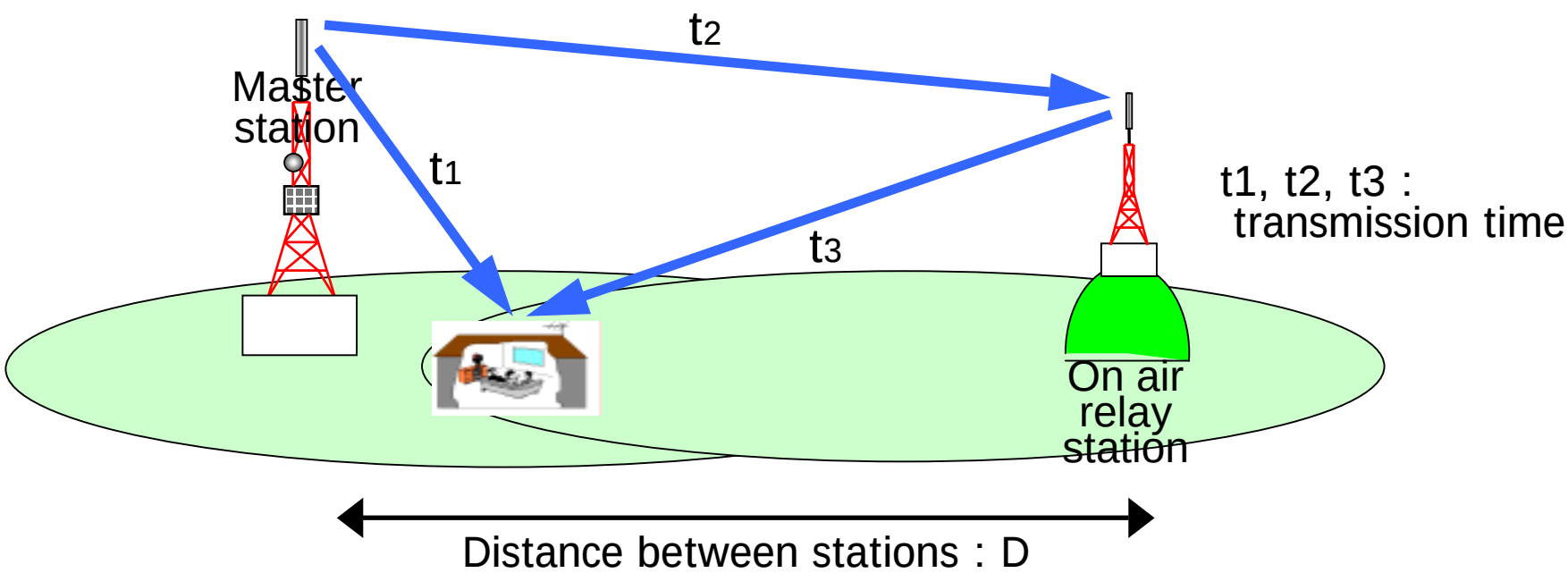


Long delay mutipath equalizer

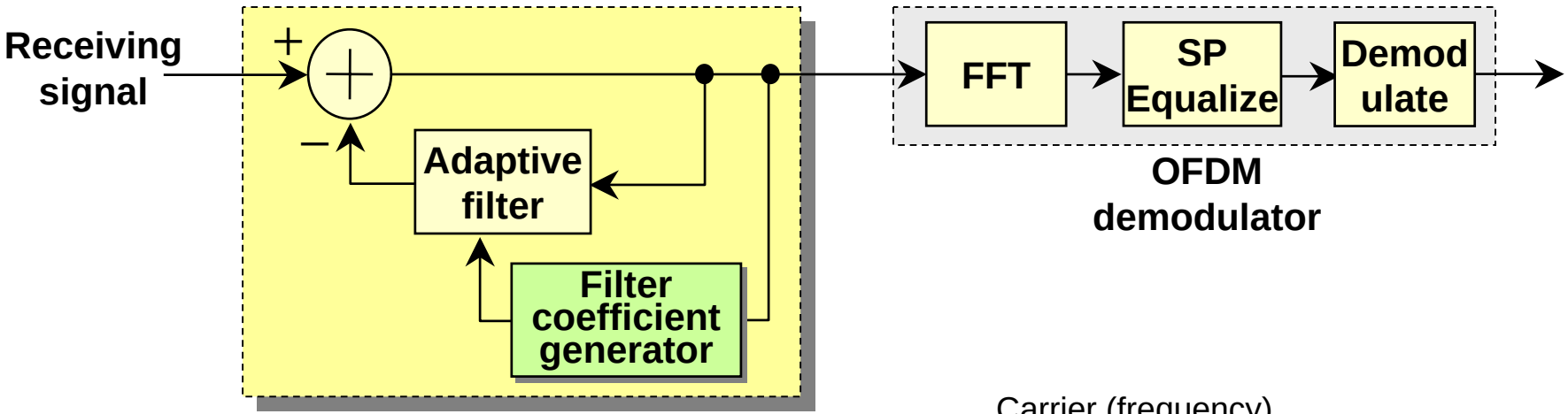
Long delay multipath situation

- Transmission time of desired signal : t_1
- Transmission time of delayed (undesired) signal : t_2+t_3
- Delay time of undesired signal τ_x = $(t_2+t_3) - t_1$
- Guard Interval : τ_{GI} (for example τ_{GI} = 126 usec)
- Long delay multipath over guard interval $\tau_x > \tau_{GI}$
- IF D>37.8km, t_2>126usec, there is possibility to be $\tau_x > \tau_{GI}$

⇒ Development of long delay multipath equalizer is important.



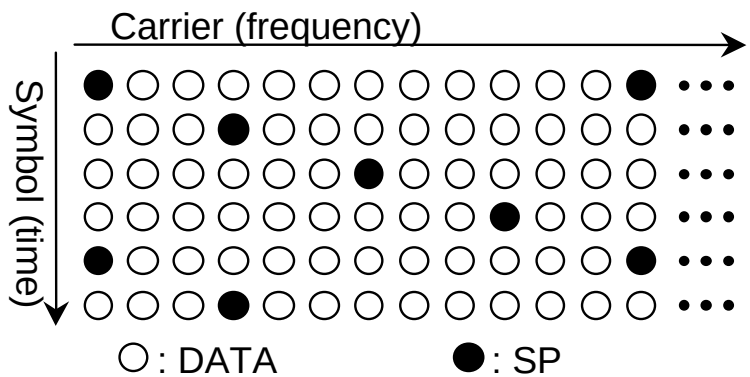
Receiver improvement
Principle of long delay mutipath equalizer



Equalizer adapted with long echo over guard interval
(Equalizer in time domain)

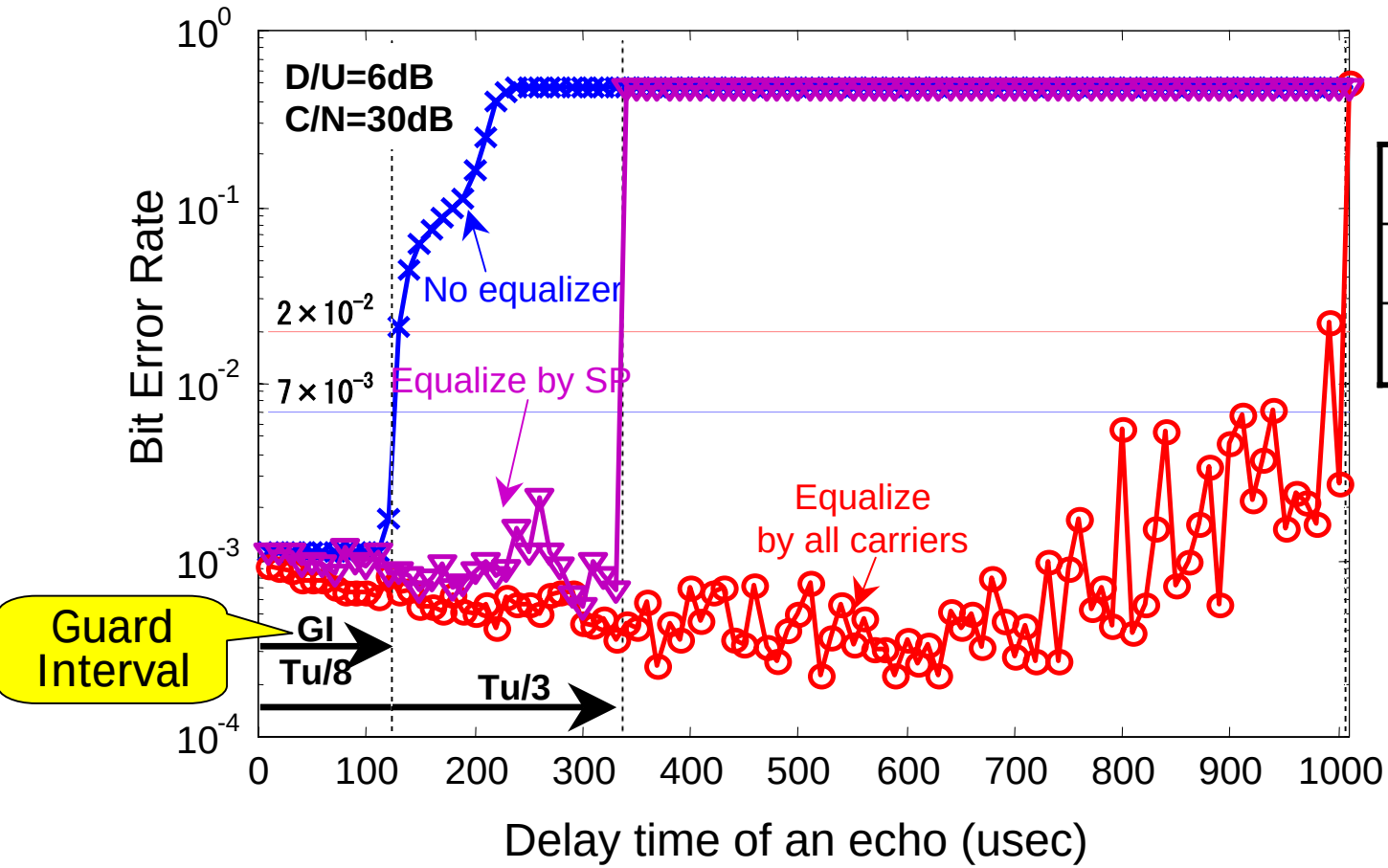
Update of filter coefficient ;

- SP : 4 symbol interval
- All carrier : 1 symbol



Distribution of Scattered Pilot symbol

Performance of long delay multipath equalizer

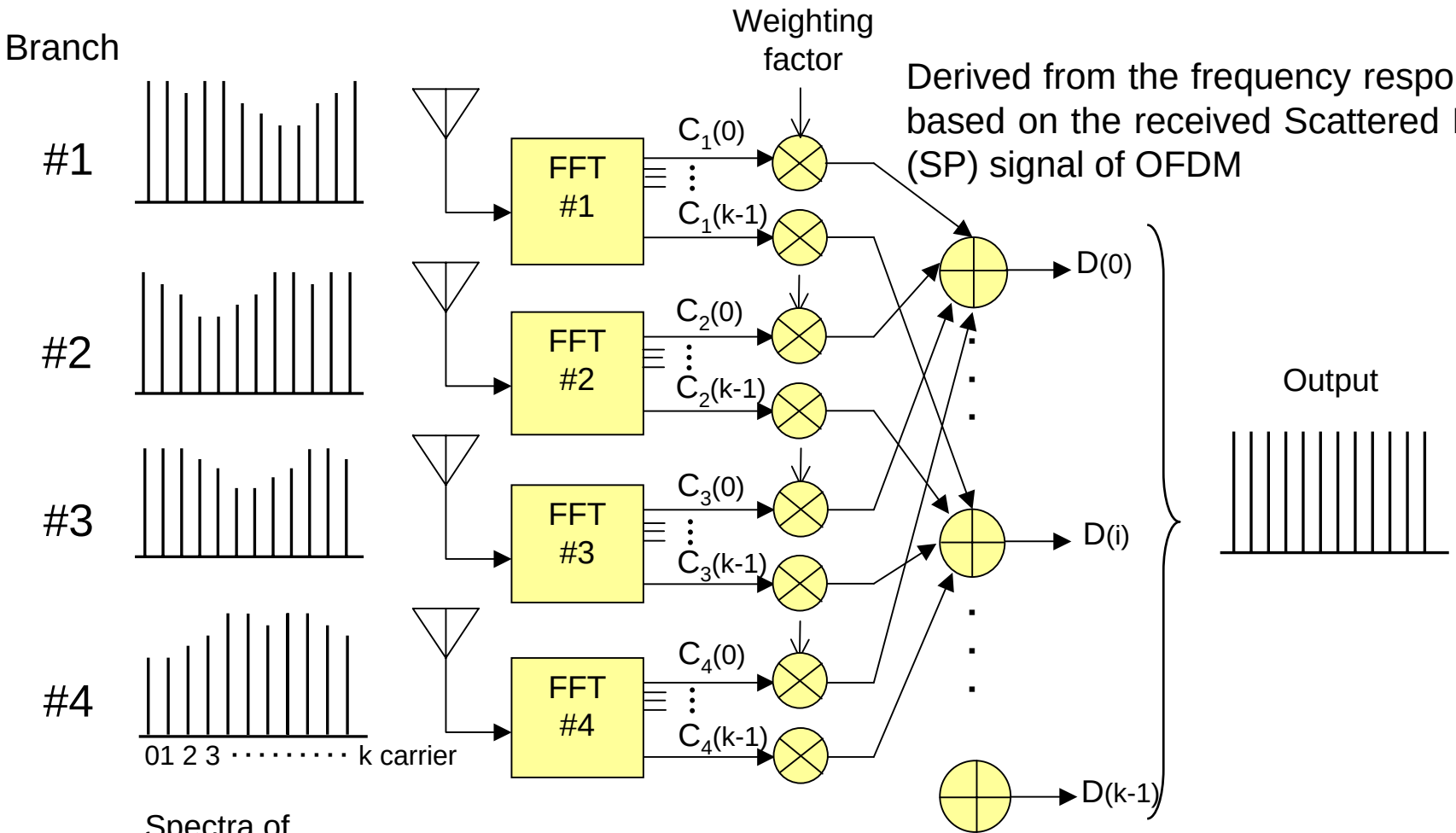


Mode	3
GI	1/8
Mod	64QAM

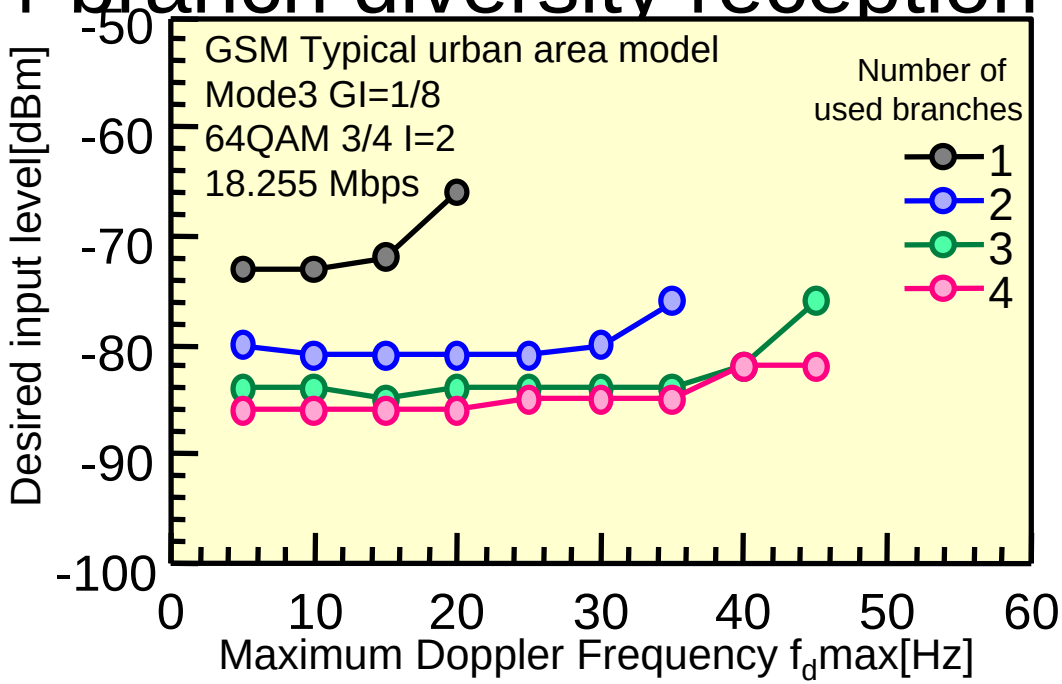
Useful symbol duration (Tu) : 1008usec

Guard interval (GI = Tu/8) : 126usec

Principle of 4-branch space diversity for OFDM signal under mobile reception



Results of lab test on 4-branch diversity reception system



Number of Branch	$f_d$max	Velocity@19ch ($v = f_d\text{max} \times \lambda$)	Velocity@62ch ($v = f_d\text{max} \times \lambda$)	Desired input level (@ $f_d$max =20Hz)
1	20Hz	42 km/h	28 km/h	-66 dBm
2	35Hz	74 km/h	49 k	-81 dBm
3	45Hz	95 km/h	63 k	-84 dBm
4	45Hz	95 km/h	63 km/h	-86 dBm

35km/h improved

20dB improved

5. Examples of Transmission System and Hardware

For digital terrestrial broadcasting, many equipment have been already provided and now are in operation. In this section, examples of transmission equipment are introduced.

(1)High Power Digital Transmitter System

(2)Micro-wave Links of Digital Terrestrial Broadcasting

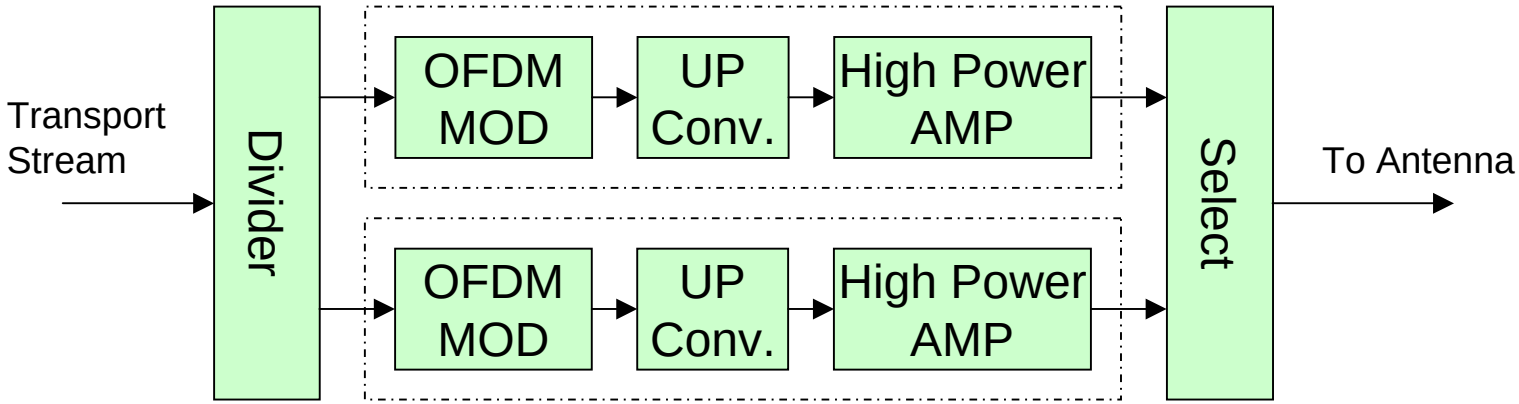
(3)Trans-poser of Digital Terrestrial Broadcasting and new technology

(4)Peripherals

These hardware data are presented by JEITA

(1) High Power Digital Transmitter system

(a) An Example of Conceptual block diagram (Full redundant system)



(b) Power Line-up in Japan

Area	Digital TX	Analog TX	note
Tokyo	UHF 10 kW	VHF 50 kW	wide area key station
Osaka	UHF 3 kW	VHF 10 kW	same as above
Nagoya	UHF 3 kW	VHF 10kW	same as above

(c) Examples of Hardware; see following pages

DiBEG
Digital Broadcasting Experts Group

Examples of High Power Digital Transmitter (Toshiba)

10 kW digital Transmitter(2/3 type)

3 kW digital transmitter rack

1 kW digital transmitter rack

Output power series;

-10kW(2/3) type; for Kanto area

-3kW dual type; for Kansai and Chukyo

-1kW dual type; for medium cover area

Feature;

-Any of cooling type (water or air)

-Equipped high performance non-linear distortion compensator

Examples of Digital Transmitter (NEC)

Features

1) **Both liquid cooling / air cooling available**
2) **Compact size / Minimized footprint**
3) **Adaptive Digital Corrector to maintain optimal signal quality**
4) **Color LCD to monitor detailed parameters**

3kW Air Cooled
UHF Digital TV Transmitter
(in operation at Osaka & Nagoya stations)

10kW Water Cooled
UHF Digital TV Transmitter
(in operation at Tokyo station)

Examples of High Power Digital Transmitter of Digital Terrestrial Broadcasting (Mitsubishi Electric)

IS-6000Series

1.Feature

✧High performance Output Power Signal C/N and IM

✧High power amplifier ratio

✧Self daignosis and remote monitoring

2.Main Specifications

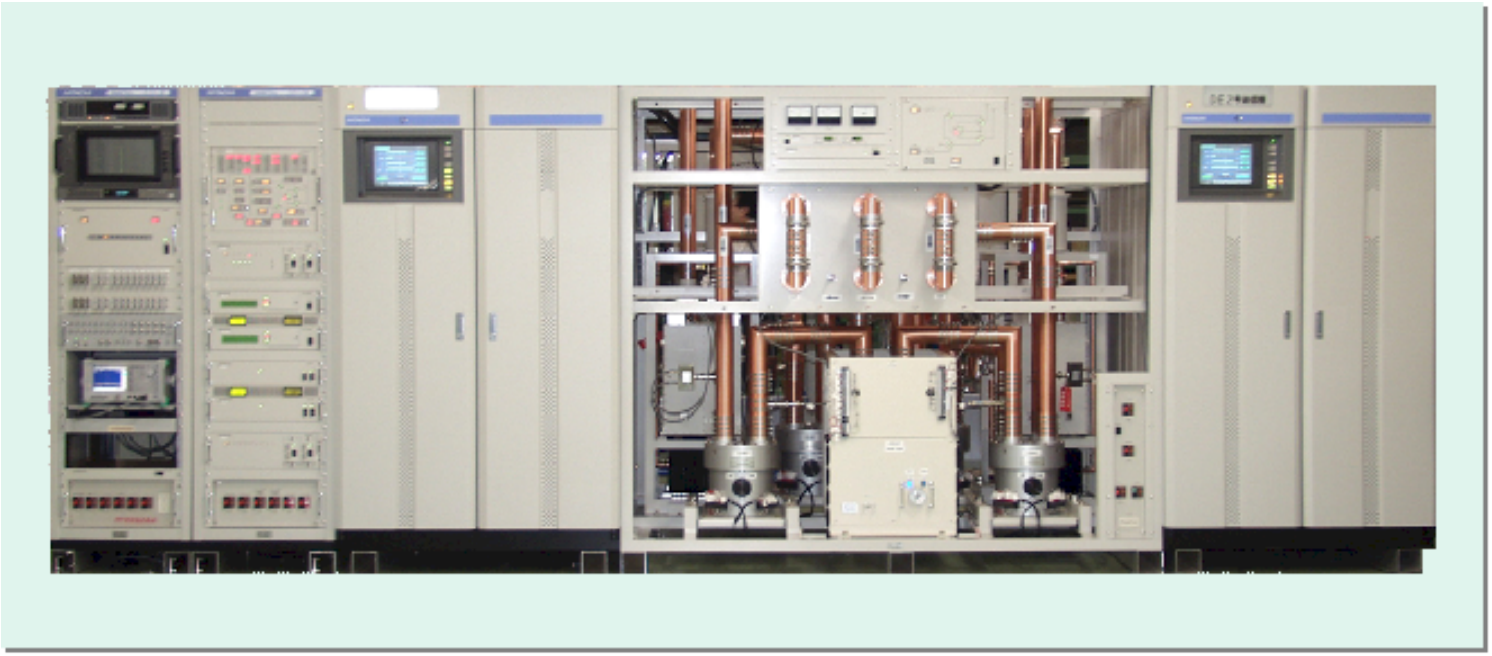
Output Signal Power	1kW,500W,300W,100W
Output Signal Frequency Range	UHF(470MHz～770MHz)
Input Signal	・DVB-ASI ・IF(37.15MHz)
Distortion Reduction	Adaptive Digital Pre Distortion
IM(Intermoduration)	Max -50dB
Input Power	AC 200V-3 ϕ (50Hz/60Hz)
Power Consumption	Max 9kW (air cooling)
Size	800(W)×1950(H)×1200(D)mm
Weight	600kg

3.Achievements

✧First product is delivered to the customer

Examples of High Power Digital Transmitter (Hitachi Kokusai Electric)

3kW dual system



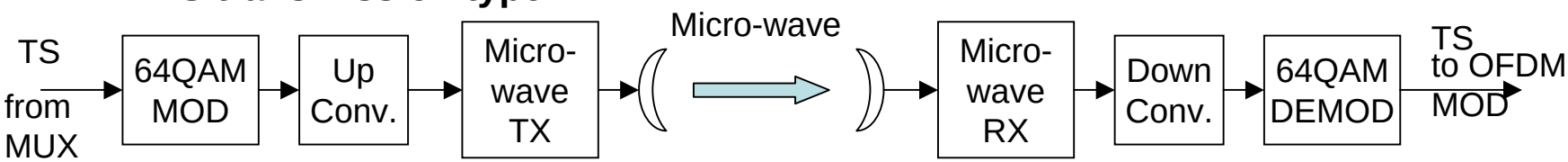
- 3kW digital Transmitter with water cooling system
  Air cooling type is also available
- Built-in latest adaptive pre-distortion technology
- Transmission Frequency is 1 channel within UHF band

(2) Micro-wave Transmission Link

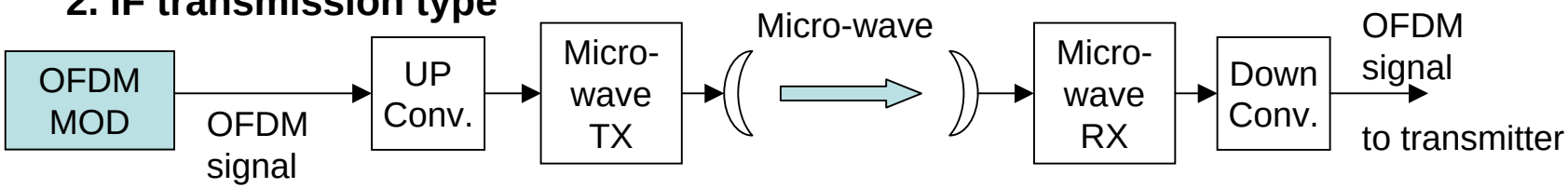
(a) STL(studio transmitter link) and TTL(transmitter transmitter link)

2 transmission types described below are available(can be applied to fiber transmission)

1. TS transmission type



2. IF transmission type



(b) FPU(Field Pick Up)

Field Pick Up is the outside program transmission system for news gathering and sports relay system, etc. Recently, digital modulation system such as single carrier QAM and OFDM are introduced.

(c) Examples of Hardware; see following pages

Examples of Digital STL (NEC)

STL Transmitter

STL Receiver

Features

1) **Ready for three different frequency bands**

7GHz/2.0W
10GHz/2.0W
13GHz/0.5W

2) **HEMT employed at LNA stage to reduce NF**

NF=3db typical for all bands

3) **Test signal (PN pattern) incorporated in digital modulator to measure BER**

4) **4 channels of telephonic signal accommodated**

5) **64QAM / HPA can be separated max. 200m (with 5D-2W) without degradation**

Examples of Digital Studio to Transmitter Link for TS Signal Transmission

(Hitachi Kokusai Electric)

2 channels dual system

・Seamless SHF Output Signal Switching

・DVB-ASI Digital Signal Interface

・High-performance automatic equalizer diminishes multi-path distortion

Examples of Microwave STL/TTL (Toshiba)

TS STL/TTL TX

TS STL/TTL RX

-Dual type, seamless switching

-DVB-ASI digital interface

-Equipped automatic multi-path equalizer

IF TTL TX/RX

-Dual type, TX/RX are installed in 1 rack

-OFDM IF signal interface

-Phase noise compensation technology with pilot signal

Examples of Micro-wave Transmission Link （Hitachi Kokusai Electric)

・Switch Selectable among analog FM, digital single carrier QAM and digital multi-carrier OFDM

・Video and audio signals transmissible in HDTV or SDTV

Digital Microwave Link

Digital / Analog in single FPU that supports three modes

PF-503 TX-H

PP-57

PF-503 RX-H

Ikegami FPU (PF-503/PP-57) makes it possible to select HDTV and SDTV by built-in Encoder Board.

PF-503 supports 3 mode transmission including analog mode.
①QAM (Single Carrier) ②QAM-OFDM (Multi Carrier) ③Analog (FM)

PF-57(QAM-OFDM) is suitable for wireless camera system in both SDTV and HDTV.

Ikegami

Examples of Microwave Television Relay Equipment (NEC)

Transmitter

Receiver

Features

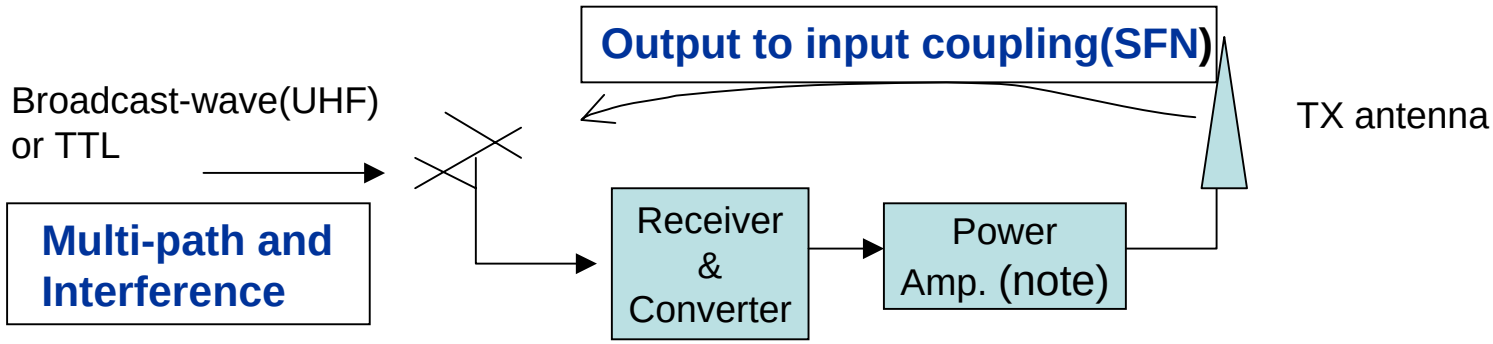
1) Supports triple mode transmission.

   Single carrier QAM / OFDM-QAM / FM

2) Built-in MPEG-2 HD / SD CODEC is available.

(3) Trans-poser of Digital Terrestrial Broadcasting And new technology

(a) Conceptual Block diagram



(note) to save the cost, common amplifier is expected

(b) Key factors of digital terrestrial trans-poser

1. **To reduce the cost, common wideband amplifier for plural channel is expected**
2. **In some cases, degradation caused on transmission link should be improved (Multi-path, interference canceller, diversity reception, etc)**
3. **For SFN, receiving and transmitting frequency is same, coupling of input and output should be decreased (coupling loop canceller)**

(c) Examples of Hardware; see following pages

Examples of Digital Transposer (NEC)

30W x 3-channels common amplification System

Features

1) Excellent IM (less than -50dB) using Feed-forward technology.

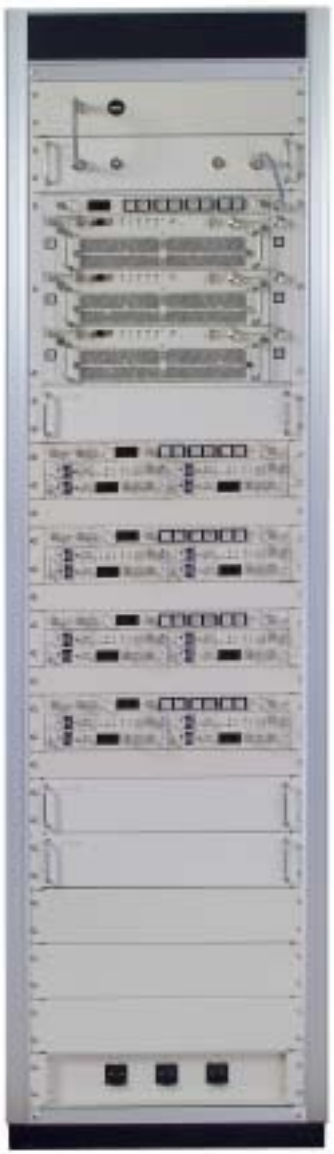
2) MCPA (Multi Channel Power Amplifier) is available.

   No required of Channel combiner, especially, in the case of adjacent channel transmitting.

3) END (Equivalent Noise Degradation) improving equipment for on air receiving system is provided.

   - Loop canceller
   - Diversity receiver
   - Noise reduction (Re-mapping) Equipment.

Examples of Transposer of Digital Terrestrial Broadcasting(Mitsubishi Electric)



IS-3000Series

1.Feature

✧Low distortion output power by feed forward compensation
✧Wide frequency range MCPA(Multi Channel Power Amplifier)
✧Easy maintenance and Compact Size

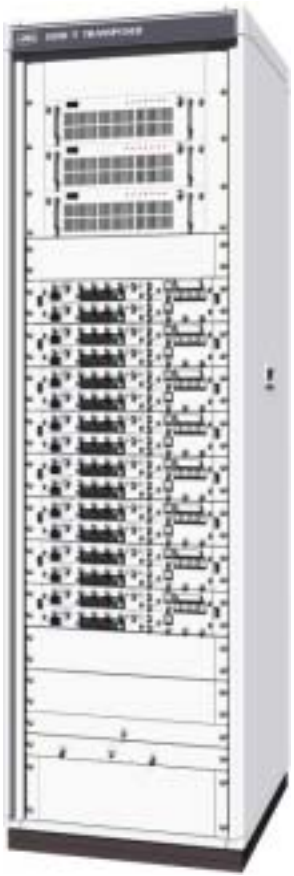
2.Main Specifications

Input Signal form	・UHF（470MHz～770MHz） ・DVB-ASI or IF（37.15MHz）
Output Signal form	UHF(470MHz～770MHz)
Output Signal Power	50W、30W、10W、3W、1W、0.3W、0.1W
IM(Intermoduration)	Max -50dB
Spurious	MAX -60dBc
Input Power	AC 100V/200V(50Hz/60Hz)
Size	570(W)×1900(H)×630(D)mm

3.Achievements

✧Several products are inspected on site and in the factory

Examples of Digital transposer (JRC)



Digital transposer

-Adopting a Multi channel common amplifier

-Output power of 10W on 8 channels

(Suitable for the Tokyo area)

50W power amplifier

-MCPA (Multi Channel Power Amplifier)

-Feed-forward distortion compensation amplifier

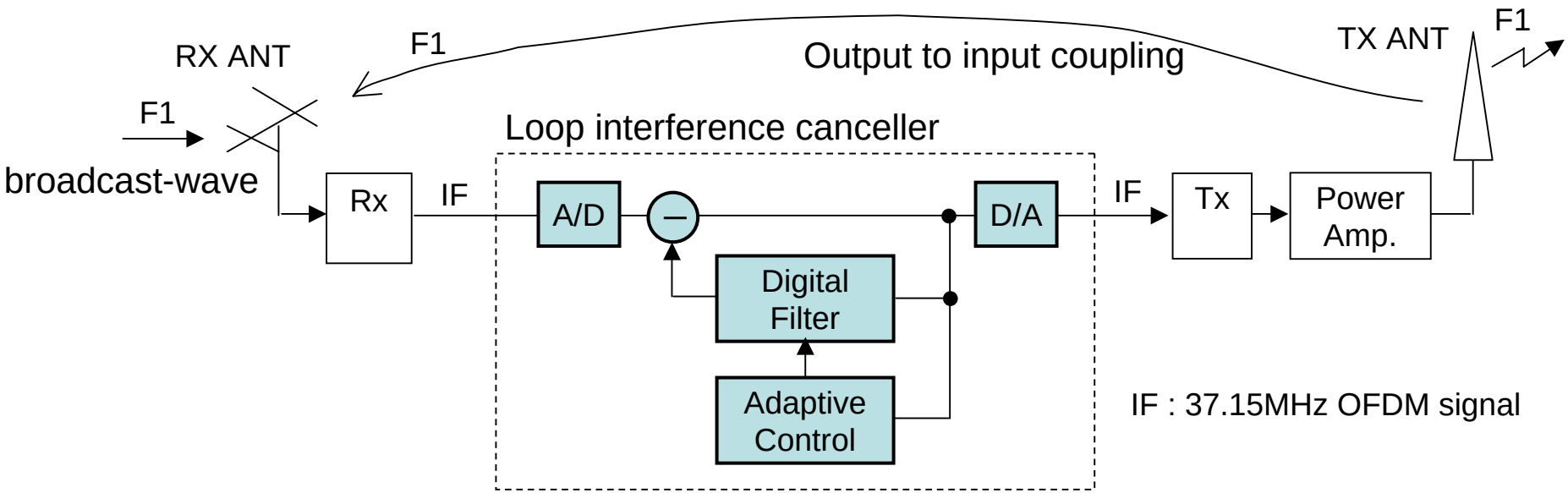
Receiver

-In-use and / or standby receiver and change-over switch

Examples of New Technologies (JRC)

Loop interference canceller for SFN (Single Frequency Network)

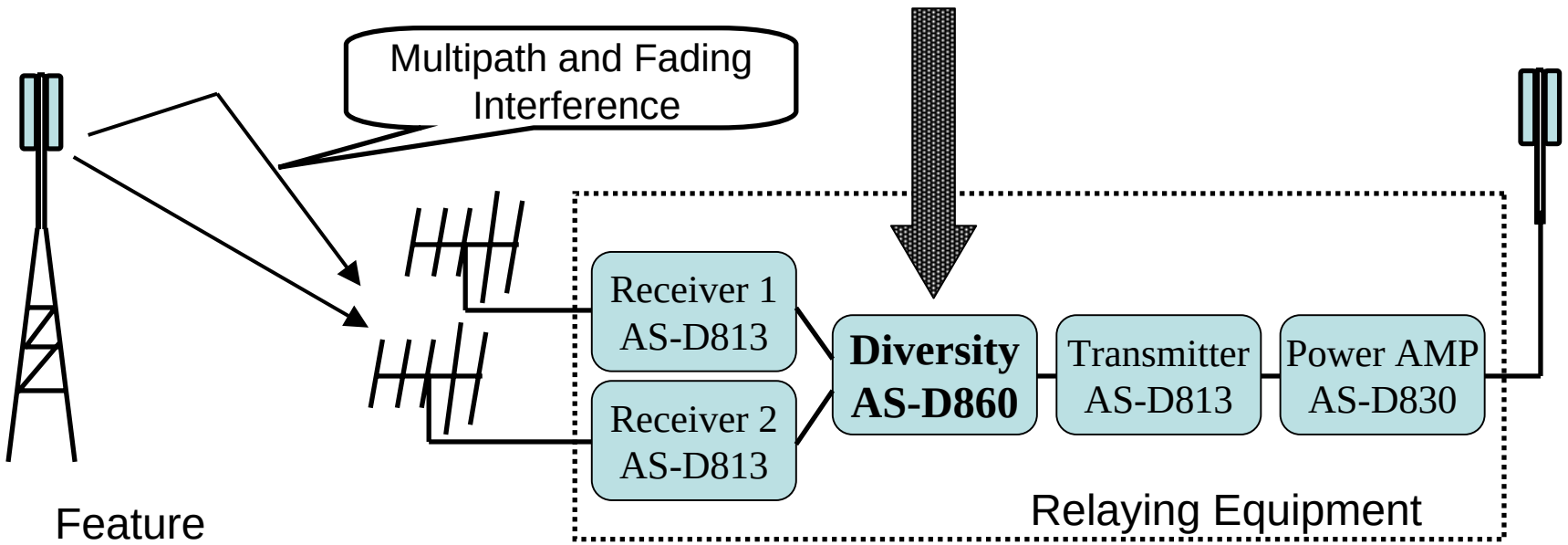
-Economical SFN by the broadcast-wave can be realized



Signal quality compensate equipment

for Terrestrial Digital Broadcasting Relay Station

MODEL AS-D860 (Panasonic).



Feature

★ Signal quality degradation by the multipath and fading is compensated.

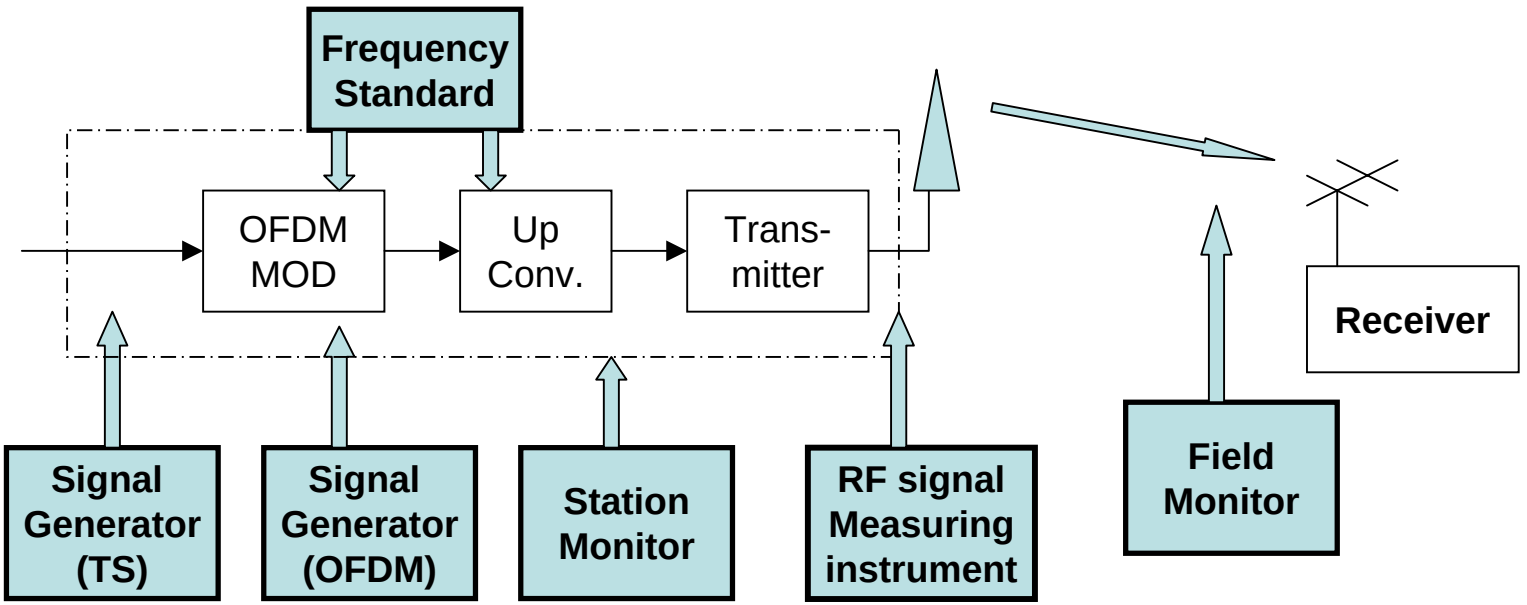
★ Adopted to maximum-ratio-combined method.

★ Miniaturization Size : 480mm(W)×400mm(D)×50mm（H)

(4) Peripherals

(a) Peripherals for digital transmitter system

Peripherals for digital transmitting system are quite different from the ones for analog system. Many types of peripherals for digital have been developed and commercialized



(b) Examples of Hardware; see following pages

OFDM FIELD ANALYZER

MODEL 5287 (NITSUKI)

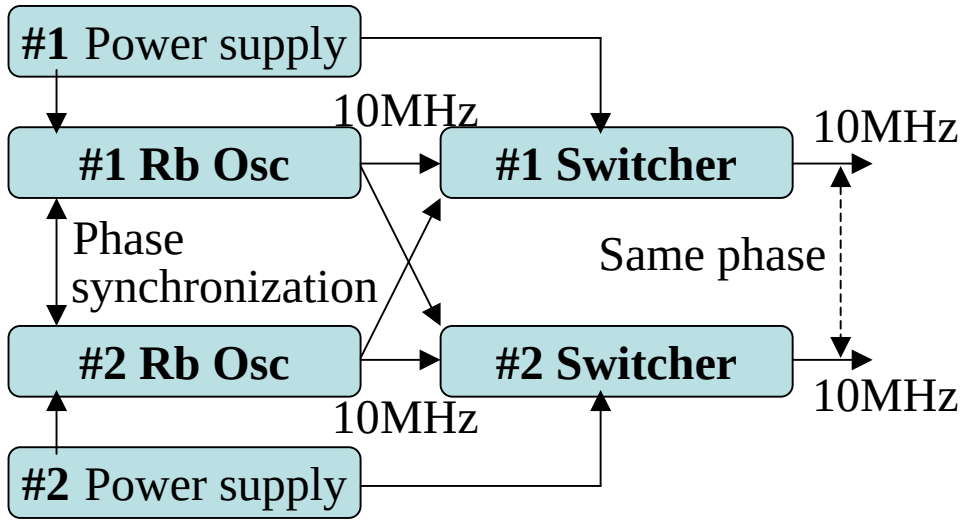
Various measurement function enables predicting recieving obstacle in the field.

* **Equipped with built-in very low noise UHF all channel down converter.**
* **Output MPEG2-TS from demodulated OFDM signal.**
* **Measured results are displayed on LCD and can be stored in memory card.**
* **Displays transmission parameters at each hierarchical level, according to TMCC information.**
* **In case measured value exceed normal range, alarm signal will be issued.**

(Japan Communication Equipment Co.,Ltd. ”Nitsuki”)

SYNCHRONIZED REFERENCE SIGNAL GENERATOR

MODEL3275 (NITSUKI)



∗ High accuracy 10MHz reference signal generator using the Rubidium resonance frequency.

∗ Synchronized two Rb oscillator(main/back up) enables switching without phase jump.

∗ Main/Back up system consists Plug-in unit, can be extract/insert during operation without any affection to the other system.

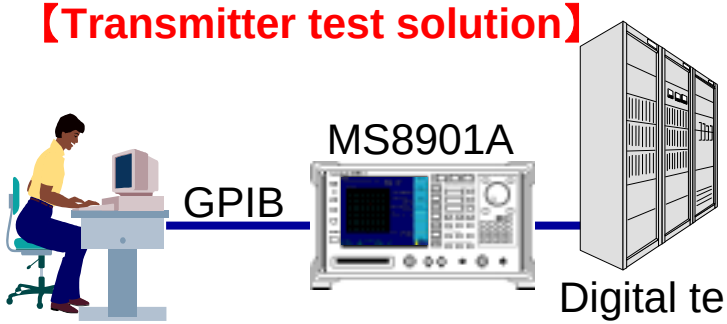
(Japan Communication Equipment Co.,Ltd. ”Nitsuki”)

Introduction of measuring instrument for digital broadcasting

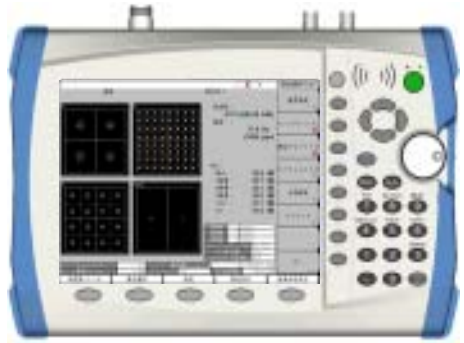
MS8901A(Anritsu)
Digital Broadcast Signal Analyzer

This is a digital broadcasting signal analyzer that makes the base of high performance Spectrum Analyzer (9kHz~3GHz). Using High-speed DSP , and you will be able to do some diverse measuring functions by installing the measurement software.

【Transmitter test solution】



MS8911A(Anritsu)
Digital Broadcast Field Analyzer



MS8911A is a suitable and optimal measuring instrument for Digital Broadcasting Signal Wave (ISDB-T). This has the most advanced ultra-portable spectrum analyzer on the market, featuring unparalleled performance and size at a modest price.

【Field measurement solution】

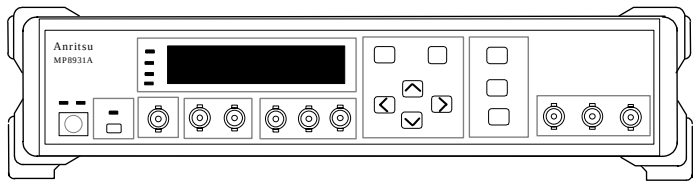
Anritsu

Introduction of measuring instrument for digital broadcasting

MG8940A(Anritsu)
Digital Broadcast Signal Generator

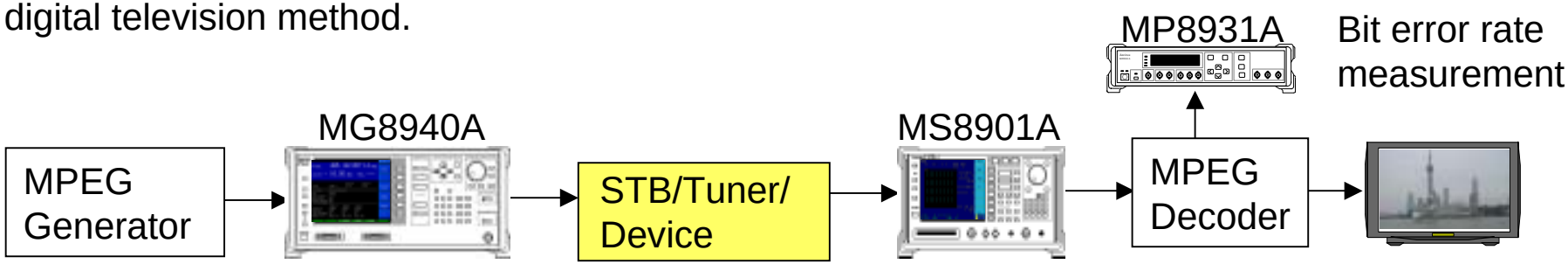
This is a digital broadcasting Signal Generator that makes the base of high performance Signal Generator(250kHz-3GHz). If you install ISDB-T transmission and code Unit in MG8940A, It can generate signal that is a high accuracy and based on the ISDB-T terrestrial digital television method.

MP8931A(Anritsu)
Bit Error Rate Tester



MP8931A is the general-purpose Bit Error Rate Tester which can be used in various fields deal with digital data, such as digital broadcasting, mobile communications and digital circuit.

【Receiver evaluation system】



Evaluate analog performance quantitatively with MER

END of Seminar #8

Thank you for your attention