Presentation 8

Outline of Comparison Test in Several Countries

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Japan

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Contents

1. Outline of 3 DTTB Systems

1.1 Receiver structure

Figure 1. shows the Simplified Block diagram of Digital Terrestrial Receiver.

(1) Tuner block: mainly specified not by system, but by regulation of each countries

(2) Demodulator block: mainly specified by each transmission system

(3) Backend block: mainly specified not by transmission system, but by Service Quality/Performances

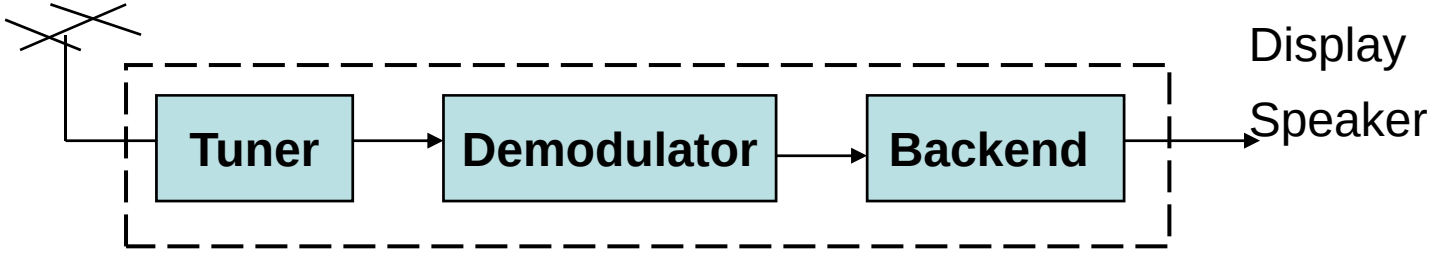

Figure 1. Simplified block diagram of receiver

Conclusion: the differences of each system mainly based on the differences of each transmission system

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1.2 Difference of transmission system

As described previous page, The difference of systems should mainly depends on the difference of Transmission system

Table 1-1 Transmission system

System		ATSC	DVB-T	ISDB-T
Modulation		8VSB	**COFDM** (QPSK, 16QAM,64QAM)	**SegmentedCOFDM** (DQPSK,QPSK, 16QAM,64QAM)
Inter-leaving	Bit/Symbol	Yes	Yes	Yes
	Frequency	-	Yes	Yes
	time	-	-	**0.1s,0.2s,0.4s,0.8s**
Excess Bandwidth/ Guard Interval		11.5%	1/4,1/8,1/16,1/32	1/2, 1/4, 1/8,1/16,1/32
TMCC		-	-	**Yes**
Information bit rate		19.39 Mbps	3.69 -23.5Mbps	3.65 -23.2 Mbps
Channel bandwidth		6/7/8 MHz	6/7/8 MHz	6/7/8 MHz

1.3 Summary of Comparison from Technical Aspect-1/2

Based on the differences of transmission system, show the difference of system performances in Comparison table below

Table 1-2 Comparison of system performances

Any improvement of digital receiver was not considered to make the table below.

Requirements	System conform to requirements
Maximum bit rate under Gaussian noise environment	ATSC
Robustness against multi-path distortion	**(note1)** **ISDB-T** >> DVB-T
Robustness against impulse noise	**ISDB-T**
Wide area single frequency network (SFN) operation	DVB-T, **ISDB-T**
Mobility and Portability	**ISDB-T>** DVB-T

(note1) Indoor reception can be available, its reduce reception cost

1.3 Summary of Comparison from Technical Aspect-2/2

Table 1-2 Comparison of system performances

Any improvement of digital receiver was not considered to make the table below.

Requirements	System conform to requirements
Hierarchical transmission (Multiple modulation systems simultaneously in the same channel is possible)	**ISDB-T**>> DVB-T
Both portable/fixed reception service by one channel and one transmitter	**ISDB-T**(note1)
System commonality with digital terrestrial sound broadcasting (One segment receiver is available)	**ISDB-T**(note2)

(note1) Save both frequency resource and Infrastructure cost

(note2) Multi purpose portable receiver is available

2. Key Points for System Comparison

Forward

As explained in Section 1. ,the differences appear mainly in transmission performances. To compare the systems, it's necessary to evaluate from several point of view shown below.

(1) Reception style: fixed/ mobile/portable

(2) Reception performances: for above each reception style, compare the reception performances under disturbance.

(3) Economical aspect: effective utilization of resources .

For (1) and (2), see Table 2-1 in next page. We recommend to test for several kinds of reception style under various kinds of disturbance.

For item (3), the view point for saving frequency/ infrastructure is important. It relates for hierarchical transmission system. See section 3.

As described in Table 2-1, consider several kinds of reception style for test configuration, and also consider degradation factors in each reception style.

Table 2-1 Classifications of Reception Style and Degradation Factors

Reception style \ Disturbance		Static multi-path	Dynamic multi-path (Fading)	Urban noise	others
Fixed reception	Outdoor Antenna	A	B	B	
	Indoor Antenna	A	A	A	
Mobile/Portable Reception (note 2)	In car reception	A	S	A	
	Handheld reception	A	S	A	Power consumption is also important

S: most critical, A: critical, B: not so critical

(note 1) for mobile/ portable reception, more field strength is requested

3. Hierarchical transmission

Purpose/Effect of “Hierarchical transmission”

- **Realize different service in same (one) frequency**
- **Save frequency resource and transmission infrastructure**

Proposed and/or actual hierarchical transmission system

ISDB-T: Segmented OFDM transmission, now in service in Japan and Brazil

DVB-T: Non-Uniform Transmission, Proposed ,but no actual service

ATSC: not proposed

See table 3-1 for details. In next page

Table 3-1: Hierarchical Transmission system

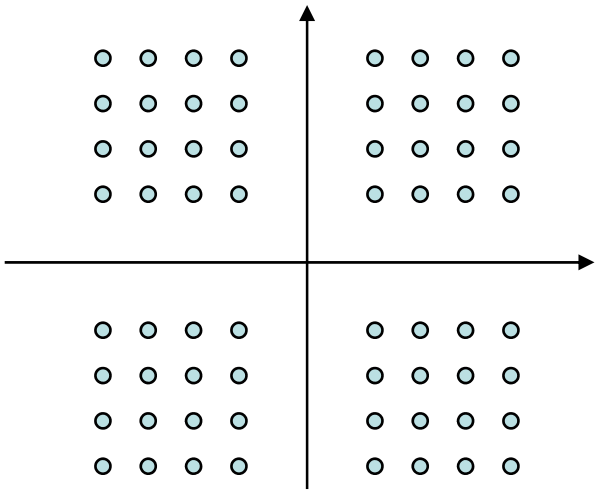
system / parameter	ISDB-T (note 1)	DVB-T (note 2)	note
Hierarchical system	Segmented OFDM Transmission (ARIB-STD-B31)	Non-Uniform transmission (ETSI EN 300 744)	Defined in each standard
Flexibility of parameter setting	Mapping/coding rate are freely selectable	Mapping: limited Coding rate: same	
Required C/N in hierarchical transmission	Not changed	Degraded	
Actual service	Japan (from 2006) Brazil (from 2007)	Trial (2006 in Trino) only	

(note 1) Transmission scheme is explained in presentation 2.

(reference only)

Non-Uniform Transmission system of DVB-T(1/2)

1.This system was demonstrated in TORINO, Italy ,Feb, 2006.
2. This system uses Non-uniform transmission system defined in ETSI EN 300 744(see below).
3.If select Non-uniform 64 QAM, 64QAM symbol has 6 bits.
Top 2 bits are used for DVB-H, transmission ,and bottom 4 bits are used for DVB-T transmission.



Non-uniform 64 QAM mapping

Advantage

-Possible to transmit DVB-T/DVB-H simultaneously in one frequency band
-As a result save frequency resource

But, it causes many disadvantage (see next page)

Non-Uniform Transmission system of DVB-T(2/2)

(from previous page)

Disadvantage (theoretical)

-Degrade required C/N ratio, both DVB-H and DVB-T, compared to conventional DVB-H(uniform QPSK) and conventional DVB-T (uniform 64 QAM)
-Reduce bit rate of DVB-T (fixed reception service), 2/3 of conventional DVB-T system (64 QAM)

Disadvantage (Implementation)

-Doesn't this system needs new demodulator LSI ?(is this in market?)
-Is DVB-T legacy receiver compatible to this new transmission system? If not compatible, new DVB-T receiver is necessary, is it now in market?

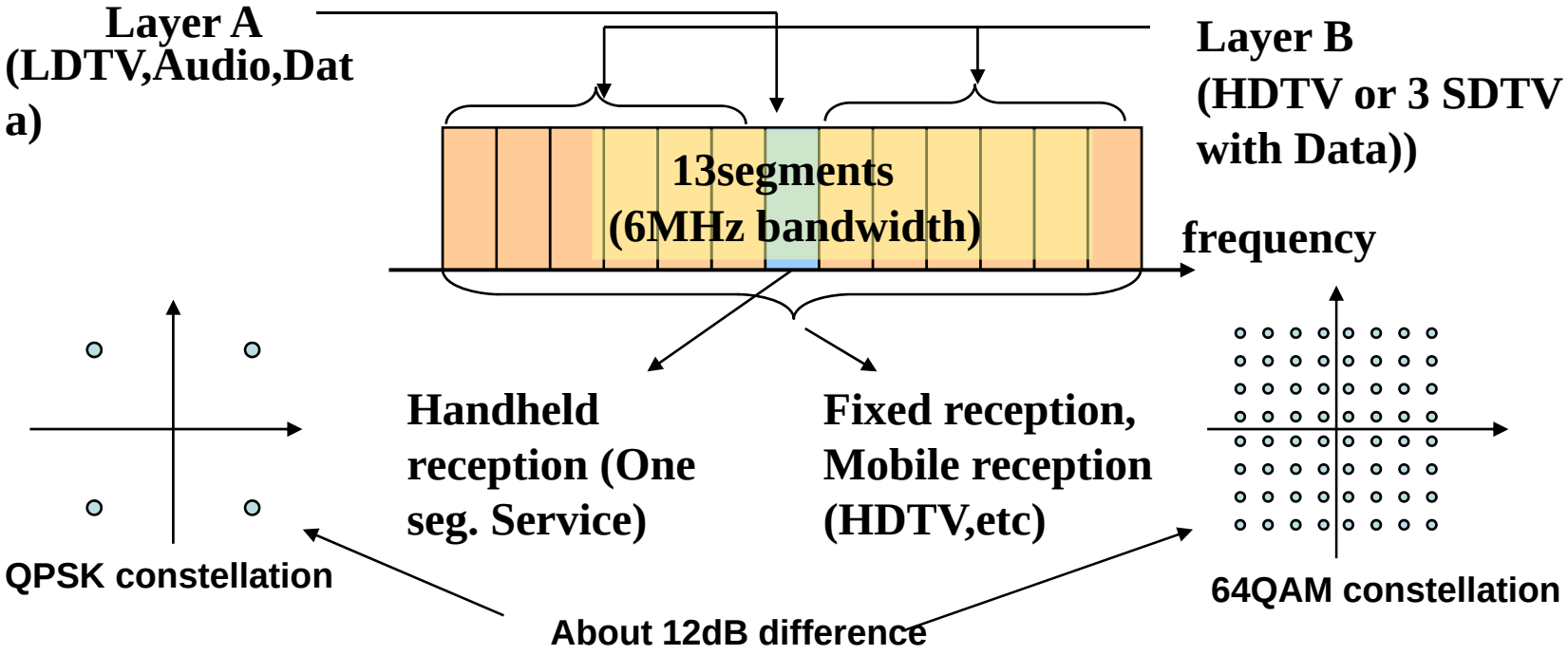
Disadvantage(schedule)

-No commercial service now.

(reference only)

An example of Hierarchical Transmission of ISDB-T (DTTB service in Japan)

(Example; 1seg + 12 seg)



*13 segments are divided into layers, maximum number of layers is 3.

*Any number of segment for each layers can be selected (totally 13 segment)

*Transmission parameter sets of each layer can be set independently

4. Examples of Comparison test

Forward

Comparison test was/has been/is done in some countries for getting the technical base and system design of DTTB system.

We will introduce some examples as a reference.

4.1 Example of Laboratory Test

- **Comparative Evaluation Tests on Terrestrial Digital TV system (Presentation only)**

This test was done in October,2005 by Mackenzie University in Brazil, the purpose of this test was to compare/ evaluate each system under critical condition.

(note) This test was finished before Brazilian decision

See another presentation document, prepared by Mackenzie University

4.2 Examples of Field Test

(1) 3 DTTB Systems Comparison Test in Brazil in 2000

This test was done by Broadcast engineers and members of Academia. The purpose of this test was to investigate the best system for Brazil on fair position.

(2) Field Test in Chile in 2007

This test was done in 2007 for evaluating the performances of each systems.

This test was mainly done for fixed reception performances, both outdoor antenna and indoor antenna.

(3) Field Test in Peru in 2007 -2008

Peru is now on testing of 3 DTTB systems for various point of view.

Such as, (a)Place(Capital city, Amazon, Andes), Reception style (outdoor, indoor, mobile).

(1) 3 DTTB Systems Comparison Test in Brazil in 2000

- This test was done by 2000
- The result of test was presented in NAB2000
- Transmission Parameters: almost same bit rate
  - **ATSC**

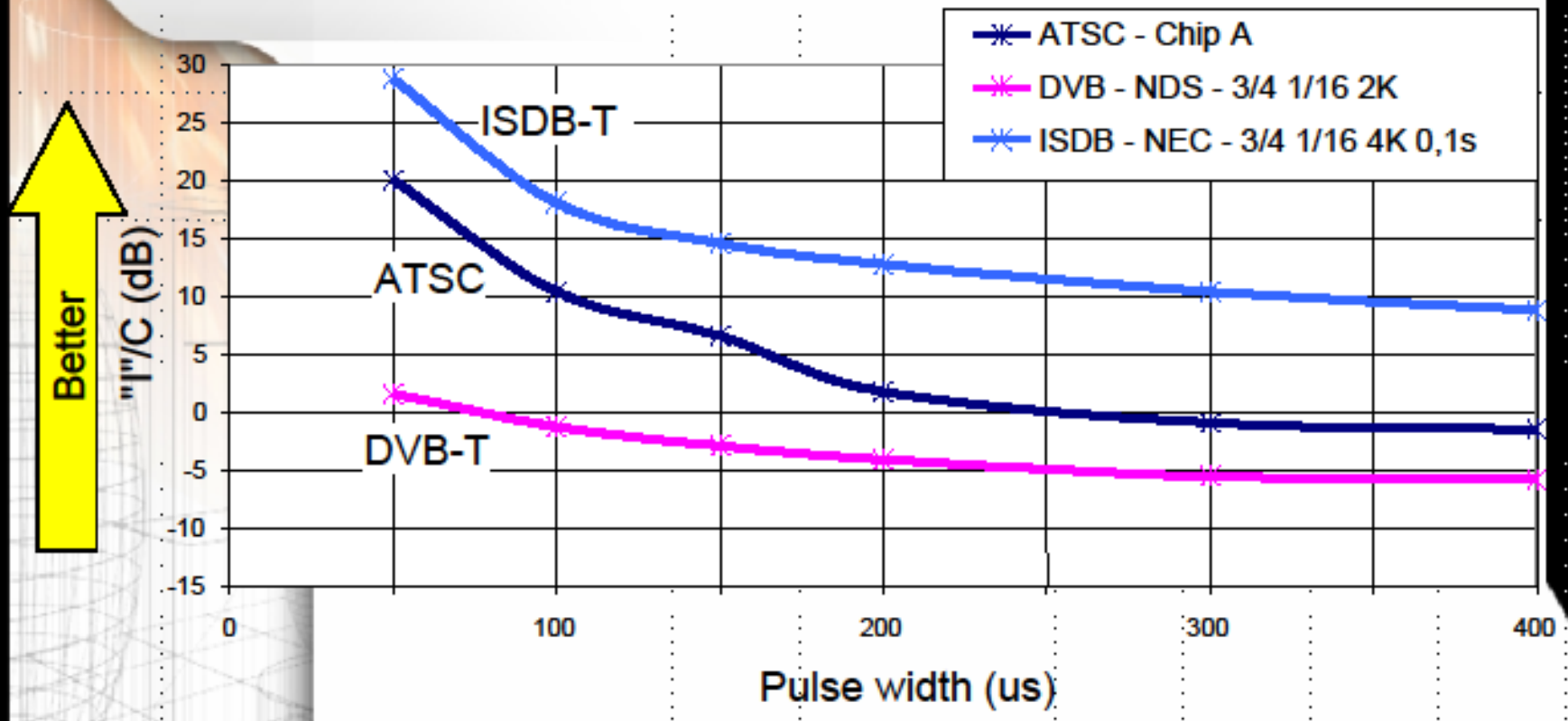
    Fixed, 8VSB FEC=2/3 (19.39Mbit/s)
  - **DVB-T**

    DVB-T 2K: 64QAM, FEC=3/4, GI=1/16, 2K (19.75Mbit/s)
  - **ISDB-T**

    ISDB-T 4K: 64QAM, FEC=3/4, GI=1/16, 4K, 0.1s (19.33 Mbit/s)

Impulse noise

Relation between the noise pulse width & interference to signal ratio

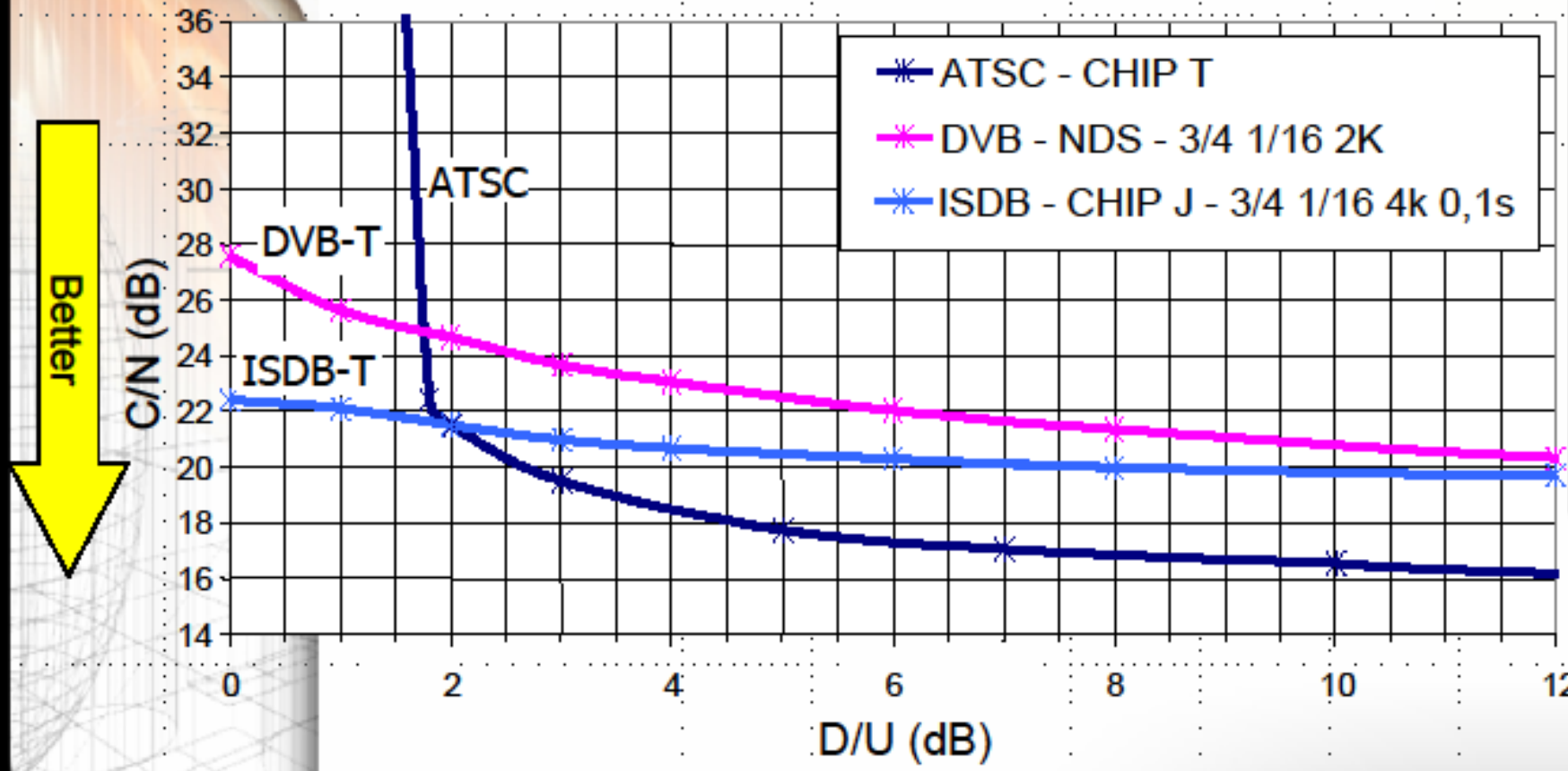


Better performance of the ISDB-T system, by introducing time interleaving

(From the presentation of Brazilian SET/ABERT study group at NAB2000)

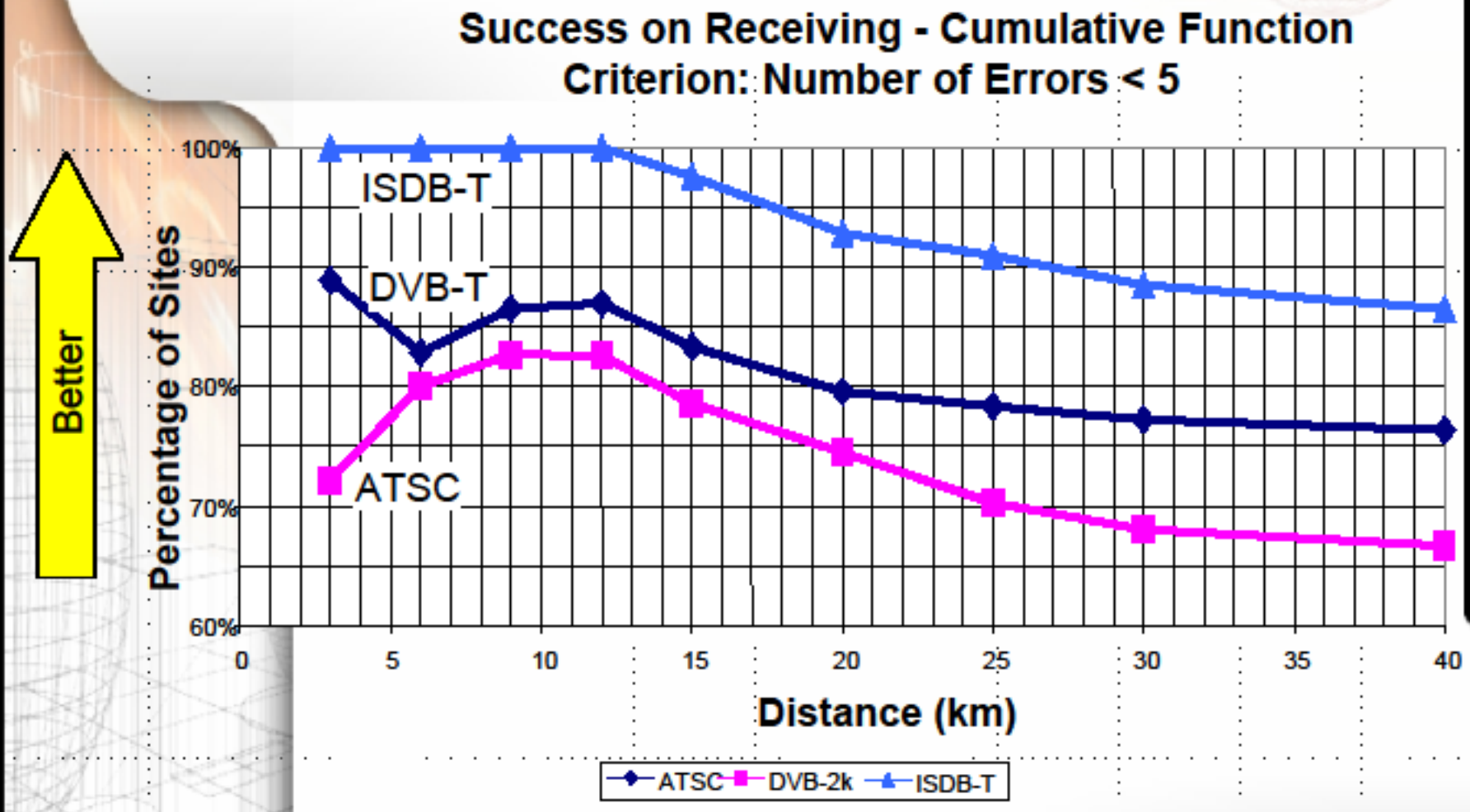
Static multipath

Carrier to noise ratio as a function of carrier to echo ratio
Comparison at post-echo = 8us



(From the presentation of Brazilian SET/ABERT study group at NAB2000)

Outdoor : Coverage



(From the presentation of Brazilian SET/ABERT study group at NAB2000)

Tests Results of Mobile Reception in Brazil

Experiment of field mobile in Brazil

Standard	Parameter				Transmission Rate (Mbps)	Errors (Times)
	Modulation	Convolution	Guard Length	Carrier		
ISDB-T	16QAM	2/3	1/16	2k	11.45	0
	64QAM	2/3	1/16	2k	17.18	6
	16QAM	2/3	1/16	4k	11.45	0
DVB-T	QPSK	1/2	1/16	2k	4.39	1
	QPSK	2/3	1/16	2k	5.85	Many
	QPSK	1/2	1/32	8k	4.52	Many
ATSC	8VSB				19.39	Out of measurement

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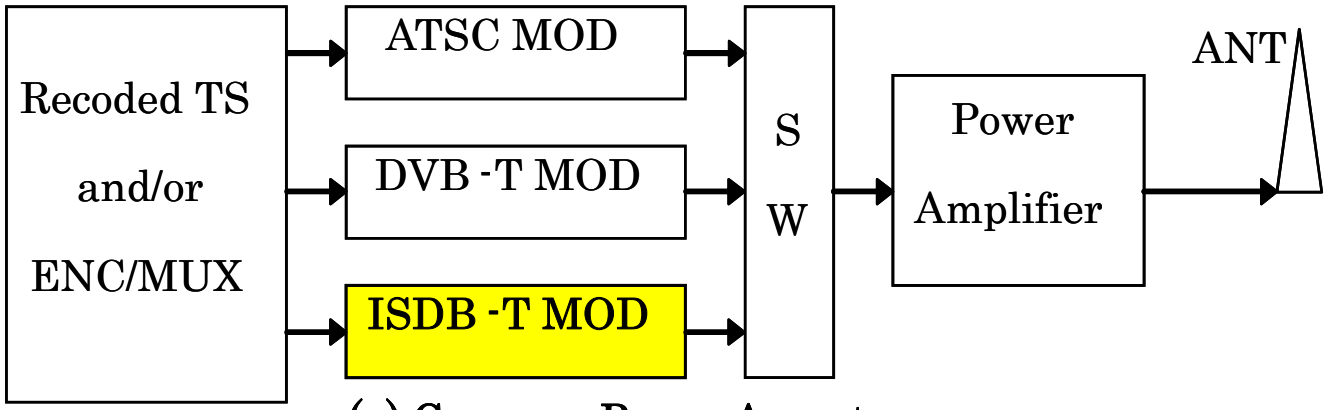
(2) Field Test in Chile in 2007

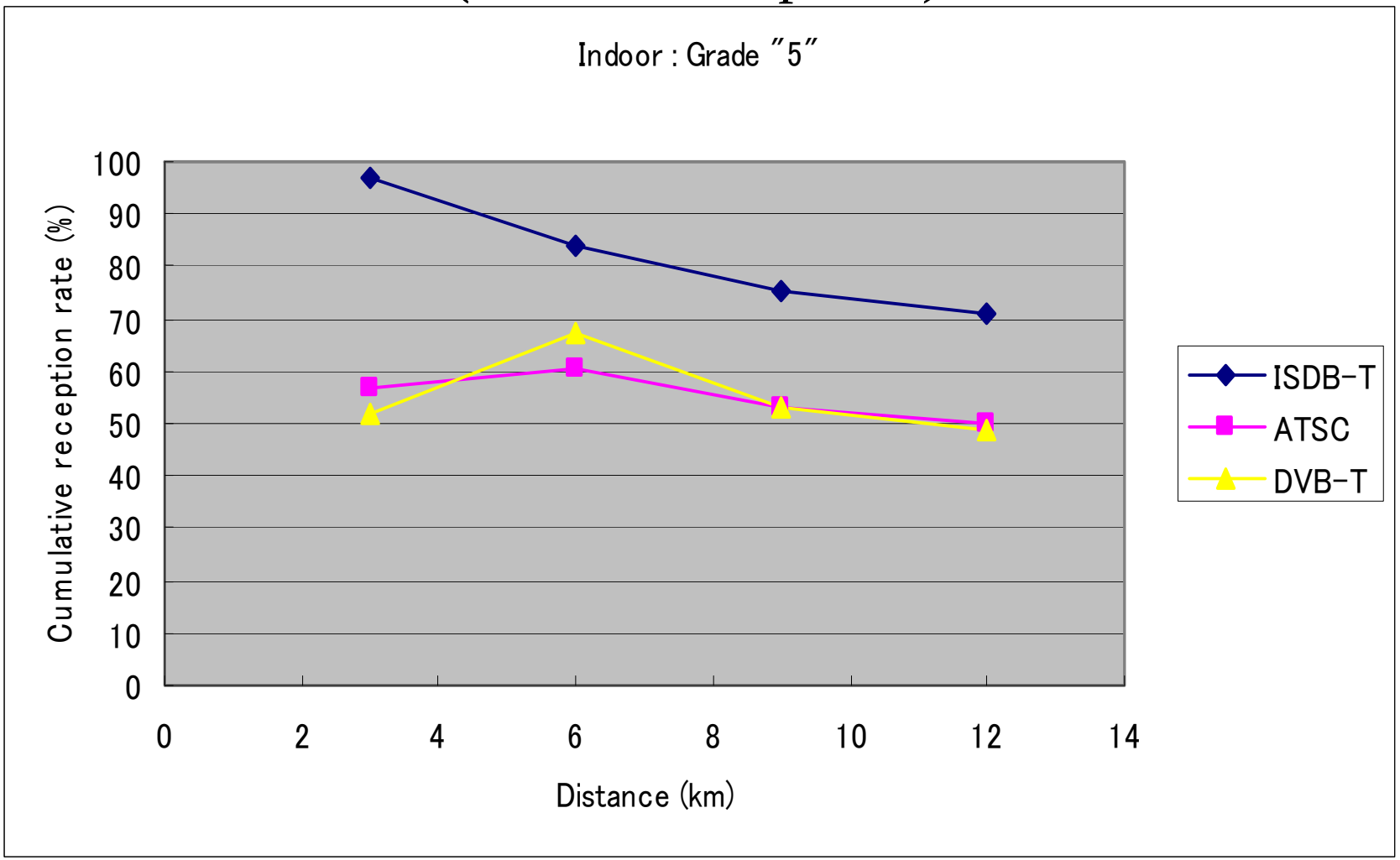
- Chile had a comparison test in Santiago in 2007
- Following test system was used, to keep equality



(a) Common Power Amp. type

- Measure many points for reception performance
- Row data is disclosed on Internet site
- Next page shows the test results of “Indoor Reception”

The Comparison Test in Chile
(Indoor Reception)



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(3) Field Test in Peru in 2007-2008

- **Peru has started 3 DTTB comparison test from 2007 and are now testing**
- **Peru has various kinds of test to investigate/evaluate**
  - **Place: Lima (Capital city), Andes (Mountain area), Amazon(Flat area)**
  - **Reception style: Fixed(outdoor/indoor), mobile**
  - **Check under various kinds of interfarence**

Comparison Test is not finished now, but we will show some test result in Peru

Impulse noise in Digital TV

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Comparative Test result in Peru

Comparative Test result in Peru

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Comparative Test in Peru

Test site	Distance & Reception		Surroundings
	15km, Strong field strength, Inside the MTC building		Multi-path
ISDB-T	ISDB-T	DVB-T	ATSC
Yagi antenna Without booster	5	1	1
Impulse noise (1m)	3	/	/
Impulse noise (5m)	5	/	/
With booster	5	5	5
Impulse noise (1m)	3	1	3
Impulse noise (5m)	5	2+	5
In-door Antenna	5	5	5
Impulse noise (1m)	**3**	**2**	4
Impulse noise (5m)	**5**	**2+**	5

Note: 5: Excellent, 4: good , 3: fair, 2: poor, 1: bad, /: cannot be received

Comparative Test in Peru (Mobile)

Test site	Receiving antenna: Omni directional antenna TV signals: HDTV		
Route	ISDB-T	DVB-T	ATSC
A - B	5 (5)	3	1
B - C	1 (5)	1	1
C - D	3 (5)	1	1
D - E	4 (5)	1+	1
E - F	4 (5)	1+	1
F - A	5 (5)	3	1

Note: 5: Excellent, 4: good, 3:fair, 2: poor, 1: bad

( ) : Using a vehicle navigation TV (“STRADA” by Panasonic)

5. Summary(comparison of robustness)

Item	ATSC	DVB-T	ISDB-T
Robustness	Equalizer Poor	OFDM Normal	OFDM Time interleave Hierarchical transmission Excellent
/Artificial noise	Poor	Poor	Excellent
/Mobile	Non	Normal	Excellent
/Portable	Non (ATSC-M/H)	Non (DVB-H)	One-seg
/In-door antenna	Poor	Poor	Excellent

6. Conclusion

- Comparison test should be done in fair condition
  - **-Similar transmission parameter should be used**
- Comparison test should be done from various kind of view point
  - **- Reception style, Place, etc**
- Transmission system should be tested under various kind of interference
  - **-Static multi-path, Dynamic multi-path, Impulse noise, etc**

- **ISDB-T shows best results**

Thank you for your attention

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