

6.2.2.1.3 Summary of Test Results

Table A 42 - Summary of Test Results - Candidate A

use case		minimum technical specification			fulfillment
PL1	Enable side-by-side operation with existing ISDB-T systems in the same frequency bands, with minimum impact over existing network planning.	PL1.1.1	frequency band	174-216 MHz	fulfilled
		PL1.1.2		174-230 MHz	not verified
		PL1.1.3		470-698 MHz	fulfilled
		PL1.1.4		other frequency bands	not verified
		PL1.2.1	channel bandwidth	6 MHz	fulfilled
		PL1.2.2		7 MHz	not verified
		PL1.2.3		8 MHz	not verified
		PL1.2.4		other channel bandwidths	not verified
		PL1.3	co-channel PR (wanted: ISDB-T / unwanted: TV 3.0)	≤ 19 dB	fulfilled
PL1.4	adjacent-channel PR (wanted: ISDB-T / unwanted: TV 3.0)	≤ -36 dB	fulfilled		
PL2	Enable scalable broadcast network deployment (in terms of coverage and capacity), flexible frequency reuse with spatial content segmentation (reuse-1), and the most efficient spectrum use possible, targeting both fixed indoor and mobile (high-speed) outdoor reception.	PL2.1	MIMO	2x2	fulfilled
		PL2.2	multi-RF channel transmission	channel bonding - content is spread over two or more RF channels	fulfilled
		PL2.3	high-speed reception	120 Km/h	partially fulfilled
		PL2.4	spectrum efficiency	bit/s/Hz @ C/N ≤ 0 dB in Rayleigh channel	0.81 bit/s/Hz 4.9 Mbps / 6 MHz (MIMO, single layer) @ C/N ≤ 0 dB ³ . 2.45 bit/s/Hz 3.5+11.2 Mbps / 6 MHz (MIMO, dual-layer) @ C/N ≤ 0 dB for main layer and C/N ≤ 16dB ³ .
		PL3	Provide "wake-up" capability for compatible receivers in case of an emergency warning.	PL3.1	"wake-up" capability
PL4	Enable future extensions to the physical layer (e.g., to support new modulation schemes).	PL4.1	extensibility	not verified	

Table A 1 - List of equipment provided by Advanced ISDB-T

Equipment	Quantity
Advanced Modulator - 0428A	2
Multiplexer - Mod. 0416A - 003	2
Impulsive Noise Generator / Up Converter Eiden - Mod. 1908-00	2
Demodulator Socionext - SC1502A-B03	2
GOP Generator - NS-G8600	1
BER Packet Analyzer - 7709C	1
RF MIMO Capturer & Player - 4422A	1
Notebook PC, Dell Latitude 3500	1
Audio Analyser SP105-12G-32	1
MMT / TLV Station	1
Channel Bond Combiner OTH001 - TX Station Side	1
Channel Bond Divider OTH001 - TX Station Side	1
Decoder 4K XJive MMT02R	1
Encoder 2K/4K - NEC MF4400 /YE-9300	1
BlackBox GbE Switch LGB2126A	1
Master Clock - 5601 MSC	2
Various cables, Coaxial Attenuators and RF Combiner/Divide	Set

Table A 2 - Single Layer MIMO 2x2 Configurations

Parameter	Config 1	Config 5	Config 10	Config 11
	Layer A (LA)	LA	LA	LA
Bandwidth	6 MHz	6 MHz	6 MHz	6 MHz
Useful Bandwidth	5.831 MHz	5.831 MHz	5.831 MHz	5.831 MHz
Modulation	QPSK	QPSK	256QAM	256QAM
Constellation	UC	UC	NUC	NUC
Error Correction	LDPC+BCH	LDPC+BCH	LDPC+BCH	LDPC+BCH
FEC	3/16	4/16	10/16	8/16
IFFT Size	16384	16384	16384	16384
GI Ratio	800/16384 (126 μs)	800/16384 (126 μs)	800/16384 (126 μs)	800/16384 (126 μs)
Dx	6	6	6	6
Dy	2	2	4	4
Time Interleaver	l = 3	l = 3	l = 3	l = 3
Number of Segments	35	35	35	35
Bit Rate (Mbps)	3.64	4.88	51.52	41.02

Table A 3 - Dual Layer MIMO 2x2 Configurations

Parameter	Config 2		Config 9	
	LA	Layer B (LB)	LA	LB
Bandwidth	6 MHz		6 MHz	
Useful Bandwidth	5.831 MHz		5.831 MHz	
Modulation	QPSK	256QAM	QPSK	256QAM
Constellation	UC	NUC	UC	NUC
Error Correction	LDPC+BCH	LDPC+BCH	LDPC+BCH	LDPC+BCH
FEC	3/16	12/16	4/16	8/16
IFFT Size	16384	16384	16384	16384
GI Ratio	800/16384 (126 μs)	800/16384 (126 μs)	800/16384 (126 μs)	800/16384 (126 μs)
Dx	6	6	6	6
Dy	2	2	2	2
Time Interleaver	l = 3	l = 3	l = 3	l = 3
Number of Segments	19	16	25	10
Bit Rate (Mbps)	1.98	27.01	3.48	11.23

³ Configuration 1 was used for single layer and configuration 9 for dual layer.

6.3.2.1.3 Summary of Tests Results

Table B 39 - Summary of Test Results - Candidate B

use case		minimum technical specification			fulfillment	
PL1	Enable side-by-side operation with existing ISDB-T systems in the same frequency bands, with minimum impact over existing network planning.	PL1.1.1	frequency band	174-216 MHz	not verified	
		PL1.1.2		174-230 MHz	not verified	
		PL1.1.3		470-698 MHz	fulfilled	
		PL1.1.4		other frequency bands	not verified	
		PL1.2.1	channel bandwidth	6 MHz	fulfilled	
		PL1.2.2		7 MHz	not verified	
		PL1.2.3		8 MHz	not verified	
		PL1.2.4		other channel bandwidths	not verified	
		PL1.3	co-channel PR (wanted: ISDB-T / unwanted: TV 3.0)	≤ 19 dB	fulfilled ⁶	
PL1.4	adjacent-channel PR (wanted: ISDB-T / unwanted: TV 3.0)	≤ -36 dB	fulfilled ⁶			
PL2	Enable scalable broadcast network deployment (in terms of coverage and capacity), flexible frequency reuse with spatial content segmentation (reuse-1), and the most efficient spectrum use possible, targeting both fixed indoor and mobile (high-speed) outdoor reception.	PL2.1	MIMO	2x2	fulfilled	
		PL2.2	multi-RF channel transmission	channel bonding - content is spread over two or more RF channels	fulfilled	
		PL2.3	high-speed reception	120 Km/h	partially fulfilled	
		PL2.4	spectrum efficiency	bit/s/Hz @ C/N ≤ 0 dB in Rayleigh channel	0.88 bit/s/Hz 5.3 Mbps / 6 MHz (MIMO, single layer) @ C/N ≤ 0 dB ⁷ . 4.0 bit/s/Hz 5.3+18.8 Mbps / 6 MHz (MIMO, dual-layer) @ C/N ≤ 0 dB for main layer and C/N ≤ 16dB for secondary layer ⁷ .	
PL3	Provide "wake-up" capability for compatible receivers in case of an emergency warning.	PL3.1	"wake-up" capability			not verified
PL4	Enable future extensions to the physical layer (e.g., to support new modulation schemes).	PL4.1	extensibility			not verified

Table B 1 - List of equipment provided by ATSC

Equipment	Quantity
ATSC 3.0 Modulator Channel Bounding CLA3-CB1000T	1
ATSC 3.0 Demodulator Channel Bounding CLA3-CB1000R	1
ATSC 3.0 Modulator MIMO CLA3-MM1000T	2
ATSC 3.0 Demodulator MIMO CLA3-MM1000R	2
CLA3-MM1000T cables and adapters (2x USB + AC + ETH + power adapter + USB adapter to 4 pins + 4 pins cable)	Set
CLA3-MM1000R Cables and Adapters (2x USB + AC + ETH + USB adapter for RS232 + 4 pin adapter)	Set

Table B 2 - Single Layer MIMO 2x2 Configurations

Parameter	Config 1	Config 3
	Core Layer (CL)	CL
Bandwidth	6 MHz	6 MHz
Useful Bandwidth	5.831 MHz	5.831 MHz
Modulation	QPSK	QPSK
Constellation	UC	UC
FEC	LDPC (3/15) 64800 + BCH	LDPC (4/15) 64800 + BCH
IFFT Size	16K	16K
GI Ratio	4 768 (111µs)	4 768 (111µs)
Pilot Pattern	MP8_2	MP8_2
Pilot Encoding	Walsh Hadamard (WP)	Walsh Hadamard (WP)
Num. of OFDM Symbols	98	98
Time Interleaver	CTI_1024	CTI_1024
Bit Rate (Mbps)	4.0	5.34

Table B 4 - Dual Layer MIMO 2x2 Configurations

Parameter	Config 2		Config 4		Config 5		Config 7	
	CL	Enhanced Layer (EL)	CL	EL	CL	EL	CL	EL
Bandwidth	6 MHz		6 MHz		6 MHz		6 MHz	
Useful Bandwidth	5.831 MHz		5.831 MHz		5.831 MHz		5.831 MHz	
Modulation	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Constellation	UC	NUC	UC	NUC	UC	NUC	UC	NUC
Injection Level	6 dB		6 dB		7 dB		10 dB	
FEC	LDPC (3/15) 64800 + BCH	LDPC (8/15) 64800 + BCH	LDPC (4/15) 64800 + BCH	LDPC (8/15) 64800 + BCH	LDPC (4/15) 64800 + BCH	LDPC (7/15) 64800 + BCH	LDPC (4/15) 64800 + BCH	LDPC (4/15) 64800 + BCH
IFFT Size	16K		16K		16K		16K	
GI Ratio	4 768 (111µs)		4 768 (111µs)		4 768 (111µs)		4 768 (111µs)	
Pilot Pattern	MP8_2		MP8_2		MP8_2		MP8_2	
Pilot Encoding	Walsh Hadamard (WP)		Walsh Hadamard (WP)		Walsh Hadamard (WP)		Walsh Hadamard (WP)	
Num. of OFDM Symbols	98		98		98		98	
Time Interleaver	CTI_1024		CTI_1024		CTI_1024		CTI_1024	
Bit Rate (Mbps)	4.0	20.1	5.34	20.1	5.34	18.82	5.34	10.7

⁶ Tested only using channel 30 (UHF).

⁷ Configuration 3 was used for single layer and configuration 5 for dual layer.

6.4.2.1.3 Summary of Test Results

Table C 30 - Summary of Test Results - Candidate C

use case		minimum technical specification			fulfillment
PL1	Enable side-by-side operation with existing ISDB-T systems in the same frequency bands, with minimum impact over existing network planning.	PL1.1.1	frequency band	174-216 MHz	not verified
		PL1.1.2		174-230 MHz	not verified
		PL1.1.3		470-698 MHz	partially fulfilled ⁹
		PL1.1.4		other frequency bands	not verified ⁹
		PL1.2.1	channel bandwidth	6 MHz	not fulfilled ⁹
		PL1.2.2		7 MHz	not fulfilled ⁹
		PL1.2.3		8 MHz	not fulfilled ⁹
		PL1.2.4		other channel bandwidths	fulfilled ⁹ 1.4, 3, 5, 10, 15, 20 MHz are defined in TS 36.101 Chapter 5.6.
		PL1.3	co-channel PR (wanted: ISDB-T / unwanted: TV 3.0)	≤ 19 dB	not verified ⁹
PL1.4	adjacent-channel PR (wanted: ISDB-T / unwanted: TV 3.0)	≤ 36 dB	not verified ⁹		
PL2	Enable scalable broadcast network deployment (in terms of coverage and capacity), flexible frequency reuse with spatial content segmentation (reuse-1), and the most efficient spectrum use possible, targeting both fixed indoor and mobile (high-speed) outdoor reception.	PL2.1	MIMO	2x2	fulfilled
		PL2.2	multi-RF channel transmission	channel bonding - content is spread over two or more RF channels	not fulfilled
		PL2.3	high-speed reception	120 Km/h	not verified
		PL2.4	spectrum efficiency	bit/s/Hz @ C/N ≤ 0 dB in Rayleigh channel	0.44 bit/s/Hz 2.6 Mbps / 6 Mbps (MIMO, single layer) @ C/N ≤ 0 dB ¹⁰ . 1.30 bit/s/Hz 1.4+6.5 Mbps / 6 MHz (MIMO, dual-layer) @ C/N ≤ 0 dB for main layer and C/N ≤ 16dB for secondary layer ¹⁰ .
PL3	Provide "wake-up" capability for compatible receivers in case of an emergency warning.	PL3.1	"wake-up" capability		not verified
PL4	Enable future extensions to the physical layer (e.g., to support new modulation schemes).	PL4.1	extensibility		not verified

Table C 1 - List of equipment provided by 5G Broadcast consortium

Equipment	Quantity
TCE901 Exciter	4
8 Port Switch	1
Server Switch	1
BSCC	1
Qualcomm Reference Design Mobile unit	2
GPS Antenna	1
SDE900	4
Cabling	1
Notebook with R&S Romes app	1

Table C 2 - Main configuration for 5G Broadcasting Evaluation

Parameter	Config	Config 2	Config 3		Config 4		Config 5	
			MCH1	MCH2	MCH1	MCH2	MCH1	MCH2
Bandwidth (ch/occ) (MHz)	10/9	10/9	10/9	10/9	10/9	10/9	10/9	10/9
Cyclic Prefix (us)	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7
Sub-Carriers for 15 kHz carrier spacing	601	601	601	601	601	601	601	601
MCS	MCS4	MCS5	MCS4	MCS15	MCS5	MCS22	MCS2	MCS22
Modulation	QPSK	QPSK	QPSK	16QAM	QPSK	64QAM	QPSK	64QAM
Turbo Code Rate	0.285	0.351	0.285	0.612	0.351	0.604	0.097	0.604
sAllocEnd	191	191	100	91 (19)	100	91 (191)	100	91 (191)
Signaling	MCS2	MCS2	MCS2	MCS2	MCS2	MCS2	MCS2	MCS2
Bit Rate (Mbps)	2.1587	2.614	1.128	4.298	1.366	6.453	0.692	6.453

⁹ Submitted equipment was compliant with Release 12 of the standard, operating only using signal bandwidth of 10 MHz at center frequencies equal to 622 or 632 MHz.

¹⁰ Configuration 2 was used for single layer and configuration 4 for dual layer.