CMA STATUS OF IMPLEMENTATION OF CGMS BEST PRACTICES IN SUPPORT TO LOCAL AND REGIONAL PROCESSING OF LEO DIRECT BROADCAST DATA

Presented to CGMS-51 CGMS-51-CMA-WP-01

Coordination Group for Meteorological Satellites

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STATUS OF OPERATIONAL DIRECT BROADCAST SYSTEMS

Instruments	FY3C	FY3D	FY3E
MERSI	Retired	Operational	Operational
MWRI	Retired	Operational	N/A
MWHS	Operational	Operational	Operational
MWTS	Retired	Operational	Operational
IRAS	Retired	N/A	N/A
HIRAS	N/A	Operational	Operational
GNOS	Operational	Operational	Operational

Executive summary of the WP

- ✓ BP.01 Global Specification for Direct Broadcast
- ✓ BP.02 Timely provision of Space-to-Ground Interface Control Documents
- ✓ BP.03 Provision of Current Orbit Information
- ✓ BP.04 Provision and maintenance of Product Processing software packages
- ✓ BP.05 Provision of auxiliary data for instrument product processing
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BP.01 Global Specification for Direct Broadcast

Operators should implement the agreed CGMS Direct Broadcast Services: LRPT/AHRPT Global Specification (Document No. CGMS 04)：
https://www.cgms-info.org/documents/Direct_Broadcast_Services__LRPT_AHRPT_Global_Specification,_Issue_2_01.pdf
In the document, application process layer， packetsaction layer， transfer frame layer， channel coding layer， Physical layer and their format and coding are defined.

FY3D：

✓ Compliant.

FY3E：

✓ Compliant.

BP.02 Timely provision of Space-to-Ground Interface Control Documents

CGMS operators should provide up-to-date and satellite-specific Space-to-Ground Interface Control Documents in English language at least 3 years before the launch of each satellite.

FY3D：
NSMC/CMA maintains a website to provide the space-to-ground interface control documents. The document now has been publicly released at the website http://satellite.nsmc.org.cn/PortalSite/StaticContent/DocumentDownload.aspx?TypeID=14&currentculture=en-US. Or directly download from http://satellite.nsmc.org.cn/PortalSite/StaticContent/FileDownload.aspx?CategoryID=1&LinkID=447.

FY3E：
Compliant, Space-to-Ground Interface details is publicly released at: http://satellite.nsmc.org.cn/PortalSite/StaticContent/DocumentDownload.aspx?TypeID=14

BP.02 Timely provision of Space-to-Ground Interface Control Documents

Space-to-Ground Interface Control Documents can be directly downloaded at website.

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BP.03 Provision of Current Orbit Information

CGMS operators should ensure timely provision of accurate and up-to-date orbit information based on their operational orbit determination and knowledge of satellite manoeuvres.

FY3D、FY3E：

Compliant. The TLE for Fengyun satellites are provided on the website **http://satellite.nsmc.org.cn/PortalSite/Satellite/Satelliteinfo.aspx?satellitetype=0&usedtype=twoline#**

BP.04 Provision and maintenance of Product Processing software packages

CGMS Operators should provide software processing package.

a) Software packages for the relevant instruments are made available with a test version made available prior to launch and the operational version made available after end of commissioning of the satellite and as soon as feasible for the satellite operator;

b) To enable deployment of the software packages within organisations not permitting installation of pre-compiled software, source code should be made available;

c) Global and local product processing shall be harmonised in that brightness temperature products derived from both paths agree within tolerances that are not greater than few tenths (goal is 10%) of the respective performance requirements for bias error at a reference brightness temperature;

d) User support and maintenance services are available for the duration of the mission;

e) Notifications for software changes are provided to the user community;

f) Complete and comprehensive user documentation and S/W release documentation is supplied in English language;

g) The software installation procedure is designed to be easily executed by an untrained user;

h) The software package is executable on a standard computer platform, typically Linux/x86-64, providing a performance compatible with the timeliness requirements defined in the Guide to DBNet (CGMS-44-WMO-WP-10);

i) For reasons of performance, it should be possible to configure the software to process only the instruments and processing levels required locally;

j) Test data for verifying the installation of the S/W packages are made available.

BP.04 Provision and maintenance of Product Processing software packages

FY3D:

✓ Partially compliant. The Direct Broadcasting software packages are required by application. Download the FY-3 pre-processing software packages application form through the website http://satellite.nsmc.org.cn/PortalSite/StaticContent/DocumentDownload.aspx?TypeID=8

Complete the form and send it to the E-mail listed to acquire a FTP account. The SW has provided the L0 to L1 pre-processing for MERSI-Ⅱ, MWTS-Ⅱ, MWHS-Ⅱ, MWRI, and HIRAS.

FY3E:

✓ Partially compliant. FY3E's software packages is provided together with FY3D's. The SW has provided the L0 to L1 pre-processing for MERSI-LL, MWTS-Ⅲ, MWHS-Ⅱ, and HIRAS-Ⅱ.

Satellite	Release time	Notes
FY3D	Jun. 15, 2022	update
	Sep. 29, 2022	update
	Mar. 01 2023	update
FY3E	Dec. 05 2022	First release
	Mar. 01 2023	update

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BP.04 Provision and maintenance of Product Processing software packages

Software packages update details:

Satellite	Release time	Notes
FY3D	Jun. 15, 2022	MWRI, Updated An additional module for hot load reflector temperature correction was added in FY-3D/MWRI pre-processing software.
	Sep. 29, 2022	MWRI, Updated fy3dl1db/bin/mipq_F3D: modified L1 SDS QA/QA_Scan_Flag (ushort: bit0~15), bit3 = 1: bad cold space data.
	Mar. 01 2023	MWTS, Updated fy3dl1db/bin/mtpq_F3D: Update the smoothing algorithm: change it from 20 lines after to 10 lines before and 10 after.
FY3E	Dec. 05 2022	First release
	Mar. 01 2023	Update, 1. Modify and update the code related to the MERSI-LL L0 processing program. The software can successfully generate MERSI-LL L0 data. 2. Modify the HIRAS preprocessing code and expand the memory space of the corresponding log variables.

BP.05 Provision of auxiliary data for instrument product processing

Each operator of instruments requiring auxiliary data for the product processing must make available the necessary auxiliary data on the Internet in a user-friendly and timely manner. Announcements of the availability of new auxiliary data should be issued giving the Direct Broadcast reception station operators sufficient time to update their systems.

FY3D：

✓ The auxiliary data is provided together with the software packages by FTP.

FY3E：

✓ The auxiliary data is provided together with the software packages by FTP.

BP.06 Recommendations of channel selection for hyperspectral instruments

Each CGMS operator of hyperspectral instrument is responsible for defining a recommended channel selection scheme for global NWP purposes. The channel selection shall be made available to DB station operators prior to the launch of the first instrument and subsequently whenever the channel selection is modified.

FY3D：

- ✓ Compliant. All the FY-3D/HIRAS geo-located and calibrated radiances are processed and delivered. The recommendation for channel selection has attached on the working paper.

FY3E：

- ✓ To be compliant. Will be provided after the assessment of FY3E HIRAS channels in May.

BP.06 Recommendations of channel selection for hyperspectral instruments

The recommendation for channels of FY3D HIRAS

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31
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BP.07 Spacecraft and Instrument Operational Status

Each CGMS operator to publish and maintain up to date spacecraft and instrument operational status information on the Internet. The CGMS operators should establish a scheme to review on a regular basis that the published status information is up to date.

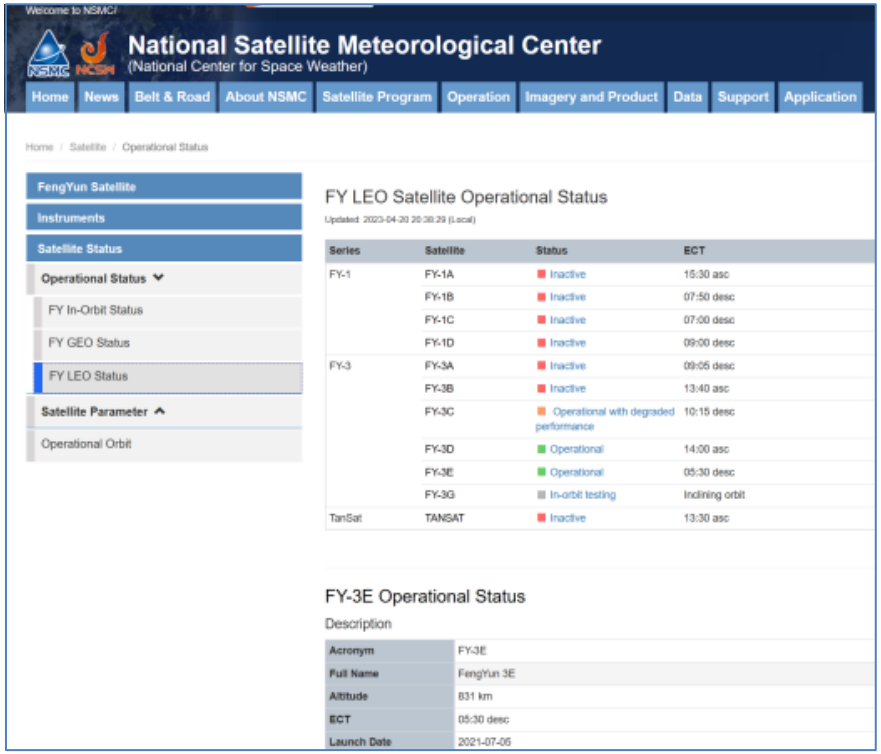
FY3D：

✓ Compliant, NSMC/CMA has maintained a website to provide the basic operational status for the spacecraft and instrument. The information is accessible from：
http://www.nsmc.org.cn/nsmc/en/operation/status.html#FY-LEO.

FY3E：

✓ Compliant, provided on
http://www.nsmc.org.cn/nsmc/en/operation/status.html#FY-LEO.

BP.07 Spacecraft and Instrument Operational Status



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FY LEO Satellite Operational Status

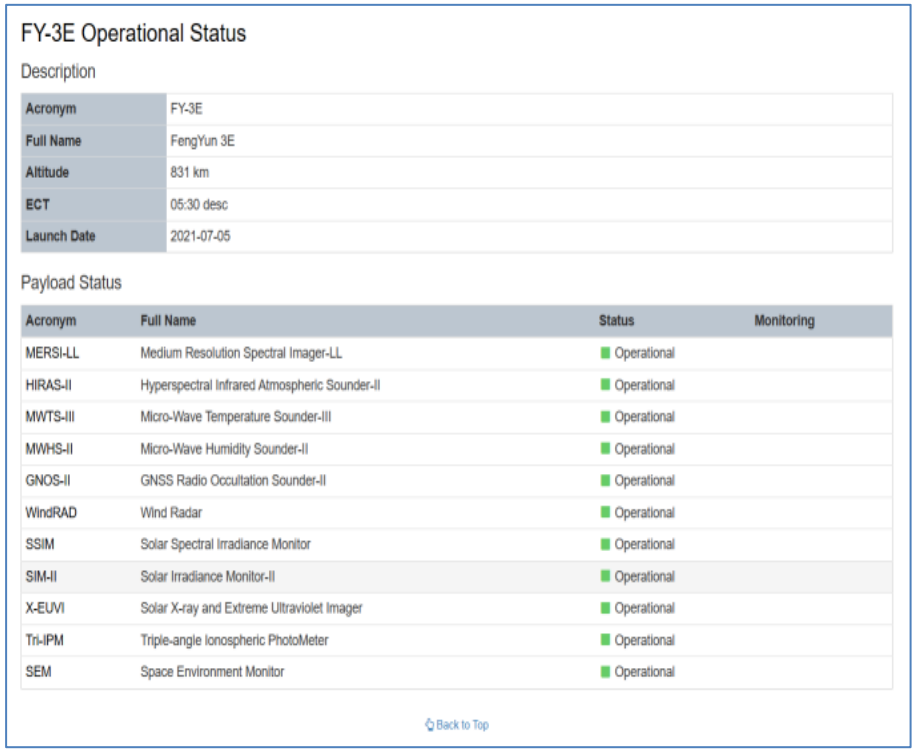
Updated: 2023-04-20 20:38:29 (Local)

Series	Satellite	Status	ECT
FY-1	FY-1A	Inactive	15:30 asc
	FY-1B	Inactive	07:50 desc
	FY-1C	Inactive	07:00 desc
	FY-1D	Inactive	09:00 desc
FY-3	FY-3A	Inactive	09:05 desc
	FY-3B	Inactive	13:40 asc
	FY-3C	Operational with degraded performance	10:15 desc
	FY-3D	Operational	14:00 asc
	FY-3E	Operational	05:30 desc
	FY-3G	In-orbit testing	Inclining orbit
TanSat	TANSAT	Inactive	13:30 asc

FY-3E Operational Status

Description

Acronym	FY-3E
Full Name	FengYun 3E
Altitude	831 km
ECT	05:30 desc
Launch Date	2021-07-05



FY-3E Operational Status

Description

Acronym	FY-3E
Full Name	FengYun 3E
Altitude	831 km
ECT	05:30 desc
Launch Date	2021-07-05

Payload Status

Acronym	Full Name	Status	Monitoring
MERSI-LL	Medium Resolution Spectral Imager-LL	Operational	
HIRAS-II	Hyperspectral Infrared Atmospheric Sounder-II	Operational	
MWTS-III	Micro-Wave Temperature Sounder-III	Operational	
MWHS-II	Micro-Wave Humidity Sounder-II	Operational	
GNOS-II	GNSS Radio Occultation Sounder-II	Operational	
WindRAD	Wind Radar	Operational	
SSIM	Solar Spectral Irradiance Monitor	Operational	
SIM-II	Solar Irradiance Monitor-II	Operational	
X-EUVI	Solar X-ray and Extreme Ultraviolet Imager	Operational	
Tri-IPM	Triple-angle Ionospheric PhotoMeter	Operational	
SEM	Space Environment Monitor	Operational	

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BP.08 Operational Announcements

Each CGMS operator to announce planned operations and status changes as well as any observed degradation of the spacecraft and its instruments via e-mail and optionally via other channels

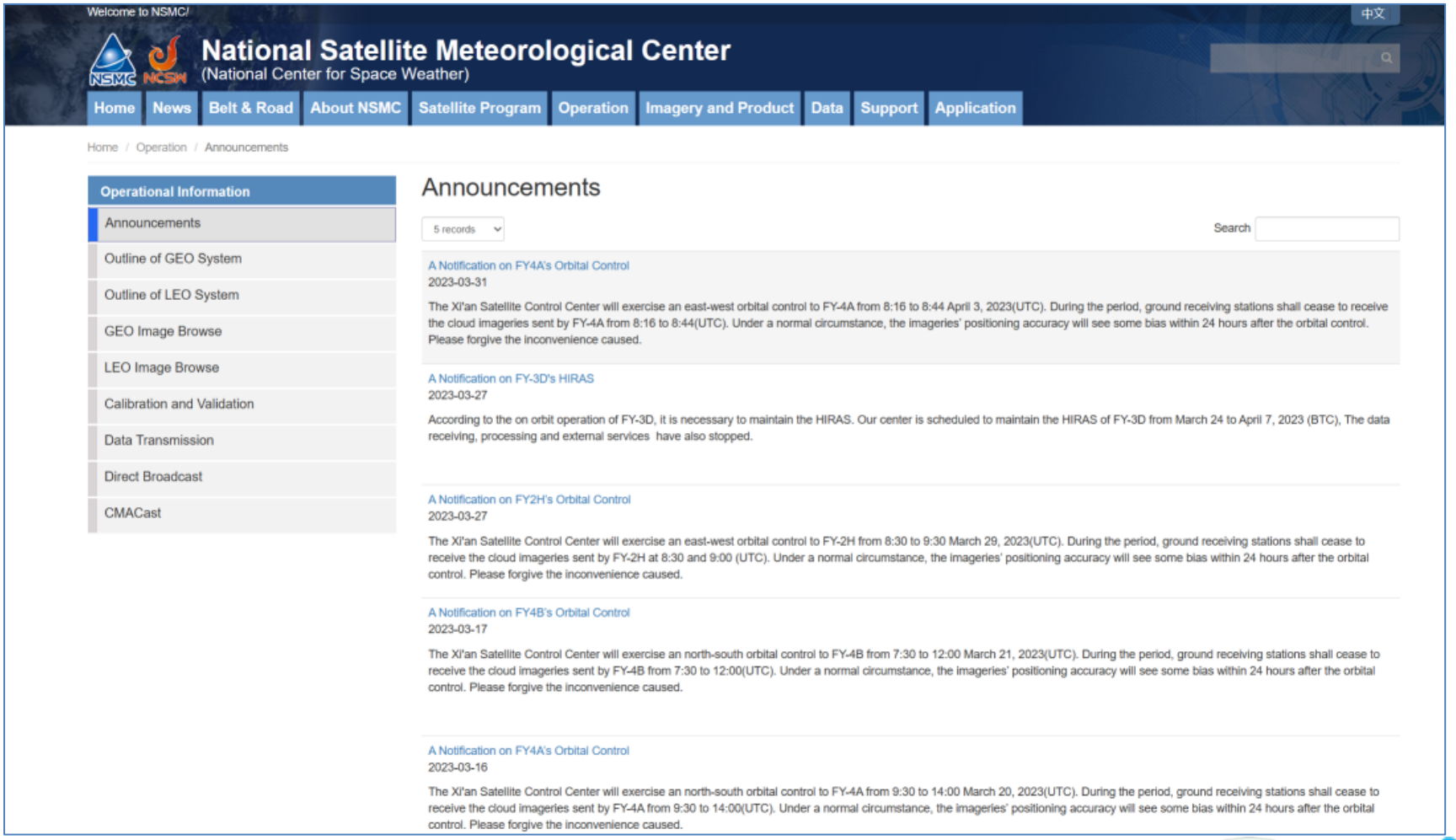
FY3D：

✓ Compliant, provided on
http://www.nsmc.org.cn/nsmc/en/news/index.html

FY3E：

✓ Compliant, provided on
http://www.nsmc.org.cn/nsmc/en/news/index.html

BP.08 Operational Announcements



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A Notification on FY4A's Orbital Control
2023-03-31
The Xi'an Satellite Control Center will exercise an east-west orbital control to FY-4A from 8:16 to 8:44 April 3, 2023(UTC). During the period, ground receiving stations shall cease to receive the cloud imageries sent by FY-4A from 8:16 to 8:44(UTC). Under a normal circumstance, the imageries' positioning accuracy will see some bias within 24 hours after the orbital control. Please forgive the inconvenience caused.

A Notification on FY-3D's HIRAS
2023-03-27
According to the on orbit operation of FY-3D, it is necessary to maintain the HIRAS. Our center is scheduled to maintain the HIRAS of FY-3D from March 24 to April 7, 2023 (BTC), The data receiving, processing and external services have also stopped.

A Notification on FY2H's Orbital Control
2023-03-27
The Xi'an Satellite Control Center will exercise an east-west orbital control to FY-2H from 8:30 to 9:30 March 29, 2023(UTC). During the period, ground receiving stations shall cease to receive the cloud imageries sent by FY-2H at 8:30 and 9:00 (UTC). Under a normal circumstance, the imageries' positioning accuracy will see some bias within 24 hours after the orbital control. Please forgive the inconvenience caused.

A Notification on FY4B's Orbital Control
2023-03-17
The Xi'an Satellite Control Center will exercise an north-south orbital control to FY-4B from 7:30 to 12:00 March 21, 2023(UTC). During the period, ground receiving stations shall cease to receive the cloud imageries sent by FY-4B from 7:30 to 12:00(UTC). Under a normal circumstance, the imageries' positioning accuracy will see some bias within 24 hours after the orbital control. Please forgive the inconvenience caused.

A Notification on FY4A's Orbital Control
2023-03-16
The Xi'an Satellite Control Center will exercise an north-south orbital control to FY-4A from 9:30 to 14:00 March 20, 2023(UTC). During the period, ground receiving stations shall cease to receive the cloud imageries sent by FY-4A from 9:30 to 14:00(UTC). Under a normal circumstance, the imageries' positioning accuracy will see some bias within 24 hours after the orbital control. Please forgive the inconvenience caused.

BP.09 Satellite Direct Broadcast and Reception Station Performance Requirements

- When planning, designing, and developing satellite Direct Broadcast (DB) downlink capabilities, the CGMS agencies will strive to minimize, when possible, negative impacts on the DB community by communicating with manufacturers and users; coordinating with the other CGMS agencies; and considering these potential impacts during the CGMS agency's decision-making process.
- The performance of the satellite's DB X-Band (7.8 GHz, ITU MetSat Band) downlink should be sufficient for nominal data reception at any reception station within the satellite's footprint at elevations above 5 degrees and a G/T value of at least 21.20 dB/K. The calculation of the satellite DB performance shall include an allocation of at least 7.05 dB for reception station losses, rain and atmospheric losses, and link budget margin. The G/T is defined at the input of the IF receiver, at 5 degree antenna elevation and clear sky conditions.
- A reception station operator may be required to establish a reception station with additional performance margin to account for local conditions, including climate, RF interference or the impact of an antenna radome.

BP.09 Satellite Direct Broadcast and Reception Station Performance Requirements

FY3D：

Compliant, provided in the FY-3D space-to-ground interface document.
http://satellite.nsmc.org.cn/PortalSite/StaticContent/DocumentDownload.aspx?TypeID=14
See Appendix A for the link budget.

FY3E：

Compliant, provided in the FY-3E space-to-ground interface document.
http://satellite.nsmc.org.cn/PortalSite/StaticContent/DocumentDownload.aspx?TypeID=14
See Appendix B for the link budget. The Link Budget assumes a reception station G/T value of 22.7 dB/K as defined in BP.09. The reception station losses (a), (c), (d), (e) rain and atmospheric losses (b), and link budget margin (f) add up to 6.56 dB, giving a negative of 0.59 dB relative to the 7.05 dB defined in BP.09 and sufficient for nominal data reception at any reception station within the satellite's footprint at elevations above 5 degrees.

Appendix A Link Budget Table for FY3D Direct Broadcasting

FY-3D DB Link Budget			
Parameter	Unit	Design Value	Source
Frequency	GHz	7820	FY-3D Space to Ground ICD
Satellite EIRP	dBW	19.92	FY-3D Space to Ground ICD
Propagation Path Length	Km	2848.77	Alt=831 Km, Elev Angle=5°
Free Space Loss	dB	179.40	
Polarisation Loss (a)	dB	1.00	FY-3D Space to Ground ICD
Rain & Atmospheric Loss (b)	dB	4.50	FY-3D Space to Ground ICD
Multipath Loss (c)	dB	0.20	FY-3D Space to Ground ICD
Ground Antenna Pointing Loss (d)	dB	0.50	FY-3D Space to Ground ICD
Ground Station G/T	dB/K	22.70	FY-3D Space to Ground ICD antenna Diameter: 3M
Boltzmann's Constant	dBW/Hz-K	-228.60	
DATA CHANNEL (QPSK)			
Data Power/No	dBm/Hz	85.62	
Information Rate	dB-Hz	77.78	60 Mbps with Reed Solomon (255/223) + Convolutional rate 3/4
Available Eb/No	dB	7.84	FY-3D Space to Ground ICD
Required Eb/No for 10^{-6}FER	dB	6.4	FY-3D Space to Ground ICD
Implementation Loss (e)	dB	1.8	FY-3D Space to Ground ICD
Available Signal Margin (f)	dB	-0.36	The reception station losses (a), (c), (d), (e) rain and atmospheric losses (b), and link budget margin (f) add up to 6.46 dB, giving a positive margin of 0.59 dB relative to the 7.05 dB defined in BP.09 and sufficient for nominal data reception at any reception station within the satellite's footprint at elevations above 5 degrees.

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Appendix B Link Budget Table for FY3E Direct Broadcasting

Parameter	Unit	Design Value	Source
Frequency	MHz	7860	FY-3E Space to Ground ICD
Satellite EIRP	dBW	19.92	FY-3ESpace to Ground ICD
Propagation Path Length	Km	2846.00	Alt=831 Km, Elev Angle=5°
Free Space Loss	dB	179.50	
Polarisation Loss (a)	dB	1.00	FY-3E Space to Ground ICD
Rain & Atmospheric Loss (b)	dB	4.50	FY-3E Space to Ground ICD
Multipath Loss (c)	dB	0.20	FY-3E Space to Ground ICD
Ground Antenna Pointing Loss (d)	dB	0.50	FY-3E Space to Ground ICD
Ground Station G/T	dB/K	22.70	FY-3E Space to Ground ICD antenna Diameter: 3M
Boltzmann's Constant	dBW/Hz-K	-228.60	
DATA CHANNEL (QPSK)			
Data Power/No	dBm/Hz	85.52	
Information Rate	dB-Hz	78.86	77MHz, after Reed Solomon (255/223) + Convolutional rate 3/4
Available Eb/No	dB	6.66	FY-3E Space to Ground ICD
Required Eb/No for 10^{-6}FER	dB	6.4	FY-3E Space to Ground ICD
Implementation Loss (e)	dB	1.8	FY-3E Space to Ground ICD
Available Signal Margin (f)	dB	-1.54	The reception station losses (a), (c), (d), (e) rain and atmospheric losses (b), and link budget margin (f) add up to 6.46 dB, giving a negative of 0.59 dB relative to the 7.05 dB defined in BP.09 and sufficient for nominal data reception at any reception station within the satellite's footprint at elevations above 5 degrees.

BP.10 Monitoring of the Direct Broadcast Downlink

Operators of satellites with DB should routinely monitor the quality of the DB downlink and address any anomalies in accordance with each organization's established procedures, and notify users of degraded performance. Monitoring should include:

a) For each satellite, during the six months following DB signal activation, a validation that nominal reception is possible for a DB reception station anywhere within the footprint of the satellite DB antenna by acquiring all passes at an elevation of 5 degrees or more above the local horizon throughout a full satellite ground track repeat cycle. Nominal reception implies a positive link budget margin as well as the signal and data quality parameters defined under d) and e) below, being in their nominal range for a reception station corresponding to the minimum requirements of BP.09;

b) During at least one pass per day for each satellite, monitoring of the signal quality parameters and the data quality parameters, as defined under d) and e) below respectively, for the part of the pass which is at an elevation of 5 degrees or more above the local horizon;

c) During at least one pass per day for each satellite, monitoring of the data quality parameter degradation, attributable to frames or packets discarded or degraded on the spacecraft, prior to transmission to the ground;

Where

a) Signal quality parameters should include receive signal strength, signal to noise ratio, spectral power distribution, and carrier, bit and frame lock statistics; and

b) Data quality parameters should include discarded frames and packets (failing error free decoding/reconstruction), missing frames and packets (calculated from measured frame and packet sequence counters), bad lengths (frame or packet out of tolerance length), and sequence errors (frame or packet detected gaps/sequence error) per Virtual Channel Identifier (VCID) for frames and Application Process Identifier (APID) for packets.

BP.10 Monitoring of the Direct Broadcast Downlink

FY3D：

✓ partially compliant. Ground Stations in Jiamusi, Guangzhou and Urumqi use 12-meter antenna to receive FY3D MPT. Signal and data quality are monitored automatically.

FY3E：

✓ partially compliant. Ground Stations in Jiamusi, Guangzhou and Urumqi use 12-meter antenna to receive FY3E MPT. Signal and data quality are monitored automatically.

Thank you