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CENTRE NATIONAL D'ÉTUDES SPATIALES

SVOM

VHF GRB SEQUENCE

CNES

25/03/2026

GRB Sequence

T0: time of the first GRB localization by ECLAIRs with significance greater than the AlertThreshold

ECLAIRs provides the VHF l1e alert message including the GRB OBS Id and the GRB position in ECLAIRs reference frame to PDPU (max every 2 seconds up to the slew or time-out 8 minutes)

The PDPU transfers the l1e Alert message to the ground via the VHF link, and to the GRM for the management of the acquisition sequence.

ECLAIRs transmits light curves, alert descriptors and shadowgram or subImages to PDPU to be sent by VHF

GRM transmits light curves to PDPU to be sent by VHF

ECLAIRs generates a slew-request in the l1e alert message if an unknown excess is localized in an image with a significance greater than the SlewThreshold

If a slew is requested by ECLAIRs, and if the sun and moon avoidance angle are compliant, the PDPU sends a « slew request » to the platform with the GRB quaternion as pointing target (J2000 ref frame)

The platform checks the validity of the request (no slew in progress, power conditions, attitude …), and if the request is valid, it starts a slew towards the J2000 attitude provided in the request and informs the PDPU that the slew is starting.

Then a slew status is updated in AAV packet provided by the PDPU to the instruments to start GRB sequence.

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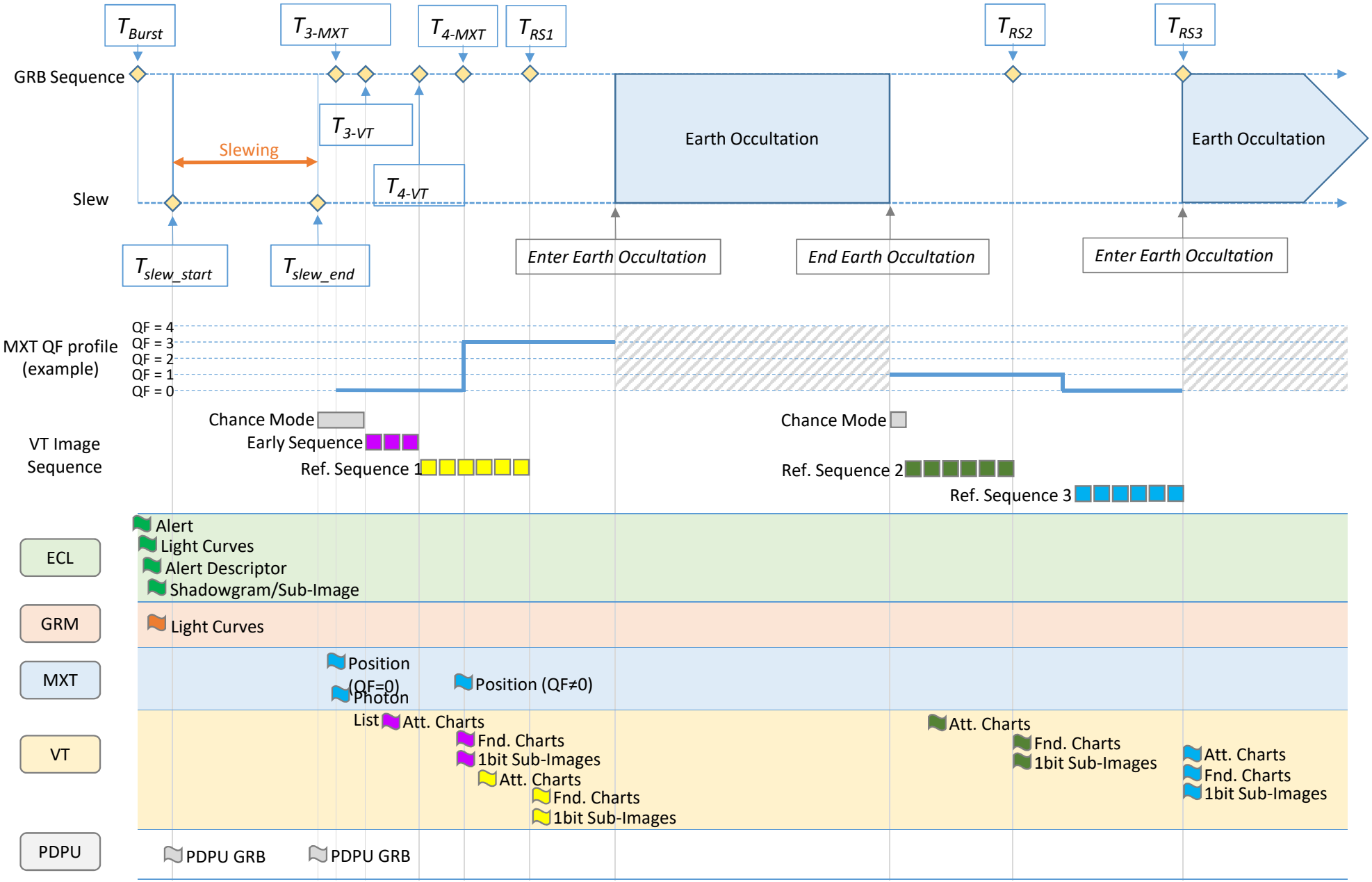
T_{Burst}
$T_{3\text{-}MXT}$
$T_{4\text{-}MXT}$
T_{RS1}
T_{RS2}
T_{RS3}
GRB Sequence
$T_{3\text{-}VT}$
Slewing
$T_{4\text{-}VT}$
Slew
Earth Occultation
Earth Occultation
T_{slew_start}
T_{slew_end}
Enter Earth Occultation
End Earth Occultation
Enter Earth Occultation
MXT QF profile (example)
QF = 4
QF = 3
QF = 2
QF = 1
QF = 0
VT Image Sequence
Chance Mode
Early Sequence
Ref. Sequence 1
Chance Mode
Ref. Sequence 2
Ref. Sequence 3
ECL
Alert
Light Curves
Alert Descriptor
Shadowgram/Sub-Image
GRM
Light Curves
MXT
Position (QF=0)
Photon List
Position (QF≠0)
VT
Att. Charts
Fnd. Charts
1bit Sub-Images
Att. Charts
Fnd. Charts
1bit Sub-Images
Att. Charts
Fnd. Charts
1bit Sub-Images
Att. Charts
Fnd. Charts
1bit Sub-Images
PDPU
PDPU GRB
PDPU GRB

GRB Sequence

Early localization sequence

T1: Start of the slew towards the GRB

- ECLAIRs disables the trigger process up to T2 (End of slew) and stops VHF l1e alert message emission
- VT enters chance mode (15 s exposure time / whole images)
- PDPU sends PDPU GRB packet

T2: End of slew

- ECLAIRs enables the trigger process (7)
- VT enters chance mode (15 s exposure time / whole images) when the stability status are satisfied
- MXT enters GRB localization process
- MXT provides to PDPU an MXT position packet (l2m) every 30s during 20 minutes and every 5 minutes up to 180 minutes after T2 to be sent to the ground by VHF. The localization is provided in MXT reference frame.
- MXT provides to PDPU an MXT photon list (10 packets with 18 photons each) to be sent to the ground by VHF
- PDPU sends PDPU GRB packet

T3-MXT: MXT stability is reached (managed by MXT)

-MXT will calculate the stability criteria from T2.T3-MXT is the first time when MXT consider that the MXT stability is reached, no valid localization provided before T3-MXT.

T3-VT: VT stability is reached (managed by PDPU using satellite attitude/AAV bulletin)

- VT enters early localization mode (50s exposure time/whole images)
- PDPU generates 2 Attitude charts (R and B) on the first 50s acquisition image (about 21 brightest objects in the whole VT image)

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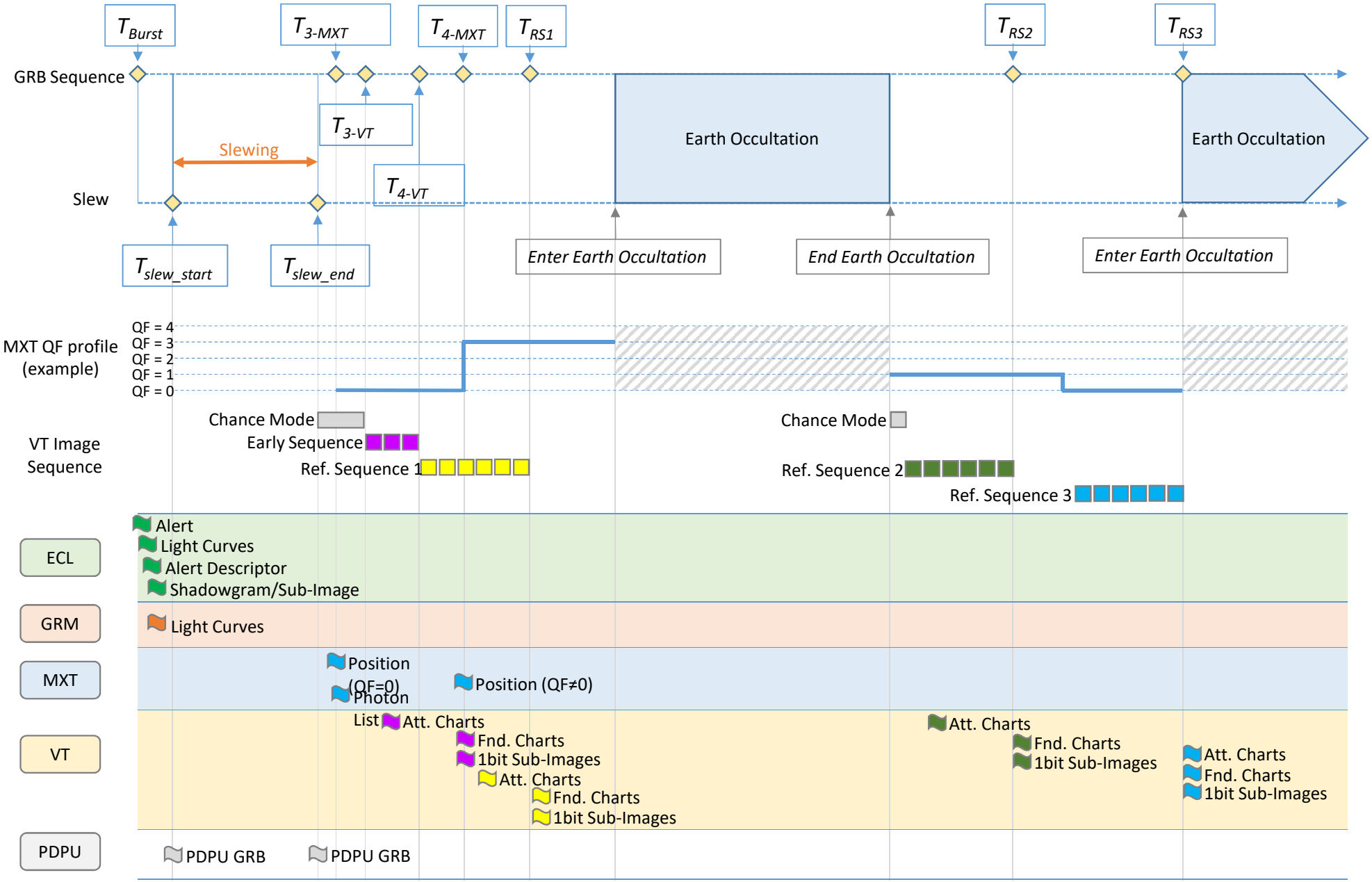
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Earth Occultation
T_{slew_start}
T_{slew_end}
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PDPU
PDPU GRB
PDPU GRB

GRB Sequence

T4-MXT : valid MXT localization is available (QF=1, 2, 3 or 4)

- the MXT position is used to define the location of the sub-window in the 3 VT's whole image

T4-VT: end of the VT early localization sequence

- 3 whole images with 50s exposure time that satisfy the image quality assessment requirements are taken

During all the observation, PDPU receives the l2m Messages, compares each QF, and records the message with maximum QF (1,2,3,4), meaning the best localization.

PDPU starts processing VT sub-image and uses this best MXT loc for the finding charts and sub images processing and to calculate target attitude for second slew,

If there is no l2m message with QF≥1 by the end of first orbit, then during second orbit observation, PDPU receives and checks the l2m Message, records the first one with QF≥1 (no second slew at first EO)

T4 : max [T4-MXT,T4-VT] valid MXT localization is available (QF=1, 2,3 or 4) and VT early localization sequence ends

- PDPU generates using 2 sub-window to be sent by VHF:

2 finding charts (Red, Blue)

2 Sub Image 1bit (Red, Blue)

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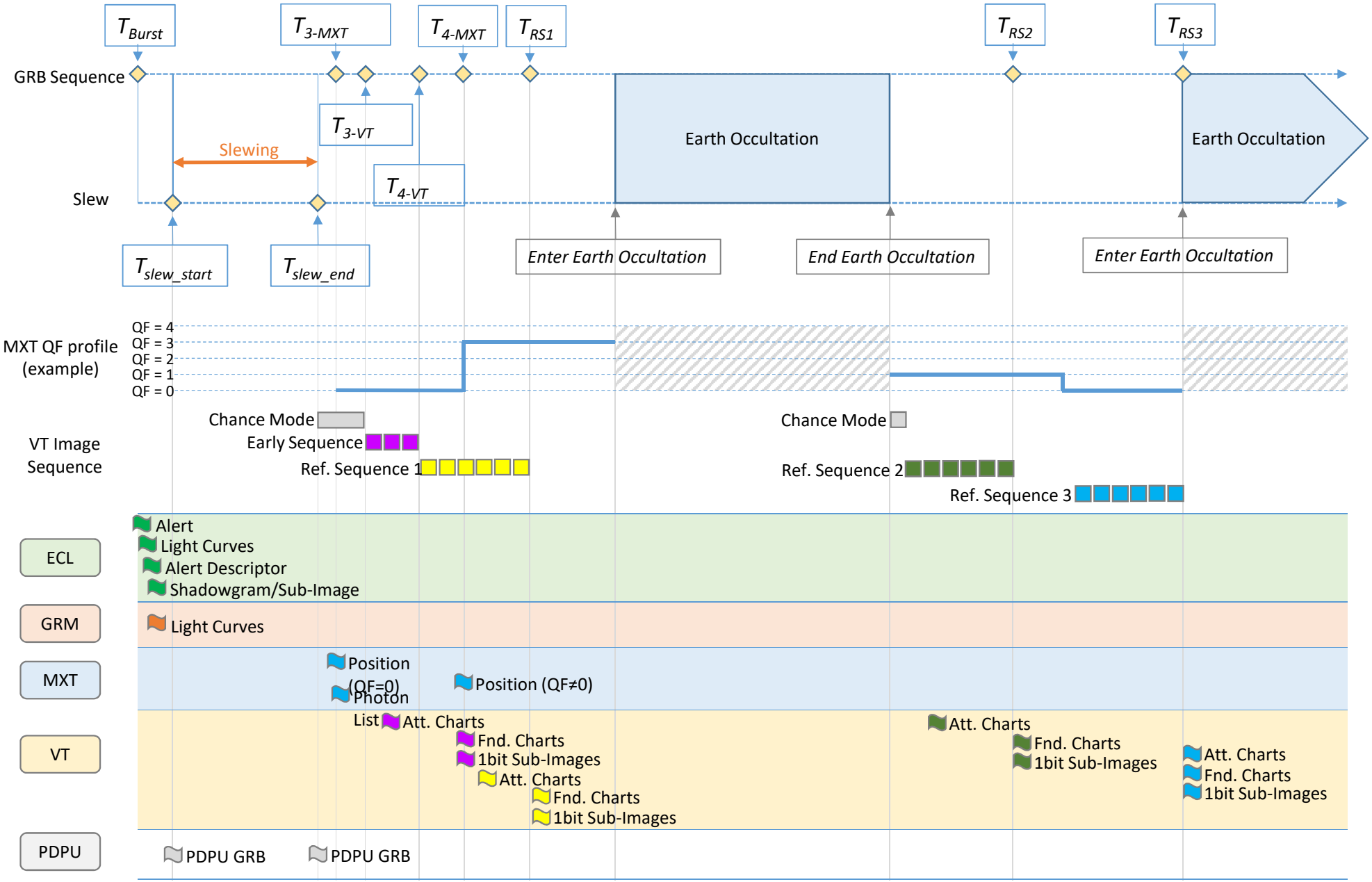
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$T_{4\text{-}MXT}$
T_{RS1}
T_{RS2}
T_{RS3}
GRB Sequence
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PDPU
PDPU GRB
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Refining sequences

T-RS1: end of VT first Refining Sequence

After the early localization sequence and when 2''/15s (3 sigma) stability is reached, VT takes the next six 50s exposure images after T4-VT, PDPU uses the recorded MXT localization (if available) and generates:

based on the first whole image: 2 Attitude charts (Red, Blue)

based on the master sub-image: 2 finding charts (Red, Blue) , 2 Sub Image 1bit (Red, Blue)

Second slew when entering first EO:

When entering first EO, the target attitude will be updated based on MXT localization recorded (if available), the goal is to put the burst in the center of VT, a minor attitude maneuver happens.

PDPU sends PDPU GRB packet at the start of the second slew.

T-RS2: end of VT second Refining Sequence

After exiting the first EO, when 2''/15s (3 sigma) stability is reached, VT takes the next six 50s exposure images, PDPU uses the recorded MXT localization (if available) and generates:

based on the first whole image: 2 Attitude charts (Red, Blue)

based on the master sub-image: 2 finding charts (Red, Blue) , 2 Sub Image 1bit (Red, Blue) (only if there is only one set of sub Image 1bit generated before T-RS2)

T-RS3: end of VT third Refining Sequence

When entering the second earth occultation, PDPU starts processing the last six 50s exposure images taken by VT, using the recorded MXT localization (if available) and PDPU generates:

based on the first whole image: 2 Attitude charts (Red, Blue)

based on the master sub-image: 2 finding charts (Red, Blue), 2 Sub Image 1bit (Red, Blue) (only if there is only one set of Sub Image 1bit generated before T-RS3)

End of the initial GRB localization sequence.

Second slew **when entering second EO:**

In case of no MXT localization received during the first orbit and MXT localization received during the second orbit, the second slew can be performed when entering the 2nd EO. The goal is still to put the burst in the center of MXT and VT for the GRB overall observation (14 orbits)

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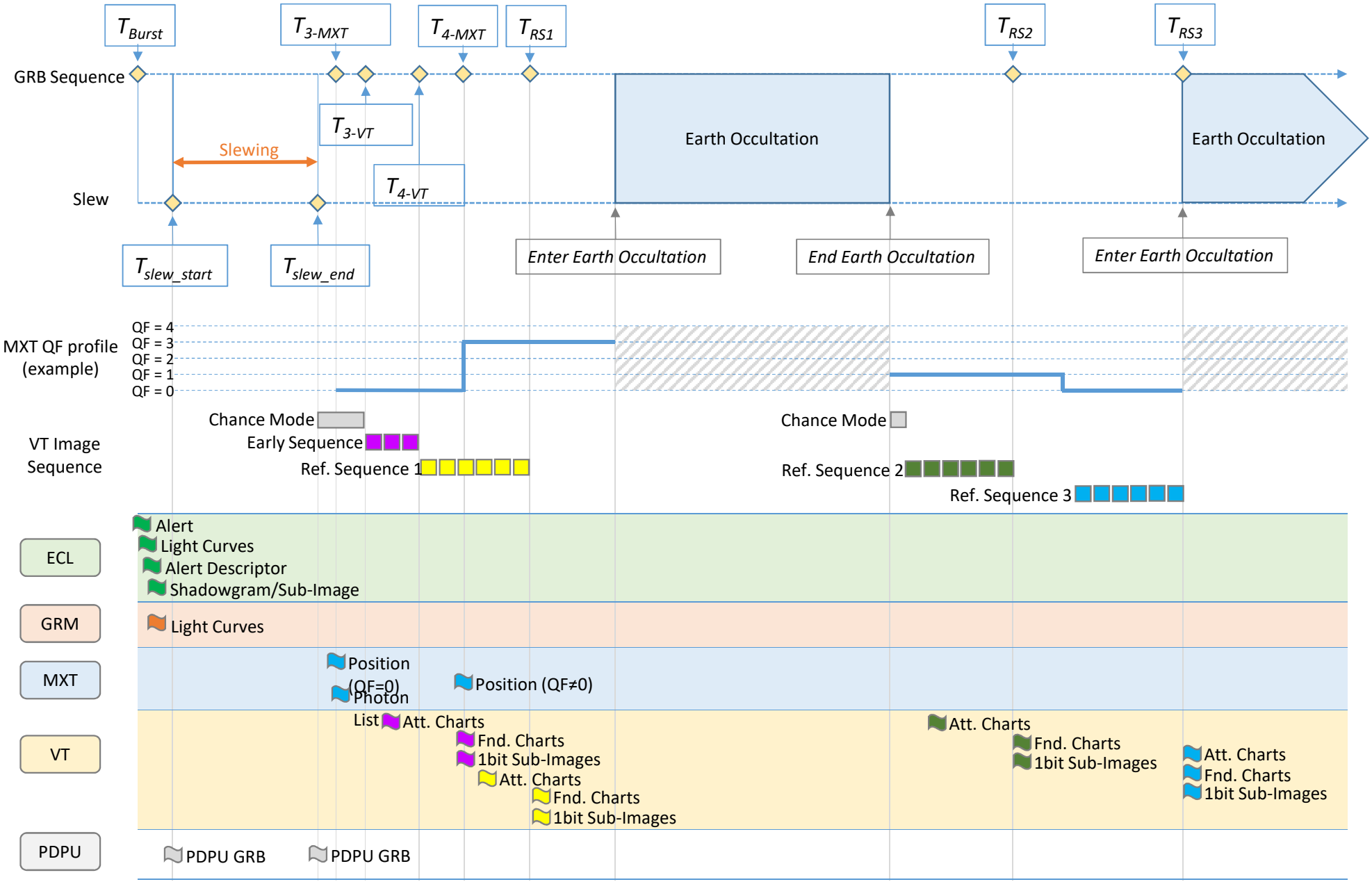
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$T_{4\text{-}MXT}$
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T_{RS2}
T_{RS3}
GRB Sequence
$T_{3\text{-}VT}$
Slewing
$T_{4\text{-}VT}$
Slew
Earth Occultation
Earth Occultation
T_{slew_start}
T_{slew_end}
Enter Earth Occultation
End Earth Occultation
Enter Earth Occultation
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QF = 4
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PDPU
PDPU GRB
PDPU GRB

Buffer Settings

message name	buffer priority	Priority difference vs pvs conf	size of message (pkts)	buffer type	buffer size (nb of mg)	buffer size (nb of pkts)	repetition number (after initial transmission)	repetition interval (s)	repetition period (s)	APID	label	Name in VHF database
ECLAIRs Trigger	1		1	2	1	1	0	300	900	0x0240	ECLALERTL1	ECL_TM_VHFALERT
MXT Position	2		1	3	1	1	3	480	0	0x0260	MXTPOSITIO	MXT_TM_VHFPOSITION
GRM General Trigger	3		1	3	2	2	4	300	0	0x0317	GRMALERT	GRM_TM_VHFGRDSPECTR
ECLAIRs Alert descriptor 1	4		1	3	2	2	7	300	0	0x0243	ECLALDESC1	ECL_TM_VHFALDESC1
VT attitude chart	5		6	3	4	24	3	480	0	0x0397	VTATTCHART	VT_TM_VHFATTCHART
VT finding chart R - 1st Seq.	6		250	3	1	250	3	480	0	0x0398	VTFCHARTR1	VT_TM_VHFFICHARTR1
VT finding chart B - 1st Seq.	7		250	3	1	250	3	480	0	0x0399	VTFCHARTB1	VT_TM_VHFFICHARTB1
MXT MM Photon Data	8		1	3	250	250	1	600	0	0x0263	MXTMMPHOTONS	MXT_TM_VHFPHOTONMM
VT ToO-MM	9		1	3	1	1	3	300	0	0x0394	VTTOOMM	VT_TM_VHFMM
MXT Photon List	10		10	3	2	20	3	480	0	0x0261	MXTPHOTONL	MXT_TM_VHFPHOTONL
GRM GRD Spectrum	11		3	3	2	6	4	300	0	0x0318	GRDTRIGGER	GRM_TM_VHFTRIGGER
PDPU GRB	12		1	3	2	2	3	480	0	0x0238	PDPUGRB	PDPU_TM_VHFGRB
ECLAIRs Recurrent 1	13		1	1	1	1	0	0	0	0x024A	ECLRECURR1	ECL_TM_VHFREC1
ECLAIRs Recurrent 2	14		1	1	1	1	0	0	0	0x024B	ECLRECURR2	ECL_TM_VHFREC2
ECLAIRs Alert descriptor 2	15		1	3	2	2	3	480	0	0x0244	ECLALDESC2	ECL_TM_VHFALDESC2
ECLAIRs Alert descriptor 3	16		1	3	2	2	3	480	0	0x0245	ECLALDESC3	ECL_TM_VHFALDESC3
ECLAIRs Alert descriptor 4	17		1	3	2	2	3	480	0	0x0246	ECLALDESC4	ECL_TM_VHFALDESC4
ECLAIRs Alert descriptor 5	18		1	3	2	2	3	480	0	0x0247	ECLALDESC5	ECL_TM_VHFALDESC5
PDPU Recurrent 1	19		1	1	1	1	0	0	0	0x0239	PDPURECURR1	PDPU_TM_VHFREC1
ECLAIRs Shadowgram	20		64	3	2	128	3	480	0	0x0249	ECLSHADOWG	ECL_TM_VHFSHADOWG
ECLAIRs Sub-image	21		49	3	2	98	3	480	0	0x0248	ECLSUBIMAG	ECL_TM_VHFSUBIMAGE
VT GRB	22		1	3	4	4	3	300	0	0x0393	VTGRB	VT_TM_VHFGRB
VT finding chart R - Next Seq.	23	↑4	250	3	2	500	3	480	0	0x039A	VTFCHARTR2	VT_TM_VHFFICHARTRN
VT finding chart B - Next Seq.	24	↑4	250	3	2	500	3	480	0	0x0395	VTFCHARTB2	VT_TM_VHFFICHARTBN
ECLAIRs High Priority Light curve	25		22	3	2	44	3	480	0	0x0241	ECLLCURHP1	ECL_TM_VHFHPLCURVE
GRM High Priority Light curve	26		22	3	2	44	3	480	0	0x0319	GRMLCURHIP	GRM_TM_VHFHPLCURVE
VT Sub-image R – 1st Seq.	27	↓4	300	3	1	300	3	480	0	0x039B	VTSUB1bALLR1	VT_TM_VHFSUBIM1BR1
VT Sub-image B – 1st Seq.	28	↓4	300	3	1	300	3	480	0	0x039D	VTSUB1bALLB1	VT_TM_VHFSUBIM1BB1
VT Sub-image R – Next Seq.	29		300	3	2	600	3	480	0	0x039C	VTSUB1bALLR2	VT_TM_VHFSUBIM1BRN
VT Sub-image B – Next Seq.	30		300	3	2	600	3	480	0	0x039E	VTSUB1bALLB2	VT_TM_VHFSUBIM1BBN
ECLAIRs Low Priority Light curve	31		42	3	2	84	3	480	0	0x0242	ECLLCURLP1	ECL_TM_VHFLPLCURVE
GRM Low Priority Light curve	32		42	3	2	84	3	480	0	0x031A	GRMLCURLOP	GRM_TM_VHFLPLCURVE
PDPU Recurrent 2	33		1	1	1	1	0	0	0	0x023A	PDPURECURR2	PDPU_TM_VHFREC2
GRM Recurrent 1	34		1	1	1	1	0	0	0	0x031B	GRMRECURR1	GRM_TM_VHFREC
MXT Recurrent 1	35		1	1	1	1	0	0	0	0x0264	MXTRECURR1	MXT_TM_VHFREC
VT Recurrent 1	36		1	1	1	1	0	0	0	0x039F	VTRECURR	VT_TM_VHFREC
MXT Photon Data	37		1	1	3	3	0	0	0	0x0262	MXTPHOTDATA	MXT_TM_VHFPHOTOND