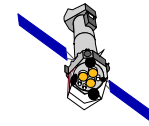


Flexible Timeline and Operations

J.Martin, XMM-Newton SOE



XMM-NEWTON BOC: 31 March 2009

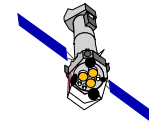


XMM

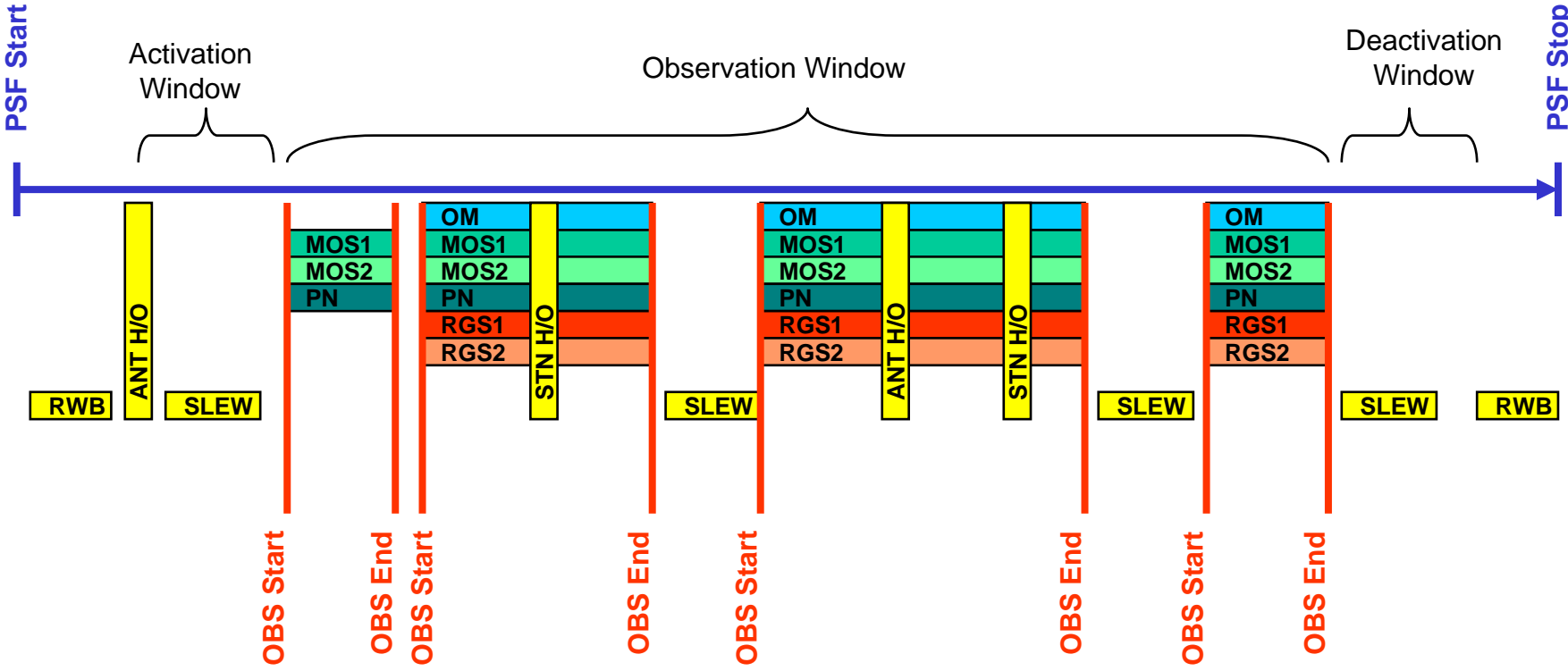
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Flexible Timeline - Introduction

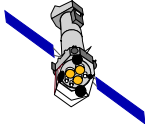
- **Flexible timeline – a tool that allows operator to “reschedule” an observation in the currently running timeline**
- **Only applies to the instrument timeline elements in the observation window**
- **Slews, Station Handovers, Antenna Handovers are unchanged**
- **Instrument timeline elements can be shifted forwards or backwards in time**
- **Shifts can be applied to all instruments or on individual instruments (although there are many constraints)**



Example Timeline



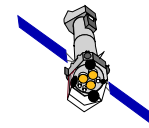
XMM-NEWTON BOC: 31 March 2009



XMM

Flexible Timeline - Terminology

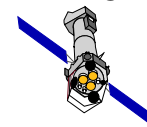
- **Forward Shift**
 - Start of observation is missed or interrupted (Radiation was still high, slew failure, ground station outage etc.)
 - Move the observation **forward** so that all commands for the observation will be executed at a **later time**. The end of the observation is fixed so a **cutoff area** is defined close to the observation end where originally scheduled commands are replaced with a **safe block** of commands to close off the observation and put the instruments safe.
 - Can be applied to **all or any combination of instruments** (subsystems 3,4,5,7,8 or 9)
- **Backward Shift**
 - Radiation low during first observation (Cal Closed)
 - Move the observation **backward** so that the **activation block** will be executed at an **earlier time**. The first exposure of the observation is stretched, the remainder of the commanding is unchanged.
 - Only makes sense if applied to **all instruments except OM** (subsystems 3,4,5,7 and 8)



Flexible Timeline vs Manual Rejoin

Flexible Timeline	Manual Rejoin
+ Formal parameters from mission planning maintained (filter wheel positions, exposure type etc)	- Manual selection of Super ED (EPICs) or manual cut-and-paste of commands from TC History (RGS)
+ Lower workload on operator. Once rescheduled the rejoin is automatic and requires no manual intervention	- High workload requiring 3 manual stacks executing in parallel. Requires constant operator interaction , sometimes to within seconds (OM rejoin)
- Risk of problems in functionality/operability – need validation	+ Proven procedures
- Risk of operator errors in use – need training	+ Current operators familiar with procedures – but how to train future operators?

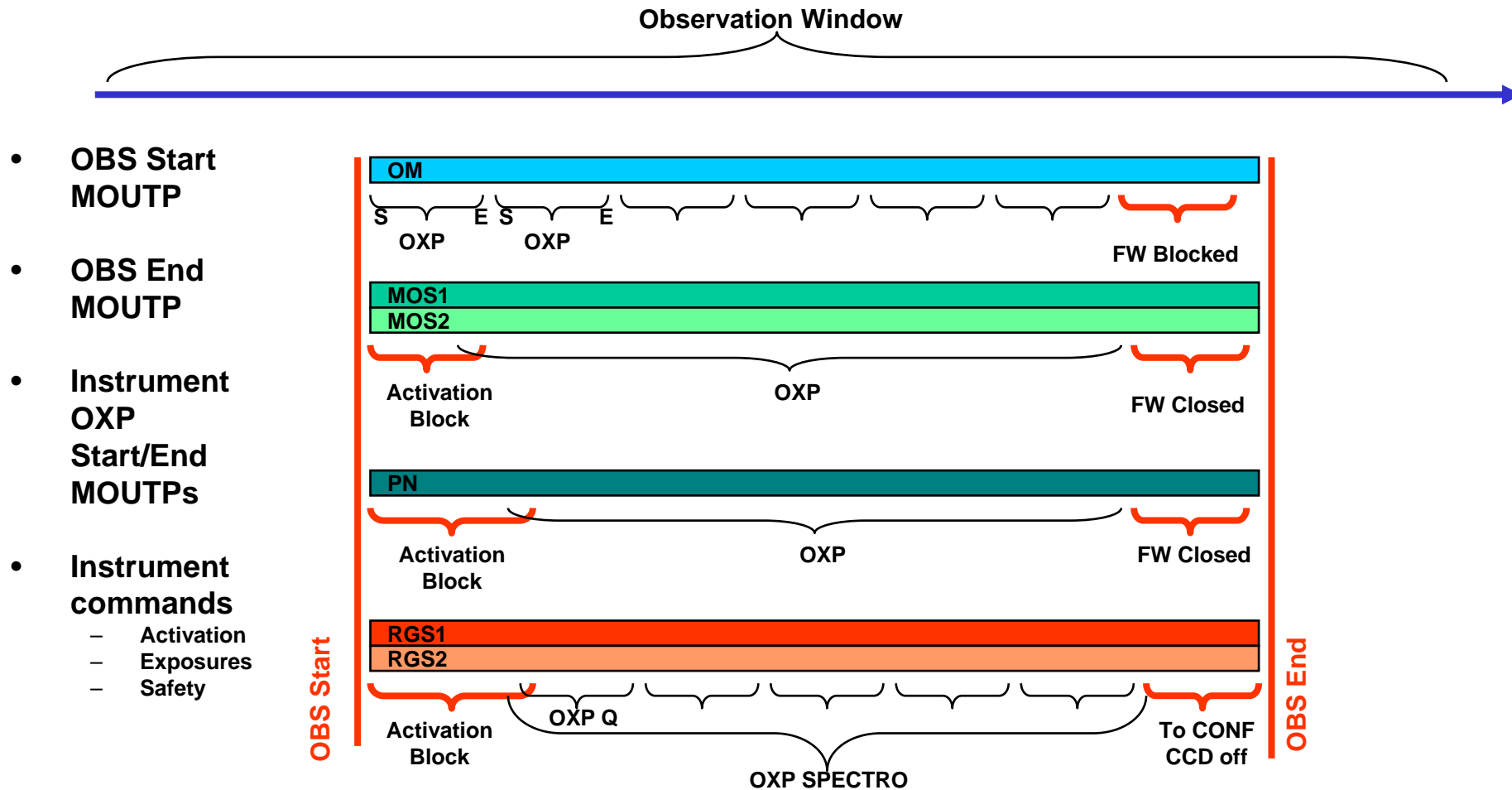
XMM-NEWTON BOC: 31 March 2009



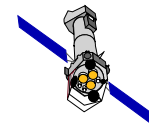
XMM

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How it works – the timeline elements

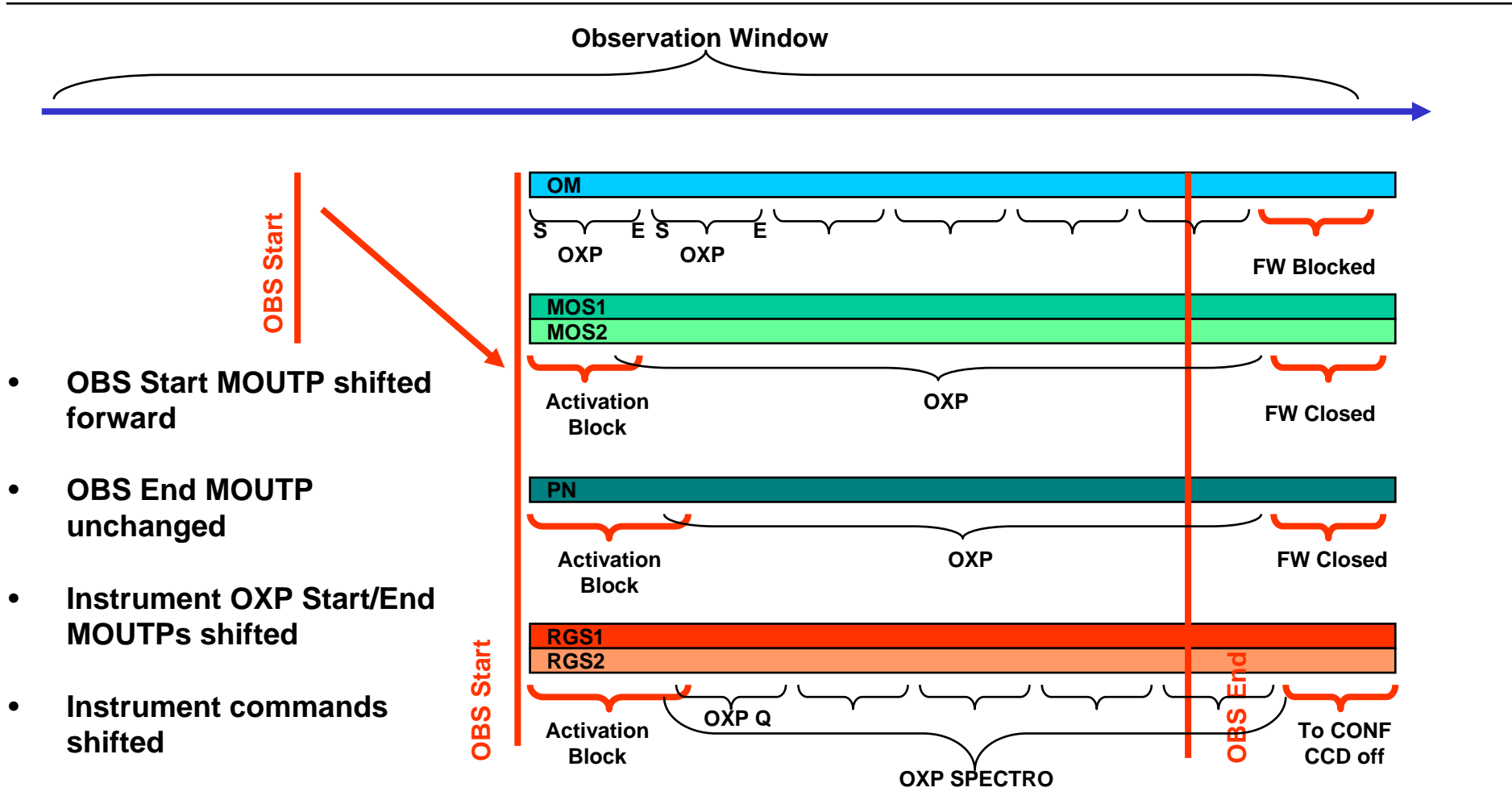


XMM-NEWTON BOC: 31 March 2009



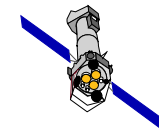
XMM

Forward Shift – All Instruments (1/3)

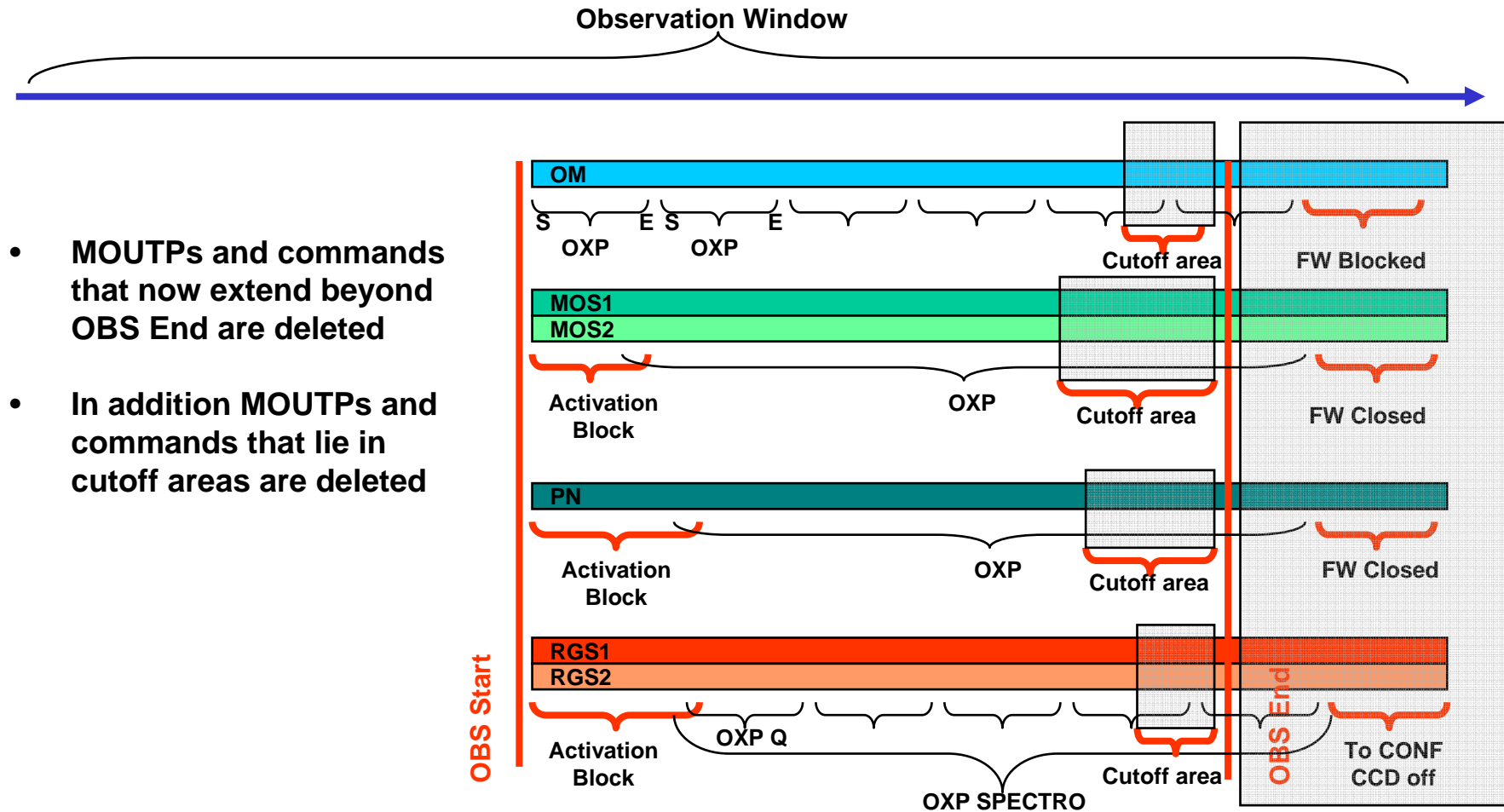


- OBS Start MOUTP shifted forward
- OBS End MOUTP unchanged
- Instrument OXP Start/End MOUTPs shifted
- Instrument commands shifted

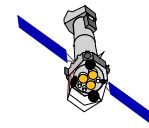
XMM-NEWTON BOC: 31 March 2009



Forward Shift – All Instruments (2/3)

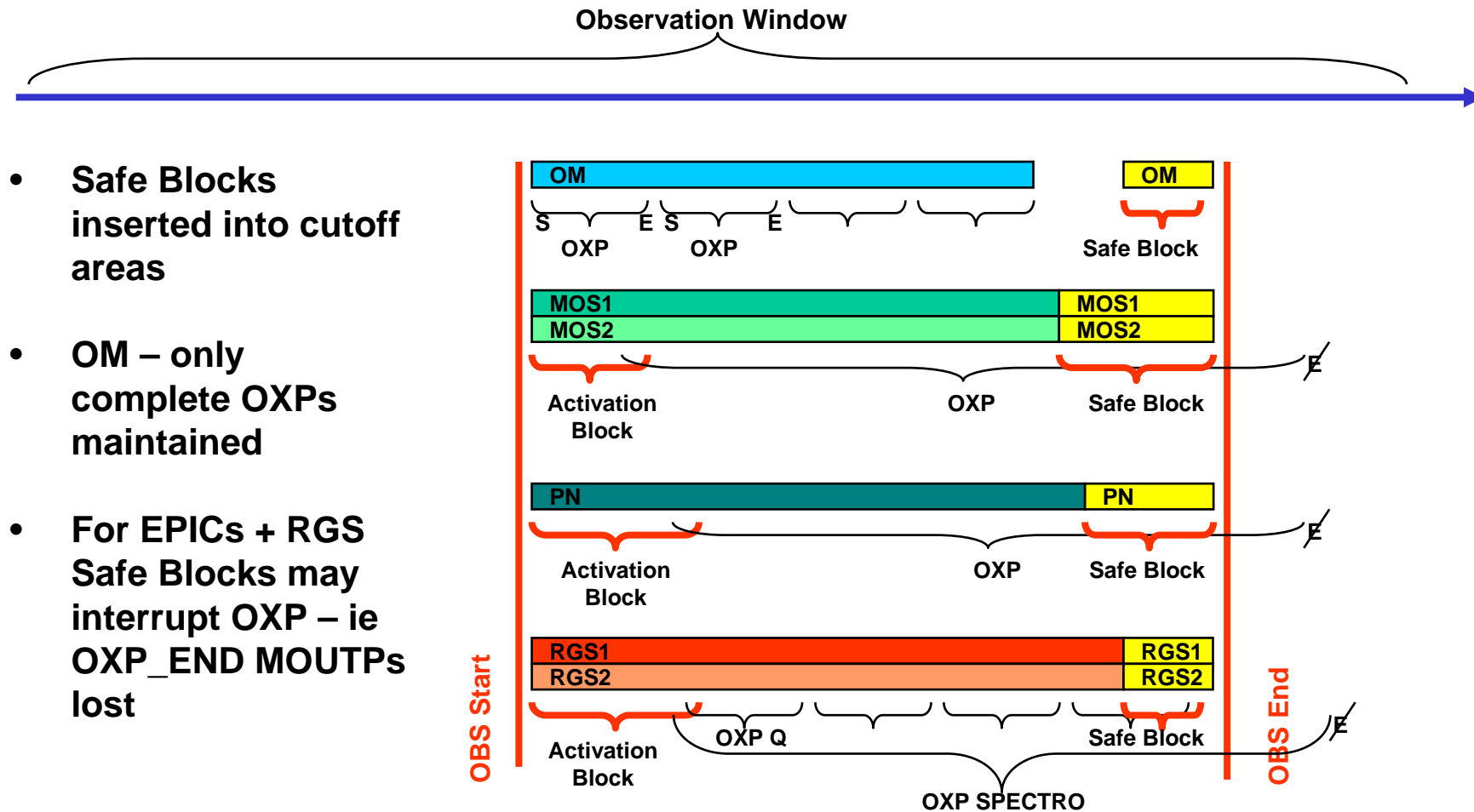


XMM-NEWTON BOC: 31 March 2009

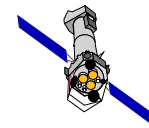


XMM

Forward Shift – All Instruments (3/3)

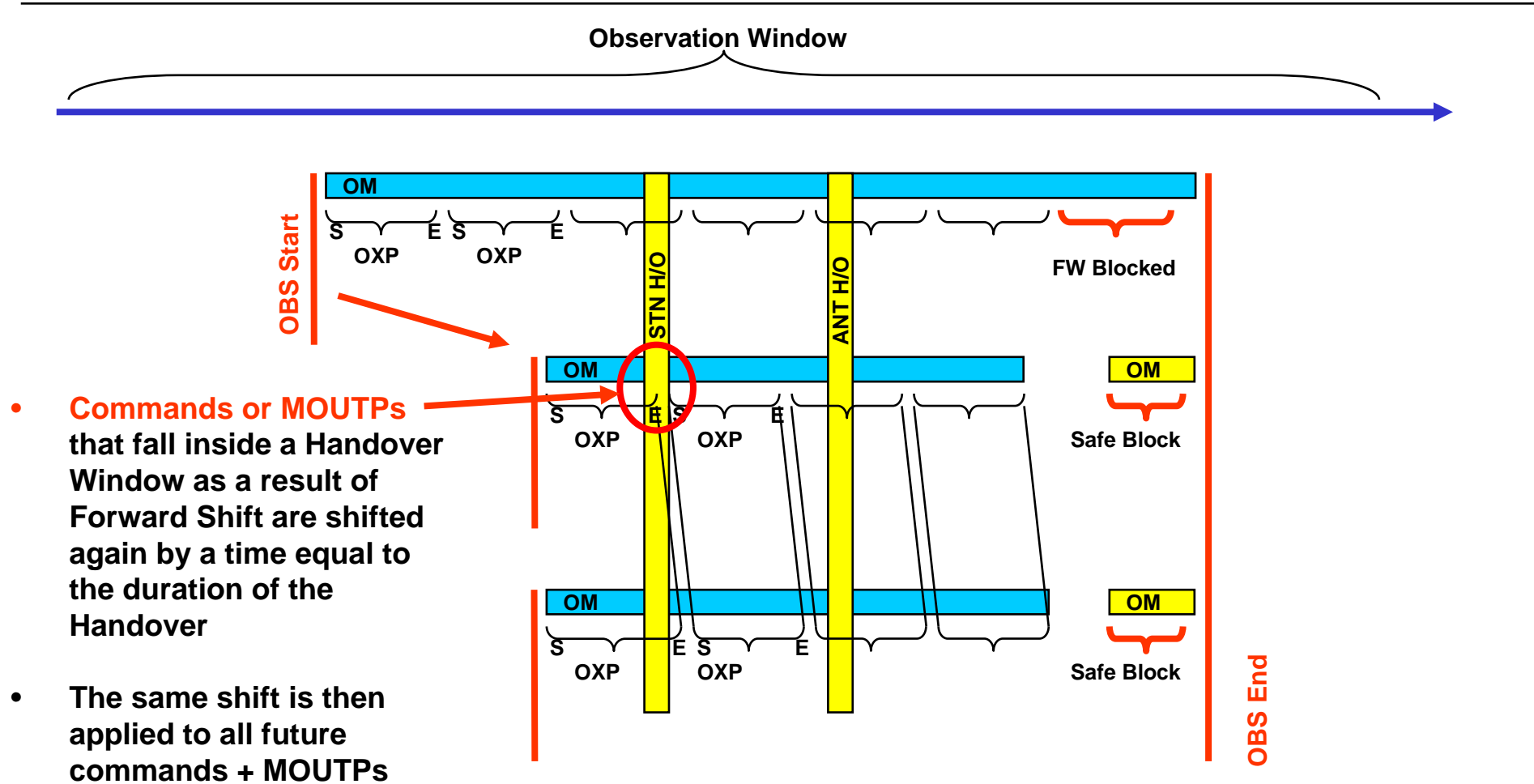


XMM-NEWTON BOC: 31 March 2009

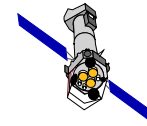


XMM

Forward Shift – with Handover Windows

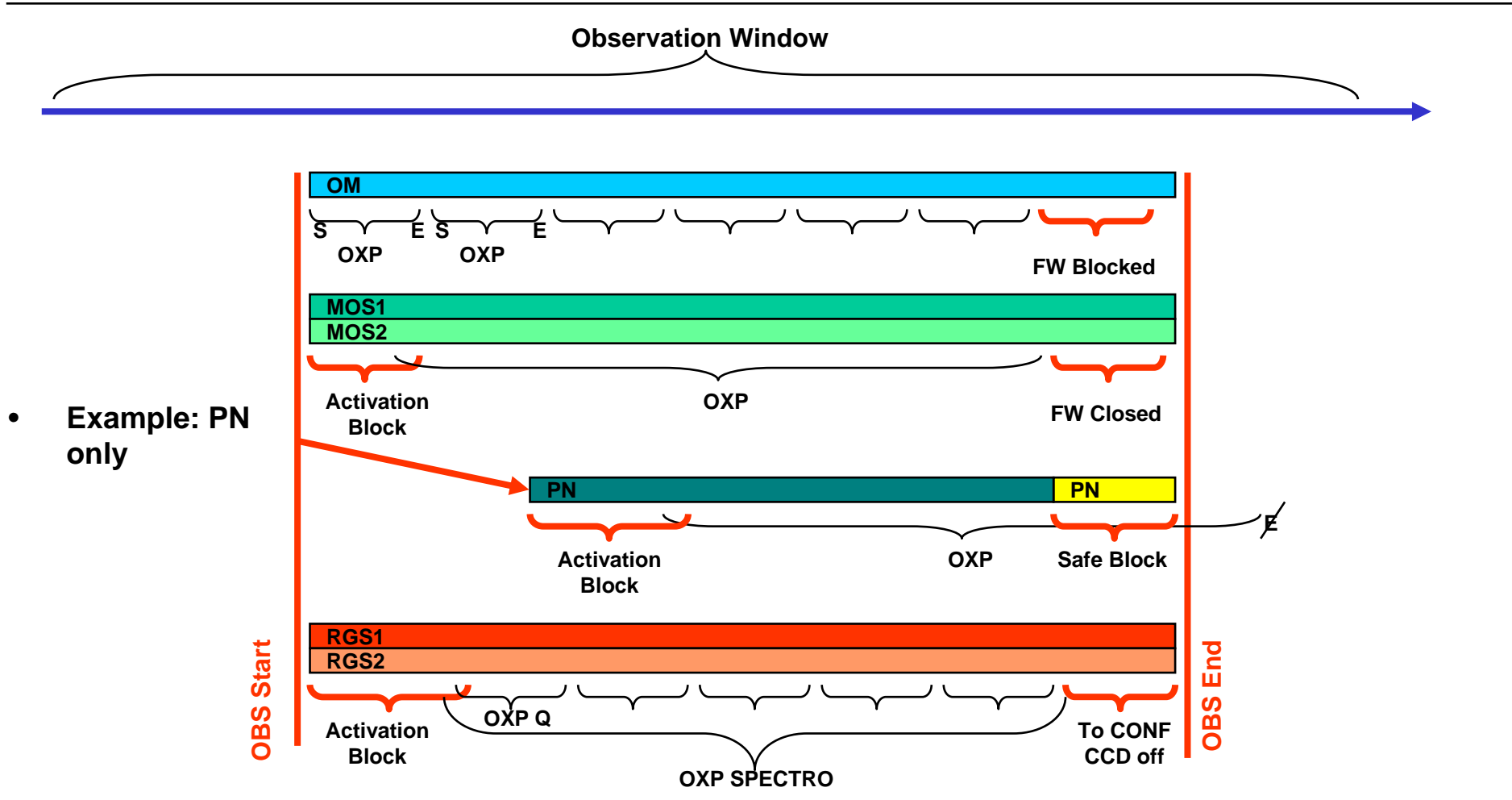


XMM-NEWTON BOC: 31 March 2009



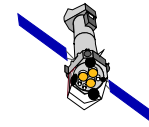
XMM

Forward Shift – Just one Instrument



- Example: PN only

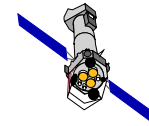
XMM-NEWTON BOC: 31 March 2009



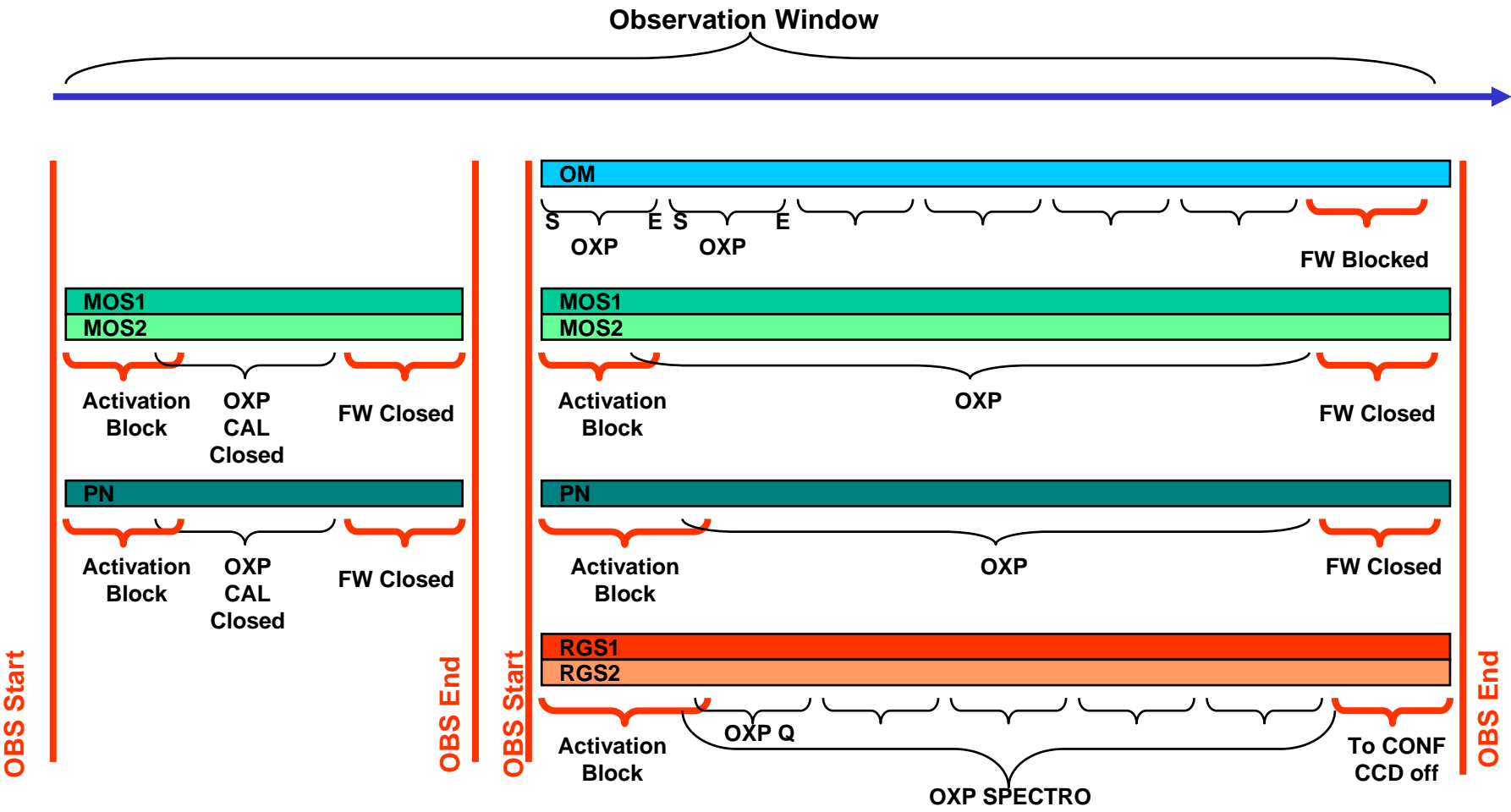
XMM

Backward Shift

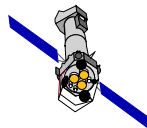
- **Moving the OBS Start backwards or earlier in time**
- **Only possible if the timeline activity before OBS Start is either on same target or is completely idle**
- **Only makes sense for all instruments except OM**
- **The activation blocks only are shifted backwards**
- **This may overwrite existing commands for the instruments**
- **An additional 10 minute buffer zone is also cleared to allow manual closure of previous observation**
- **Most likely case is interruption of a CAL Closed observation on EPICs to start FW open observation earlier**



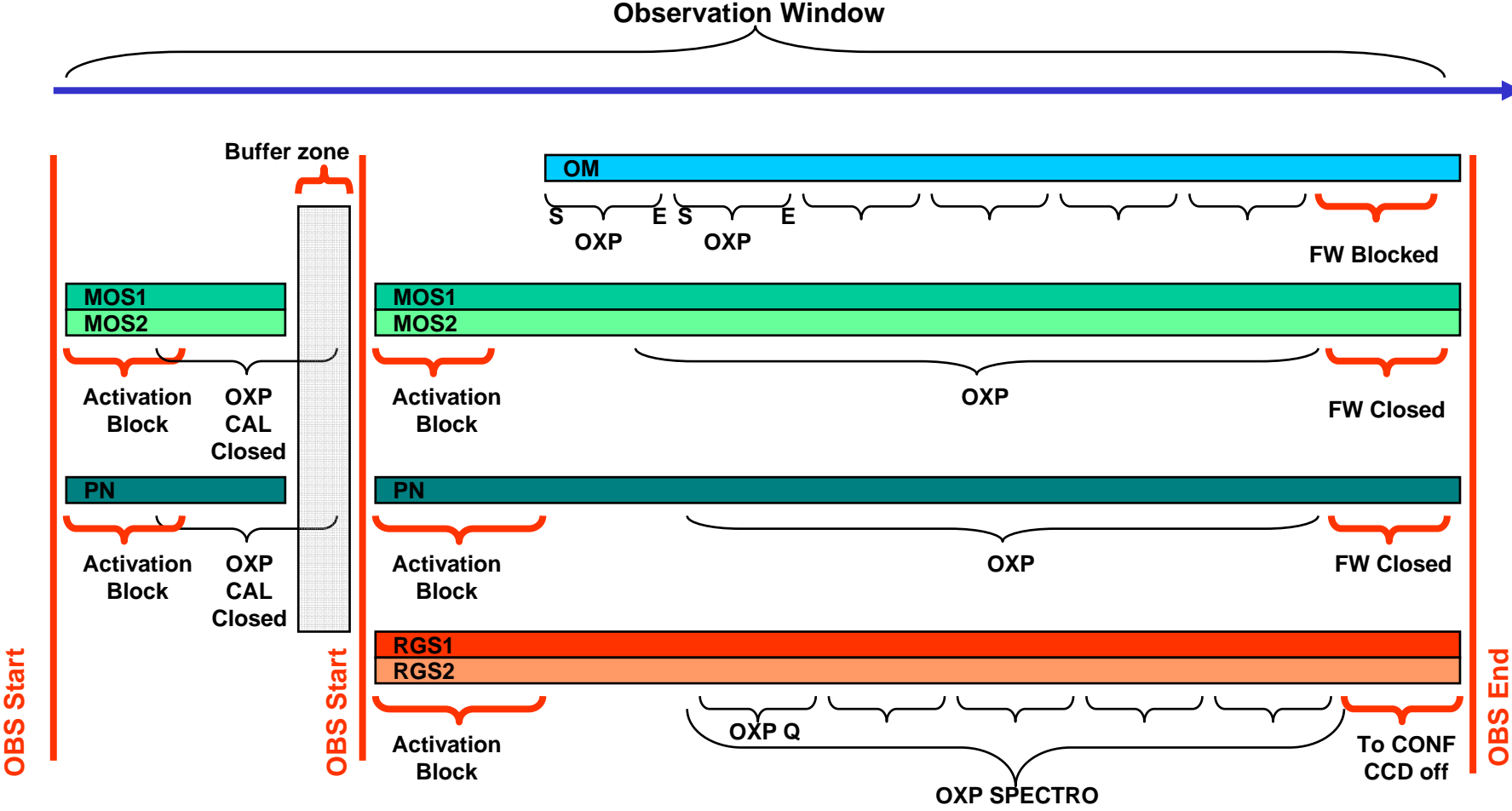
Backward Shift – All but OM (1/2)



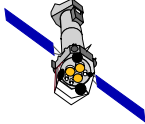
XMM-NEWTON BOC: 31 March 2009



Backward Shift – All but OM (2/2)



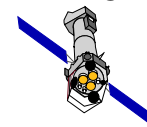
XMM-NEWTON BOC: 31 March 2009



XMM

Flexible Timeline – Validation History

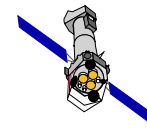
- Requirements go back to 2001
- First implementation in the SCOS1b MCS
- **Testing S1B was completed MOC/SOC in Feb 2004**
 - Following review of the testing additional tests were carried out at the MOC for specific revolutions.
 - All anomalies were raised as anomalies on S1B and eventually transferred to S2K ([See table – S1B Anomalies](#))
- **SPACON training provided at the MOC in July 2004**
- **In parallel re-validation of Flexible Timeline (Autostack Reschedule function) for SCOS-2000 was carried out over the period May 2004 to September 2005**
 - Validation covered both forward and backward shift
 - Validation repeated 5 times for different versions of S2K (last was SW V8.7)
 - During validation 8 new Anomalies raised and Closed out with issue of final S2K test report November 2005 ([See table – S2K Anomalies](#))
- **Since 2006 only two anomalies have been raised**



Flexible Timeline – S2K Anomalies

Anomaly	Date	Description	Status	Comments
XMM_S2K-125	2004-05-27	Only one Reschedule Report generated	Closed	
XMM_S2K-126	2004-05-27	Cut-off times for Safe EDs are out of date	Closed	
XMM_S2K-127	2004-05-27	Forward shift report is incorrect	Rejected	
XMM_S2K-130	2004-05-28	Flexible TL "View report" option	Closed	
XMM_S2K-132	2004-05-28	Flexible TL schedule report misaligned	Closed	
XMM_S2K-136	2004-05-28	Unexpected failure when applying forward shift	Closed	
XMM_S2K-217	2004-09-07	SAFE EDs inserted incorrectly after forward shift	Closed	
XMM_S2K-378	2005-03-21	Event log does not echo reschedule parameters	Closed	

XMM-NEWTON BOC: 31 March 2009



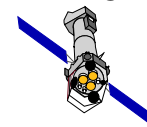
XMM

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Flexible Timeline - S1B Anomalies

Anomaly	Date	Description	Status	Comments
XMM_S2K-121	2004-05-27	Forward shift to an observation which start is the past	Closed	Correct behaviour for S2K
XMM_S2K-212	2004-02-17	Applying a multiple shift on the same observation does not work	Closed	Constraint - undo forward shift before applying another forward shift to same OBS
XMM_S2K-214	2004-06-16	The UNDO function always removes all previously applied shifts	Closed	Correct behaviour for S2K - undo only removes last applied shift
XMM_S2K-215	2004-07-30	After a backward shift is active you cannot forward shift next observation	Closed	Constraint - backward shift on OBS-1 should be undone before forward shift on OBS-2
XMM_S2K-216	2004-07-06	OBS_START MOUTP Release Time not updated for backward shift	Closed	Revalidated March 2008 (SW 9.8.6) and works
XMM_S2K-231	2004-09-08	Reschedule cannot cope with 3 H/O Windows	Closed	Correct behaviour for S2K
XMM_S2K-232	2004-09-08	Reschedule error with H/O window near end of Observation	Closed	Constraint- need to visually check no H/O STOP close to OBS_END
XMM_S2K-240	2004-09-23	Flexi-timeline can shift S/S 1 commands	Closed	Revalidated August 2005 (SW 8.2). The option to shift "All" subsystems will select subsystems 3,4,5,7,8,9.

XMM-NEWTON BOC: 31 March 2009

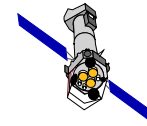


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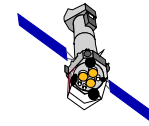
Flexible Timeline – Later Anomalies

Anomaly	Date	Description	Status	Comments
XMM_S2K-476	2006-08-11	Autostack reschedule (backward shift) crashes autostack	Closed	Revalidated March 2008 (SW 9.8.6) and works
XMM-955	2008-07-04	SAFE Blocks do not execute from Autostack	Pending	2008-09-09 Logica responded that problem is accepted as a bug and should be fixed for next release (SW 10.1)



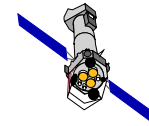
Flexible Timeline - Validation

- **Functional tests**
 - Use test chain of mission control system
 - Load timelines and execute forward / backward shift test cases
 - Check by inspection the shifted timelines
- **Operational tests with spacecraft simulator**
 - Use test chain of mission control system + spacecraft simulator
 - Check real-time execution of shifted timelines forward/backward
 - Combine with procedure validation and operator training



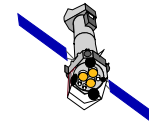
Flexible Timeline – Procedure updates

- **Procedure updates needed**
 - **CRP_SYS_5004** “Top level procedure for contingency cases during timeline execution”
 - Case b - Problems during slew – **Forward shift** for all instruments
 - Case d – Timeline command failure – **Forward shift** for single instrument
 - Case h – Observation cannot start on time – **Forward shift** for all instrument
 - Case l – Recovery after announced ground station gap **Forward shift** for all instrument
 - **CRP_ERM_0021** “M5012 Rad Mon WF Active”
 - Step 10 onwards – rejoin of instruments once WF returns to inactive – **Forward shift** for all instruments
 - **FCP_SYS_5010** “Top level procedure for instrument nominal operations”
 - Step 5 – Observation window – Allow **Backward shift** of first “science” observation if WF inactive during CAL closed.



Flexible Timeline – In flight test

- **WF active at science observation start – use the forward shift once WF inactive**
- **WF inactive during CAL closed – use backward shift to start next science observation early**
- **Announced GS gap – instead of replan from PSF use the forward shift (- only possible if no slew lost during the gap)**



Flexible Timeline – Plan B

- For any problem - there is always the UNDO !!
- Then Manual timeline rejoin.....

