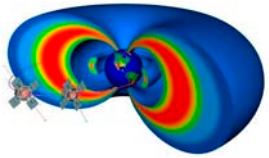
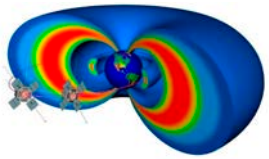


Telemetry Compression

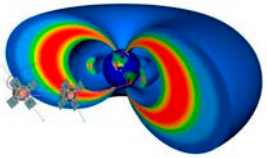
Nicola Fox

Overview



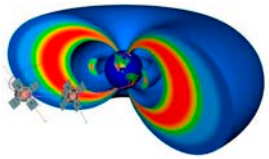
- The onboard SSR allocations were defined so that each investigation would have 2.5 days of storage during normal operations
- It was agreed that if additional SSR space could be recovered, that extra would be given to EMFISIS to allow more burst data to be taken.
- Mark Reid performed some initial tests of compression techniques and developed a robust algorithm that would allow us to free up SSR resources
- A detailed analysis was performed to assess the risks and benefits of compression.

Compression Algorithm



- Operates at the packet level when writing files to the SSR:
  - Packets are grouped together to form a “super” packet of no more than 4Kbytes
  - This 4Kbyte packet is compressed using libz (gzip)
  - If there is no benefit (zero or worse compression), the uncompressed data is written.

Possible Issues



- Inefficient compression

  In some cases compression algorithms result in larger data, how is this addressed?

  – The algorithm protects against this by comparing the uncompressed and compressed data

- Bit errors on SSR or during downlink

  What are the risks a bit error would cause corruption to multiple packets if they are compressed?

  – SSR hardware correction and SFDP protocol protect against this – we have never seen an issue with files on the SSR or corruption during downlink

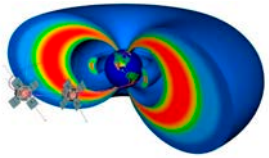
- Monitoring SSR usage

  We mechanisms are there for monitoring SSR usage?

  – SSR usage is reported in the time and status message on board

  – MOC produces weekly SSR usage plots that will be included in the weekly report

Possible Issues Continued



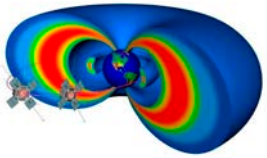
- Loss of data during a big geophysical event

  Would the SSR overflow resulting in data loss during a big storm?

  – The analysis attempted to use storm time conditions as a worst case

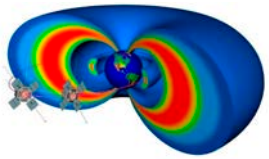
  – Differences in compression ratio between quiet and active were insignificant. The margins on the changes in allocation were designed to make sure that if no other changes were made, then this would not be a risk.

Analysis



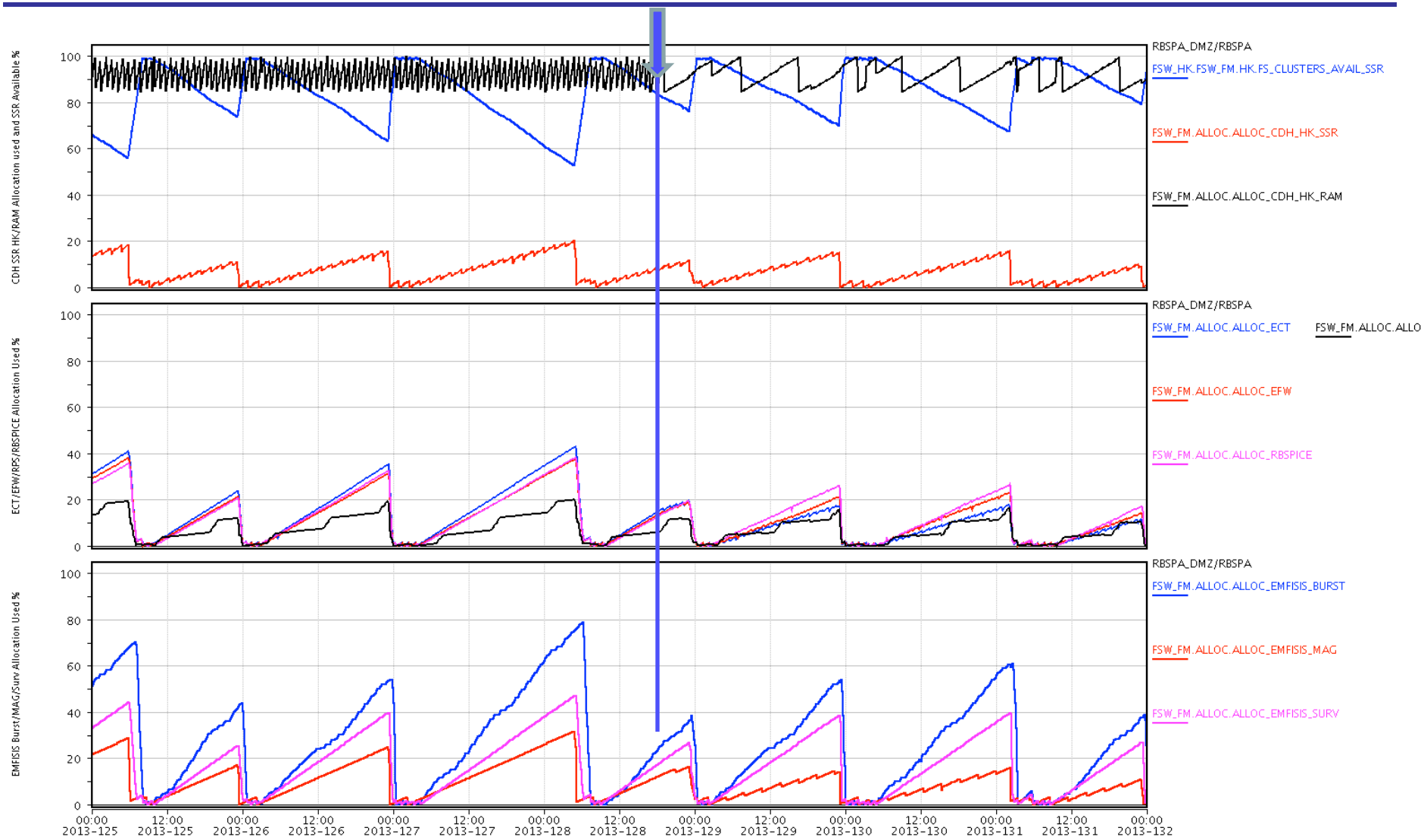
- Mark Reid and Rob Barnes performed independent analysis
  - A selection of SSR files were compressed using the Algorithm to generate compression statistics
  - A selection of random days were selected to find the “average” performance
  - The March 17th Storm was used to find “worst case” performance
  - This gave us a predicted compression performance

Predicted Performance

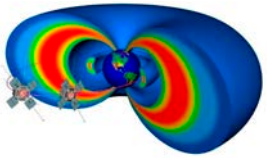


Instrument	**Compression Ratio** (Random 3 Days)	**Compression Ratio** (March 17th Storm Event)
HOPE	0.25	0.37
MagEIS	0.43	0.47
REPT	0.47	0.44
EFW	0.75	0.8
EMFISIS	0.92	0.94
RBSPICE	0.48	0.64
PSBR	0.74	0.72

Observed Changes

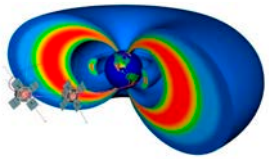


Rationale for Change



- Maintain the existing 2.5 days safety margin
- Provide extra allocation to EMFISIS
- To not cut the effective allocation of any team
- To give some effective extra allocation to everyone.

Allocation Changes



Instrument/Data	Current Allocation (Bytes)	Change in Allocation	New Allocation (Bytes)	Average Compression Ratio	Effection New Allocation (Bytes)	Effective Change in Allocation
ECT	538,804,224	70%	377,162,956	0.45	838,139,904	155%
EFW	316,964,864	100%	316,964,864	0.68	466,124,800	147%
EMFISIS Survey	176,979,968	100%	176,979,968	0.94	188,276,561	106%
EMFSIS Burst	612,761,600	144%	882,376,704	0.94	938,698,621	153%
EMFISIS Mag	60,751,872	40%	24,300,748	0.5	48,601,497	80%
RBPICE	142,639,104	100%	42,639,104.00	0.73	195,396,032	136%
RPS	52,854,784	100%	52,854,784	0.74	71,425,383	135%
Housekeeping	138,510,336	50%	69,255,168	0.4	173,137,920	125%