

Housekeeping Telemetry Viewer: 10 years of operations

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What is HKTV?



HKTV stands for House-keeping Telemetry Viewer.

In essence, HKTV is a **packet**¹ viewer and analyzer.

¹What is packet? A chunk of data with some properties: length, type (TM/TC), APID. Example: CCSDS packet.



HKTV development has been initiated by EUMETSAT exactly 10 years ago as an in-house project to enable the analysis of IASI² data collected during AIT at Satellite level:

- telemetry
- telecommands
- science data.

For:

- reporting, trending, investigation, and
- to preserve knowledge in long term program.

²Part of EUMETSAT Polar System, on board Metop-A,B,and C satellite.



HKTV in 2009:

- Monolithic Java application (only standalone processing on one PC)
- Java 5 and 6 support
- GUI based on Java Swing
- Proprietary archive format
- Plotting based on JFreeChart
- Reporting based on JFreeReport

HKTV past and current use

HKTV in 2009-2019 supports:

- IASI on Metop
- MHS on Metop
- IASI-NG on Metop-SG
- METIMAGE on Metop-SG
- Metop-SG (all instruments)

Good tools survive... with little maintenance

HKTV in 2019:

- Monolithic Java application (main target platform: MacOS)
- Distributed processing support via message bus (ActiveMQ)
- PUS support
- Java 8-13 support
- GUI based on Java Swing
- Archive format: proprietary and MongoDB
- Plotting based on JFreeChart
- Reporting based on JFreeReport
- Synoptic displays based on SVG/HTML/JavaScript and JavaFX

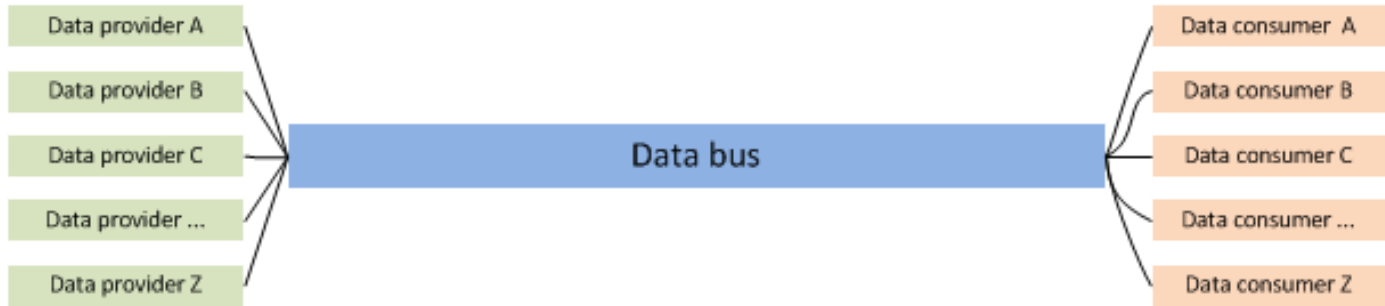
HKTV follows the following concepts:

- **One Click** – satisfy the user, not the requirement
- **AGILE**
- **KISS** (keep it small and simple): if functionality is needed in >90% of use cases, it goes into the kernel, otherwise it's implemented as an extension (dedicated java package per instrument). This keeps the kernel very simple.
- **YAGNI** (you aren't gonna need it): never process anything unless really needed. Opaque packets remain the only data always available. Everything else, e.g. parameters are extracted only upon request. Plots painted only if visible.
- **CI/CD** with automated testing

HKTV is built around a **data bus**. Every CCSDS packet is pushed through this bus. The bus is implemented in ActiveMQ, meaning that you can have both local and remote clients.

Once you want to add an additional component (a window, data processing, specific storage, etc.) just subscribe to the data bus.

Each data consumer runs in a separate thread.



IASI-NG HKTV - FM4

File Plots Archive Automation Export Windows Help

Test display
 Test text Test switches Test color changers Get fields for subscription Test data up reset

Activities

Time	Activity	Status

DC MAIN DC K -0.04 V

HKTV logging

Time	From	Message	Exception
2019-11-11 12:07:40.608	org.eumetsat.hktv.ui.HTMLUserDisplayPanel	test_user_display.html: field PPFT1072 was not found	
2019-11-11 12:07:40.610	org.eumetsat.hktv.ui.HTMLUserDisplayPanel	test_user_display.html: field PPFT1039 was not found	
2019-11-11 12:07:40.613	org.eumetsat.hktv.ui.HTMLUserDisplayPanel	test_user_display.html: field PPFT1055 was not found	
2019-11-11 12:07:40.708	org.eumetsat.hktv.ui.HTMLUserDisplayPanel	test_user_display.html: field CFT00290 was not found	
2019-11-11 12:07:40.711	org.eumetsat.hktv.ui.HTMLUserDisplayPanel	test_user_display.html: field PPETy127 was not found	
2019-11-11 12:07:40.713	org.eumetsat.hktv.ui.HTMLUserDisplayPanel	test_user_display.html: field PPETy111 was not found	
2019-11-11 12:07:40.716	org.eumetsat.hktv.ui.HTMLUserDisplayPanel	test_user_display.html: field @IASING_tm.PUS.3.25...	
2019-11-11 12:07:54.216	org.eumetsat.hktv.dataproc.IASINGDataEnvelopeFact...	IASI-NG data envelope factory initialised	
2019-11-11 12:07:54.217	org.eumetsat.hktv.AppBase	Stopping all data providers	
2019-11-11 12:07:54.217	org.eumetsat.hktv.AppBase	Adding data provider org.eumetsat.hktv.dataproc.I...	
2019-11-11 12:07:55.552	org.eumetsat.hktv.ui.DataRatePanel	too many packets with the same timestamp APID=9...	
2019-11-11 12:07:55.562	org.eumetsat.hktv.ui.DataRatePanel	too many packets with the same timestamp APID=1...	
2019-11-11 12:07:56.702	org.eumetsat.hktv.ui.DataRatePanel	too many packets with the same timestamp APID=9...	
2019-11-11 12:07:56.703	org.eumetsat.hktv.ui.DataRatePanel	too many packets with the same timestamp APID=1...	
2019-11-11 12:07:57.798	org.eumetsat.hktv.ui.DataRatePanel	too many packets with the same timestamp APID=1...	
2019-11-11 12:07:58.846	org.eumetsat.hktv.ui.DataRatePanel	too many packets with the same timestamp APID=1...	
2019-11-11 12:08:27.785	org.eumetsat.hktv.dataproc.IASINGDataEnvelopeFact...	IASI-NG data envelope factory initialised	
2019-11-11 12:08:27.786	org.eumetsat.hktv.AppBase	Stopping all data providers	
2019-11-11 12:08:27.787	org.eumetsat.hktv.AppBase	Adding data provider org.eumetsat.hktv.dataproc.I...	
2019-11-11 12:08:28.887	org.eumetsat.hktv.ui.SscVerificationPanel	got SSC 66 where last SSC was 40 for NS IASING.tc.P...	

SSC verification

No.	OBT	Local time	PUS	APID	SID	NS	Size	Status	Desc	Act.SSC	Prev.SSC
1	-	2019-11-11 11...	140.1	988	-	IASING.tc.PUS.1...	29	OK_UNVERIFIED	ChangeValueOn...	66	40

Data rate

APID	Packets	KBytes received	Packets per sec...	Data rate (kbit/s)	Avg data rate (...)	Peak data rate ...
977	16	0.384	0.164	0.032	0.032	0.032
980	299	60.869	1.233	2.008	1.995	2.076
983	14	0.448	0.146	0.037	0.037	0.037
993	2106	75.928,677	15.415	4.392,084	4.723,989	5.985,100
994	132	5.946,732	1.028	370.379	369.983	377.187
995	1152	32.819,904	10.536	2.398,275	2.763,636	3.494,322
996	131	6.563,624	1.028	411.921	410.981	418.903
997	131	2.237,087	1.028	140.396	140.075	142.775

Data packets

No.	OBT	Local time	PUS
1	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3
2	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3
3	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3
4	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3
5	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
6	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
7	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
8	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
9	2004-01-28 17:34:36.249	2019-11-11 12:...	200.3
10	2004-01-28 17:34:36.249	2019-11-11 12:...	200.3
11	2004-01-28 17:34:36.249	2019-11-11 12:...	200.3
12	2004-01-28 17:34:38.710	2019-11-11 12:...	3.25
13	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3
14	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3
15	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3
16	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3
17	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3
18	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3
19	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3
20	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
21	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
22	2004-01-28 17:34:37.068	2019-11-11 12:...	200.3
23	2004-01-28 17:32:01.457	2019-11-11 12:...	200.3
24	2004-01-28 17:34:37.887	2019-11-11 12:...	200.3
25	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
26	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
27	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
28	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
29	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
30	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
31	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
32	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
33	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
34	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
35	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3
36	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3

Telecommands

No.	Local time	PUS	APID	NS
844	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.5...
845	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.5...
846	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.5...
847	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.5...
848	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.5...
849	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.5...
850	2019-11-11 12:08:...	190.1	988	IASING.tc.PUS.1...
851	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.5...
852	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.5...
853	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.5...
854	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.5...

ESA UNCLASSIFIED

Main window



IASI-NG HKTV - FM4

data up [reset]

Status

Message Exception

Message	Exception
test_user_display.html: field PPT1070 was not found	
test_user_display.html: field PPT1072 was not found	
test_user_display.html: field PPT1039 was not found	
test_user_display.html: field PPT1055 was not found	
test_user_display.html: field CFT00290 was...	
test_user_display.html: field PPETy127 was not found	
test_user_display.html: field PPETy111 was not found	
test_user_display.html: field @IASING_tm.PUS.3.25...	

DataEnvelopeFact... IASI-NG data envelope factory initialised

Stopping all data providers

Adding data provider org.eumetsat.hktv.dataproc.l...

too many packets with the same timestamp APID=9...

too many packets with the same timestamp APID=1...

too many packets with the same timestamp APID=9...

too many packets with the same timestamp APID=1...

too many packets with the same timestamp APID=1...

too many packets with the same timestamp APID=1...

DataEnvelopeFact... IASI-NG data envelope factory initialised

Stopping all data providers

Adding data provider org.eumetsat.hktv.dataproc.l...

got SSC 66 where last SSC was 40 for NS IASING.tc.P...

SID	NS	Size	Status	Desc	Act.SSC	Prev.SSC
-	IASING.tc.PUS.1...	29	OK_UNVERIFIED	ChangeValueOn...	66	40

No.	OBT	Local time	PUS	APID	SID	NS	Size	Desc	SSC
1	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7878
2	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7879
3	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7880
4	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36565	ODS science...	7881
5	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	997	80	IASING.sd.PUS.200.3#ISY_MIS67042	17077	ADV_MET_S...	493
6	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	1002	161	IASING.sd.PUS.200.3#ISY_MIS67051	1602	ADV_MET_IF...	1749
7	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	1002	162	IASING.sd.PUS.200.3#ISY_MIS67052	1602	ADV_MET_O...	1750
8	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	1002	163	IASING.sd.PUS.200.3#ISY_MIS67053	1602	ADV_MET_S...	1751
9	2004-01-28 17:34:36.249	2019-11-11 12:...	200.3	1002	161	IASING.sd.PUS.200.3#ISY_MIS67051	1602	ADV_MET_IF...	1752
10	2004-01-28 17:34:36.249	2019-11-11 12:...	200.3	1002	162	IASING.sd.PUS.200.3#ISY_MIS67052	1602	ADV_MET_O...	1753
11	2004-01-28 17:34:36.249	2019-11-11 12:...	200.3	1002	163	IASING.sd.PUS.200.3#ISY_MIS67053	1602	ADV_MET_S...	1754
12	2004-01-28 17:34:38.710	2019-11-11 12:...	3.25	980	28	IASING.tm.PUS.3.25#IFV_HK_66028	206	HK Packet S...	1641
13	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7882
14	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7883
15	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7884
16	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7885
17	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7886
18	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7887
19	2004-01-28 17:34:34.611	2019-11-11 12:...	200.3	994	32	IASING.sd.PUS.200.3#ISY_MIS67030	45051	ODI science...	492
20	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	996	65	IASING.sd.PUS.200.3#ISY_MIS67040	50104	ADA_MET_O...	493
21	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	998	67	IASING.sd.PUS.200.3#ISY_MIS67041	26166	ADA_MET_R...	493
22	2004-01-28 17:34:37.068	2019-11-11 12:...	200.3	1005	208	IASING.sd.PUS.200.3#ISY_MIS67001	9858	ADA_PROCE...	585
23	2004-01-28 17:32:01.457	2019-11-11 12:...	200.3	1004	208	IASING.sd.PUS.200.3#ISY_MIS67101	9858	ADA_PROCE...	40
24	2004-01-28 17:34:37.887	2019-11-11 12:...	200.3	1005	208	IASING.sd.PUS.200.3#ISY_MIS67001	9858	ADA_PROCE...	586
25	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	33904	ODS science...	7888
26	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7889
27	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7890
28	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7891
29	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7892
30	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7893
31	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7894
32	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7895
33	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7896
34	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36565	ODS science...	7897
35	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7898
36	2004-01-28 17:34:35.430	2019-11-11 12:...	200.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7899

No.	Local time	PUS	APID	NS	Size	Status	Desc	SSC
844	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5111
845	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5112
846	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5113
847	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5114
848	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5115
849	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5116
850	2019-11-11 12:08:...	190.1	988	IASING.tc.PUS.190.1#1...	16	TC_ACCEPTANCE_SUCC...	Request a change mode.	65
851	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5117
852	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5118
853	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5119
854	2019-11-11 12:08:...	9.132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5120

Avg data rate (...)

Peak data rate (...)

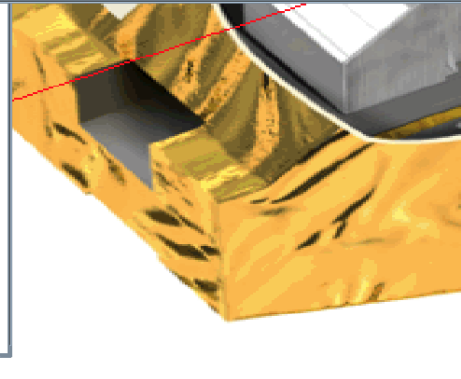
Avg data rate (...)	Peak data rate (...)
0.032	0.032
1.995	2.076
0.037	0.037
4.723.989	5.985.102
369.983	377.187
2.763.636	3.494.322
410.981	418.903
140.075	142.775
214.628	218.765

Main Window

2019-11-11 12:07:40.713	org.eumetsat.hktv.ui.HTMUserDisplayPanel	test_user_display.html: field PPE[y]11 was not found
2019-11-11 12:07:40.776	org.eumetsat.hktv.ui.HTMUserDisplayPanel	test_user_display.html: field @IASING.tm.PUS.3.25...
2019-11-11 12:07:54.216	org.eumetsat.hktv.dataproc.lasIngDataEnvelopeFact...	IASI-NG data envelope factory initialised
2019-11-11 12:07:54.217	org.eumetsat.hktv.AppBase	Stopping all data providers
2019-11-11 12:07:54.217	org.eumetsat.hktv.AppBase	Adding data provider org.eumetsat.hktv.dataproc.Ir...
2019-11-11 12:07:54.217	org.eumetsat.hktv.ui.DataRatePanel	too many packets with the same timestamp APID=9...
2019-11-11 12:07:54.217	org.eumetsat.hktv.ui.DataRatePanel	too many packets with the same timestamp APID=1...
2019-11-11 12:07:56.702	org.eumetsat.hktv.ui.DataRatePanel	too many packets with the same timestamp APID=9...
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2019-11-11 12:07:57.798	org.eumetsat.hktv.ui.DataRatePanel	too many packets with the same timestamp APID=1...
2019-11-11 12:07:58.846	org.eumetsat.hktv.ui.DataRatePanel	too many packets with the same timestamp APID=1...
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980	299	60,869	1,233	2,008	1,995	2,076
983	14	0,448	0,146	0,037	0,037	0,037
993	2106	75,928,677	15,415	4,392,084	4,723,989	5,985,102
994	132	5,946,732	1,028	370,379	369,983	377,187
995	1152	32,819,904	10,536	2,398,275	2,763,636	3,494,322
996	131	6,563,624	1,028	411,921	410,981	418,903
997	131	2,237,087	1,028	140,396	140,075	142,775
998	131	3,427,746	1,028	215,119	214,628	218,765
999	288	9,767,611	2,164	587,016	619,541	1,009,572
1000	18	470,988	0,143	29,874	29,874	48,681
1001	19	749,094	0,202	63,627	63,627	63,627
1002	474	759,348	3,737	47,893	47,244	48,823
1003	18	810,918	0,143	51,435	51,435	83,816
1004	18	177,444	0,143	11,255	11,255	18,34
1005	156	1,537,848	1,233	97,256	96,914	100,305
1007	18	901,872	0,143	57,204	57,204	93,217



Mode chang...
Limits violat...
User events

test name: Untitled

packet: **5121 OBT:2004-01-28 17:38:42.773 local: 12:08:01**

instrument mode: **<unknown>**

data server: -

saving stream to: /Users/Jakoblvschitz/Desktop/Projects/HKTV_IASING/archive/2019/315_2019-11-11/FM4_20191111_UTC_120736.hkp

No.	OBT	Local time	PUS	APID	NS
19	2004-01-28 17:34:36.611	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
20	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
21	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
22	2004-01-28 17:34:37.068	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
23	2004-01-28 17:32:01.457	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
24	2004-01-28 17:34:37.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
25	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
26	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
27	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
28	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
29	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
30	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
31	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
32	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
33	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
34	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
35	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
36	2004-01-28 17:34:35.430	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...

No.	OBT	Local time	PUS	APID	NS
844	2019-11-11 12:08:28.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
845	2019-11-11 12:08:28.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
846	2019-11-11 12:08:28.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
847	2019-11-11 12:08:28.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
848	2019-11-11 12:08:28.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
849	2019-11-11 12:08:28.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
850	2019-11-11 12:08:28.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.190.1#1...
851	2019-11-11 12:08:28.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
852	2019-11-11 12:08:28.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
853	2019-11-11 12:08:28.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...
854	2019-11-11 12:08:28.887	2019-11-11 12:08:28.887	988	988	IASING.tc.PUS.9.132#1...

No.	OBT	Local time	PUS	APID	NS
1	2004-01-28 17:36:...	2019-11-11 12:08:28.887	5.1	983	IASING.tm.PUS.5.1#WY...
2	2004-01-28 17:37:...	2019-11-11 12:08:28.887	5.1	983	IASING.tm.PUS.5.1#WY...
3	2004-01-28 17:37:...	2019-11-11 12:08:28.887	5.1	983	IASING.tm.PUS.5.1#WY...
4	2004-01-28 17:37:...	2019-11-11 12:08:28.887	5.1	983	IASING.tm.PUS.5.1#WY...
5	2004-01-28 17:37:...	2019-11-11 12:08:28.887	5.1	983	IASING.tm.PUS.5.1#WY...
6	2004-01-28 17:37:...	2019-11-11 12:08:28.887	5.1	983	IASING.tm.PUS.5.1#WY...
7	2004-01-28 17:37:...	2019-11-11 12:08:28.887	5.1	983	IASING.tm.PUS.5.1#WY...
8	2004-01-28 17:37:...	2019-11-11 12:08:28.887	5.1	983	IASING.tm.PUS.5.1#WY...
9	2004-01-28 17:37:...	2019-11-11 12:08:28.887	5.1	983	IASING.tm.PUS.5.1#WY...
10	2004-01-28 17:37:...	2019-11-11 12:08:28.887	5.1	983	IASING.tm.PUS.5.1#WY...
11	2004-01-28 17:37:...	2019-11-11 12:08:28.887	5.1	983	IASING.tm.PUS.5.1#WY...

The IASI instrument



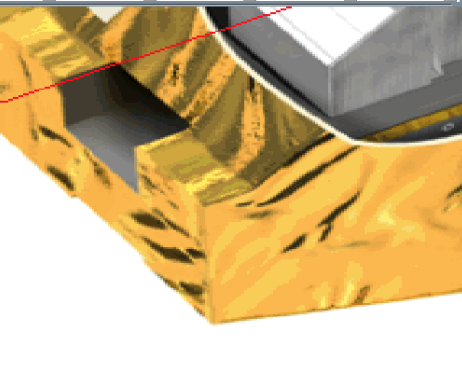
test_user_display.html: field PPETY111 was not found
 test_user_display.html: field @IASING_tm.PUS.3.25...
 DataEnvelopeFact... IASI-NG data envelope factory initialised
 Stopping all data providers
 Adding data provider org.umetsat.hkv.dataproc.ls...
 too many packets with the same timestamp APID=9...
 too many packets with the same timestamp APID=1...
 too many packets with the same timestamp APID=1...
 too many packets with the same timestamp APID=1...
 DataEnvelopeFact... IASI-NG data envelope factory initialised
 Stopping all data providers
 Adding data provider org.umetsat.hkv.dataproc.ls...
 got SSC 66 where last SSC was 40 for NS IASING.tc.P...

Main window

SID	NS	Size	Status	Desc	Act.SSC	Prev.SSC
-	IASING.tc.PUS.1...	29	OK_UNVERIFIED	ChangeValueOn...	66	40

Avg data rate ... Peak data rate ...

0.032	0.032
1.995	2.076
0.037	0.037
4.723.989	5.985.102
369.983	377.187
2.763.636	3.494.322
418.903	418.903
140.075	142.775
214.628	218.765
619.541	1.009.572
29.874	48.681
63.627	63.627
47.244	48.823
51.435	83.816
11.255	18.34
96.914	100.305
57.204	93.217



No.	Local time	PUS	APID	NS	Size	Status	Desc	SSC
19	2004-01-28 17:34:34.611	2019-11-11 12:00:00.3	994	32	IASING.sd.PUS.200.3#ISY_MIS67030	45051	ODI science...	492
20	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	996	65	IASING.sd.PUS.200.3#ISY_MIS67040	50104	ADA MET_O...	493
21	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	998	67	IASING.sd.PUS.200.3#ISY_MIS67041	26166	ADA MET_R...	493
22	2004-01-28 17:34:37.068	2019-11-11 12:00:00.3	1005	208	IASING.sd.PUS.200.3#ISY_MIS67001	9858	ADA PROC...	585
23	2004-01-28 17:34:37.457	2019-11-11 12:00:00.3	1004	208	IASING.sd.PUS.200.3#ISY_MIS67101	9858	ADA PROC...	40
24	2004-01-28 17:34:37.887	2019-11-11 12:00:00.3	1005	208	IASING.sd.PUS.200.3#ISY_MIS67001	9858	ADA PROC...	586
25	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	33904	ODS science...	7888
26	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7889
27	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7890
28	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7891
29	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7892
30	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7893
31	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7894
32	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7895
33	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36556	ODS science...	7896
34	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36565	ODS science...	7897
35	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7898
36	2004-01-28 17:34:35.430	2019-11-11 12:00:00.3	993	16	IASING.sd.PUS.200.3#ISY_MIS67010	36557	ODS science...	7899

Telecommands

No.	Local time	PUS	APID	NS	Size	Status	Desc	SSC
844	2019-11-11 12:08:00.9	132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5111
845	2019-11-11 12:08:00.9	132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5112
846	2019-11-11 12:08:00.9	132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5113
847	2019-11-11 12:08:00.9	132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5114
848	2019-11-11 12:08:00.9	132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5115
849	2019-11-11 12:08:00.9	132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5116
850	2019-11-11 12:08:00.9	190	198	IASING.tc.PUS.190.1#1...	16	TC_ACCEPTANCE_SUCC...	Request a change mode.	65
851	2019-11-11 12:08:00.9	132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5117
852	2019-11-11 12:08:00.9	132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5118
853	2019-11-11 12:08:00.9	132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5119
854	2019-11-11 12:08:00.9	132	988	IASING.tc.PUS.9.132#1...	20	UNDEF	Accept Time Update	5120

Instrument events

No.	OBT	Local time	PUS	APID	NS	Size	Status	SSC
1	2004-01-28 17:36:00.0	2019-11-11 12:08:00.5	1	983	IASING.tm.PUS.5.1#WVY_EVT65115	32		45
2	2004-01-28 17:37:00.0	2019-11-11 12:08:00.5	1	983	IASING.tm.PUS.5.1#WVY_EVT65115	32		46
3	2004-01-28 17:37:00.0	2019-11-11 12:08:00.5	1	983	IASING.tm.PUS.5.1#WVY_EVT65115	32		47
4	2004-01-28 17:37:00.0	2019-11-11 12:08:00.5	1	983	IASING.tm.PUS.5.1#WVY_EVT65115	32		48
5	2004-01-28 17:37:00.0	2019-11-11 12:08:00.5	1	983	IASING.tm.PUS.5.1#WVY_EVT65115	32		49
6	2004-01-28 17:37:00.0	2019-11-11 12:08:00.5	1	983	IASING.tm.PUS.5.1#WVY_EVT65115	32		50
7	2004-01-28 17:37:00.0	2019-11-11 12:08:00.5	1	983	IASING.tm.PUS.5.1#WVY_EVT65115	32		51
8	2004-01-28 17:37:00.0	2019-11-11 12:08:00.5	1	983	IASING.tm.PUS.5.1#WVY_EVT65115	32		52
9	2004-01-28 17:37:00.0	2019-11-11 12:08:00.5	1	983	IASING.tm.PUS.5.1#WVY_EVT65115	32		53
10	2004-01-28 17:37:00.0	2019-11-11 12:08:00.5	1	983	IASING.tm.PUS.5.1#WVY_EVT65115	32		54
11	2004-01-28 17:37:00.0	2019-11-11 12:08:00.5	1	983	IASING.tm.PUS.5.1#WVY_EVT65115	32		55

The IASI instrument

42.773 local: 12:08:01

SING/archive/2019/315_2019-11-11/FM4_20191111_UTC_120736.hpk

set test name... UI refresh

set time range... start monitoring

AMBIENT and TV - as is - OFFLINE

sounds animate

set filename prefix... stop monitoring

autoscrol: on autoscrol: off

rolling: on rolling: off

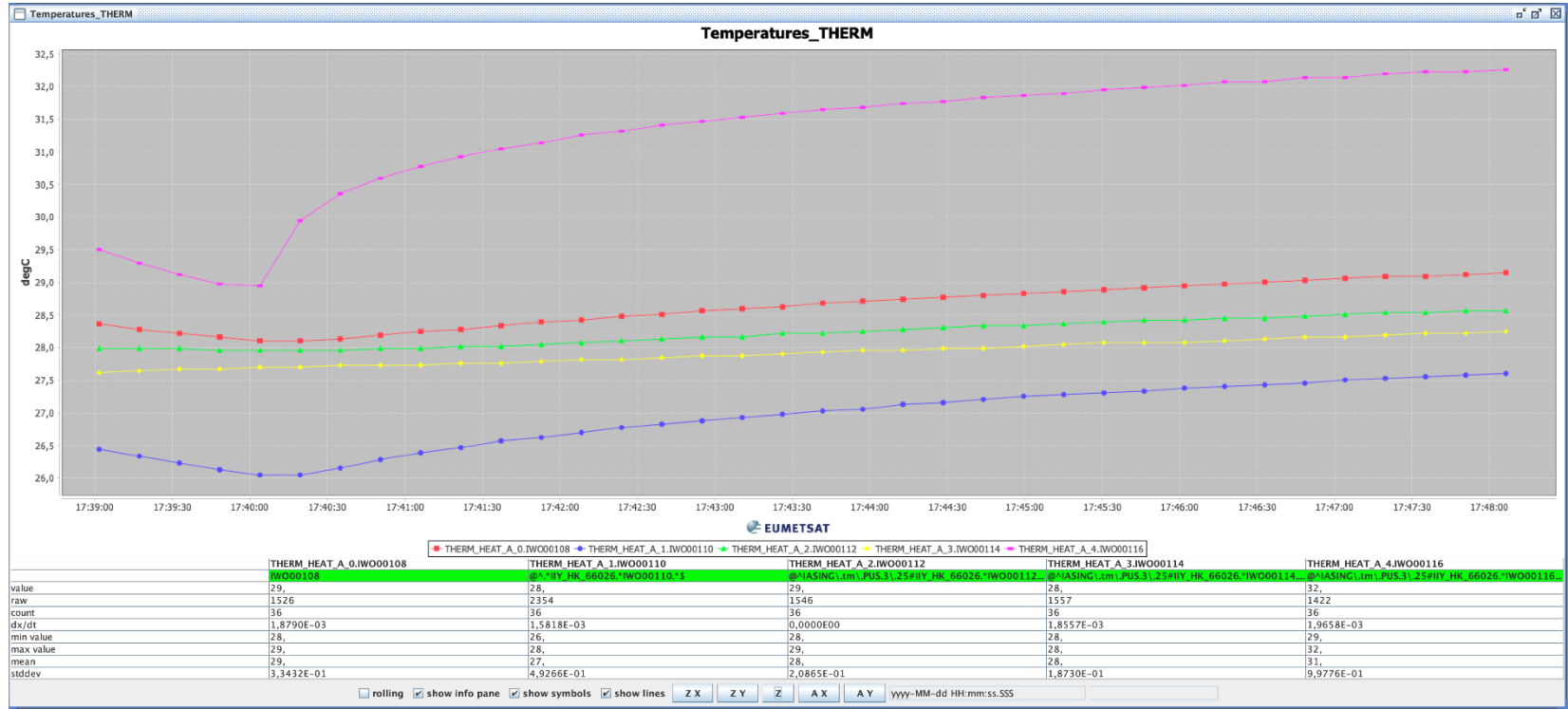
lines: on lines: off

symbols: on symbols: off

info: on info: off

zoom out zoom out X zoom out Y





- **DataProvider** – pushes packets into the system
- **PacketSaver** – saves received packets
- **PacketFormatDetector** - detects packet format
- **StreamConsistencyChecker** – checks input stream (e.g. OBT or SSC jumps)
- **TimeCorrelation** - OBT <-> Java time
- **Archive** – stores data
- **Automation** – infrastructure to run scripts
- **LimitsChecker**
- **SynopticsDisplay** (e.g. redundancies switch)
- **TimeSeriesDisplay** (e.g. for temperatures)



HKTV implements a bunch of input data providers. As HKTV message bus requires data packets on input, some preprocessing is usually required to extract/generate the packet from the input data. Supported data sources:

- Local files with CCSDS packets, CADU stream, MMFU SCOE dumps, UDMS dumps, IRIG dumps, etc.
- Remote TCP connection (incoming/outgoing): CCSDS packet with some optional headers
- Data loading from CCS5 MySQL database

Data loaders are light-weight components (100-200 lines) extracting the data from the input source and putting onto the bus, so it's very easy to add a new one.

HKTV supports several output data formats:

- proprietary HKP-2 format (portable house-keeping data format)
- MHS SD archive data format
- CCSDS packet stream
- Easily extensible to add other data formats

Default implementation determines packet format based on PUS service/subservice and fixed values as specified in the MIB database.

Tailored mission-specific implementations can be provided overriding the virtual method (e.g. for performance reasons).

HKTV implements archive in MongoDB.

The archive stores:

- opaque data (bytestream of CCSDS packets received)
- decomposed data (each mnemonic stored separately: high resources need!)

What exactly is stored is configurable: opaque packets, CCSDS packet headers, serialized packets, decomposed packets (individual parameters).

HKTV implements automation in Groovy language.

From the Groovy environment access is granted to all HKTV components.

Groovy execution is mirrored line-by-line into as-run report.

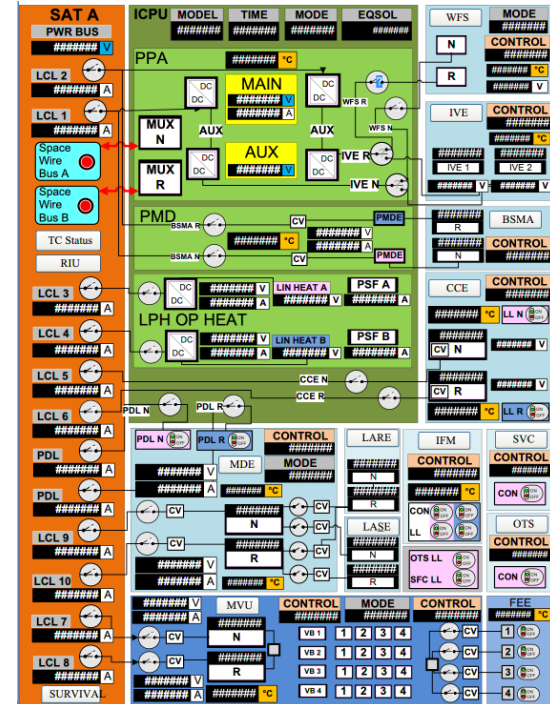
Example to load a set of CADU files:

```
logger.info("starting CADUs data feed")
x = new CaduStreamDataProvider()
app.setDataProvider(x)
path = "/data/REC_2019_09_13_14_11_59_TMRATE_FORMAL_RUN_SMDA/"
x.loadCadu(new File(path + "0.dat"))
x.loadCadu(new File(path + "1.dat"))
x.loadCadu(new File(path + "2.dat"))
x.loadCadu(new File(path + "3.dat"))
logger.info("CADU data feed finished")
```

Synoptics displays

HKTV supports synoptics displays specified in SVG or HTML.

The displays receive the full data feed, including parameter status. JavaScript is used for additional data processing, special effects, etc.



Limits checking

Fully SCOS2000 compatible.

In addition, different limit sets can be chosen (e.g. for ambient, thermal vacuum, etc.)

Each monitoring parameter is represented internally in DataField class: can be PhysicalDataField or SyntheticDataField.

To retrieve data, a Fetcher shall be obtained using `DataField.getFetcher()`. Normally it is a BitStreamFetcher. A fetcher is a highly-optimized class going directly into bit stream and getting the necessary piece of data.

But it's also flexible due to a proxying approach, e.g.

- PatchableFetcher(Fetcher): real-time data patching
- ConditionalFetcher(Fetcher): conditional field
- EnumFetcher(Fetcher): fetch number and apply textual calibration

And this is absolutely transparent to the users.

Performance depends on the deployment configuration, e.g. archive options, plotting options, synoptic displays, etc.

Reference configuration loading Metop-SG CADU stream processes >5000 CCSDS packets per second on a 14-core Mac Pro (Xeon 2.5GHz). Deployment options: no archive, 4 plots, no synoptic displays.

Switching on MongoDB archive on local machine reduces performance by ~30-90% depending on settings (proprietary HKTv archive has no performance impact).

Build time (gradle): ~2 minutes.

HKTV memory footprint:

- 15000 IASI-NG packets: 1.3GB
- 365000 MetOp-SG packets: 5.6GB

Each data consumer runs in a separate thread. Thus performance on a single machine is limited by the number of cores.

The slowest data consumer defines the length of backlog, since packets have to be kept in memory as long as they have not been processed.

It is possible to connect to the message bus remotely via TCP, thus some processing can be made on a remote machine.

MDB is represented by a set of XML files and includes definitions of:

- TM, TC and Science data packets description
- Transfer functions definitions
- Limits definitions
- Plots definitions
- User displays definitions
- Reporting can also be customized, but functioning defaults are provided

Tailoring means:

- Creation of a new application class (inherit from AppBase and implement abstract methods), tailor creation of windows and menus
- Provision of mission database (manual or automatic conversion; convertors from SCOS MIB, RangeDB XLS and EGS-CC CDM are available)
- Cosmetic: background, logo, etc.

If needed: implementation of instrument-specific data processing

MHS bench:

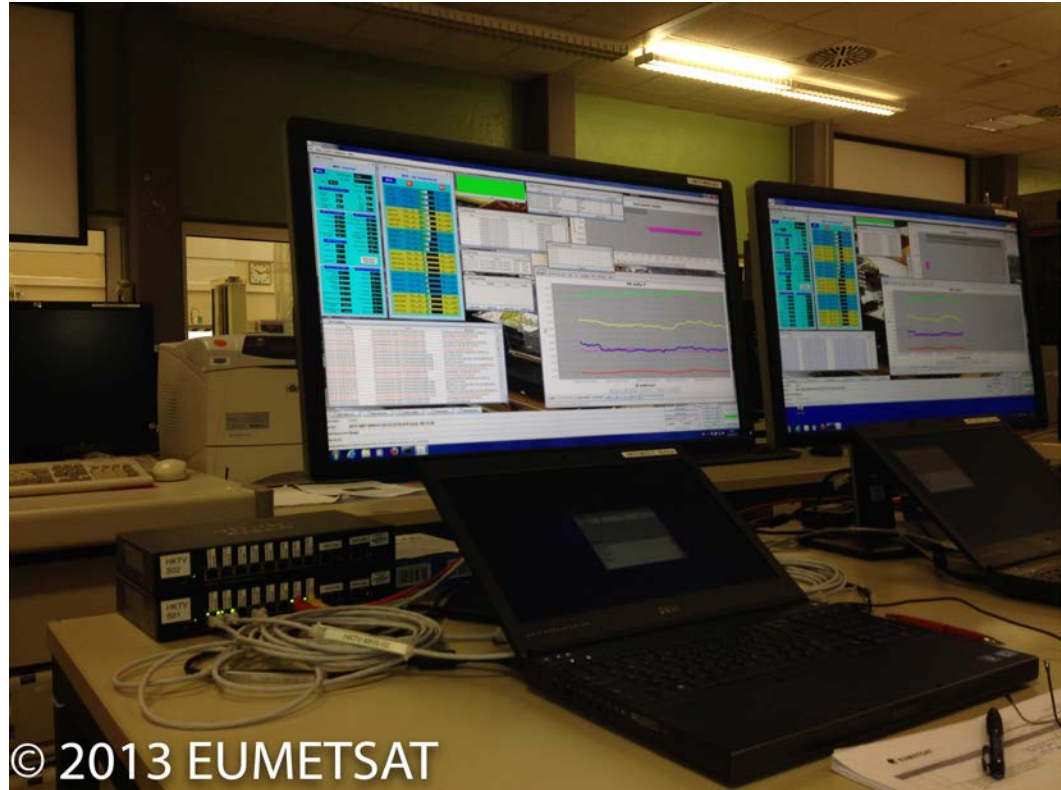
- 2 DELL laptops
- 2 monitors
- 2 Cisco switches
- 1 printer



HKTV in action

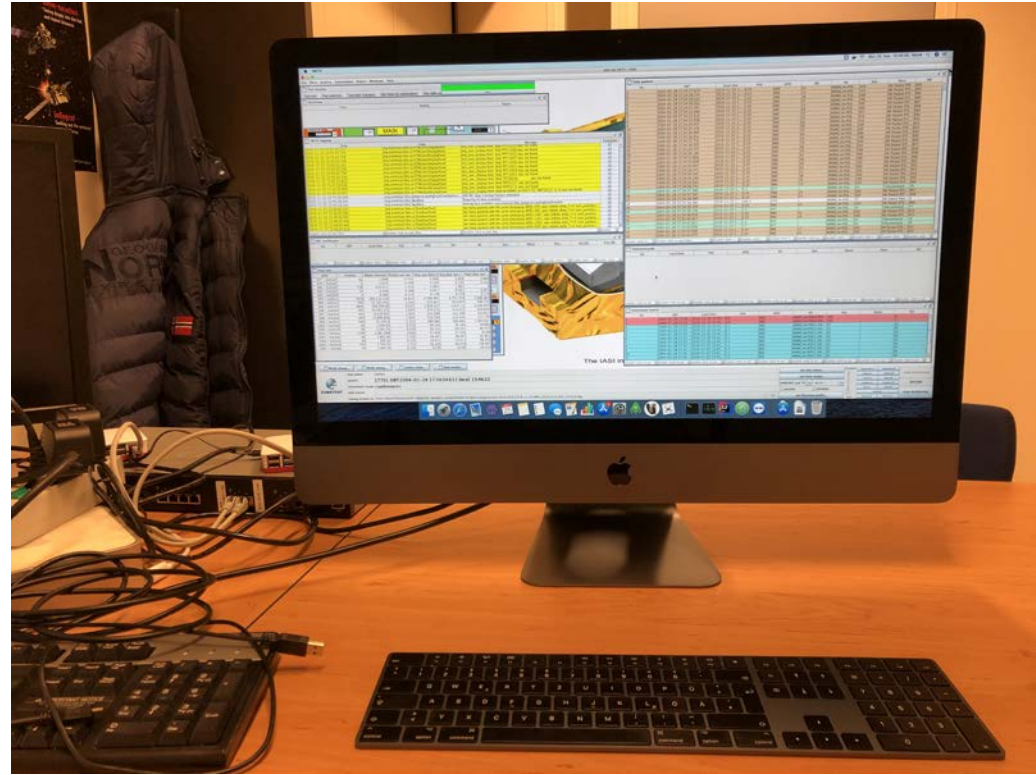
MHS bench:

- 2 DELL laptops
- 2 monitors
- 2 Cisco switches
- 1 printer



IASI-NG bench:

- Mac Pro
- Cisco switch
- CCS5 simulator (2 Raspberry Pis)



- Java proved to be the right choice due to its API stability and multiplatform support. HKTV required almost no adaptation moving from Java 5 to Java 13.
- Java Swing proved to be the right choice for UI. Other technology, e.g. SWT, JavaFX or Web-based have not remained that stable over 10 years and would have required significant adaptations.
- Monolithic application is appropriate for such project (~50K LOC). Clean package and component separation is essential. Other approaches e.g. OSGi or service based would have often required reengineering and adaptations.
- Data bus concept proved to be extremely flexible and extensible. Numerous data sources and consumers added without any changes being necessary.
- Build system migrated from ant to gradle: minor change.