VSD FINAL PRESENTATION

SPACE SYSTEM REFERENCE DATABASE

INNOVATING SOLUTIONS

OVERVIEW

The Space System Reference Data Base (SSRDB) acts as the information hub for model management and data sharing.

SSRDB provides services to the SSDE and SSVT tools through a common interface.

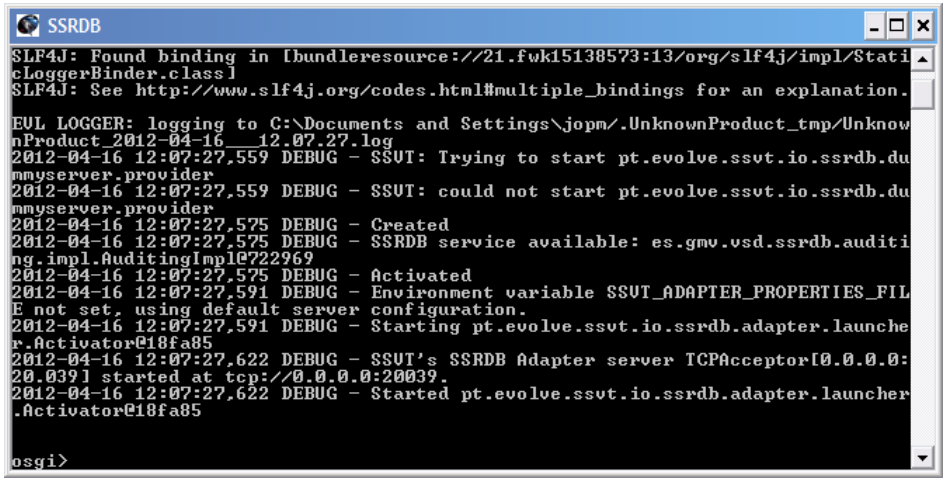
A simple SSRDB MMI has been developed to allow administration and testing of the provided services.

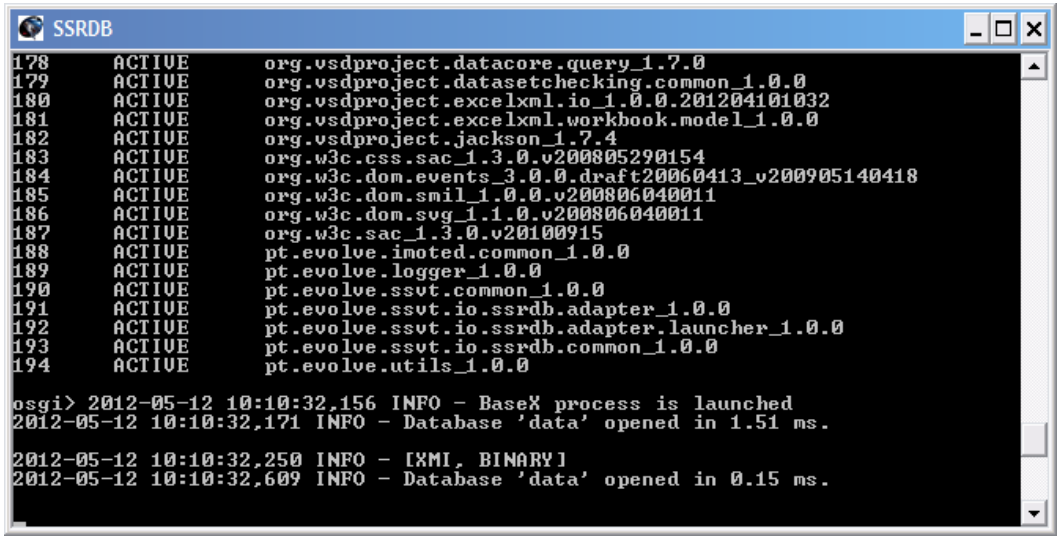
SSRDB MMI

SSRDB runs in an Equinox OSGi container.

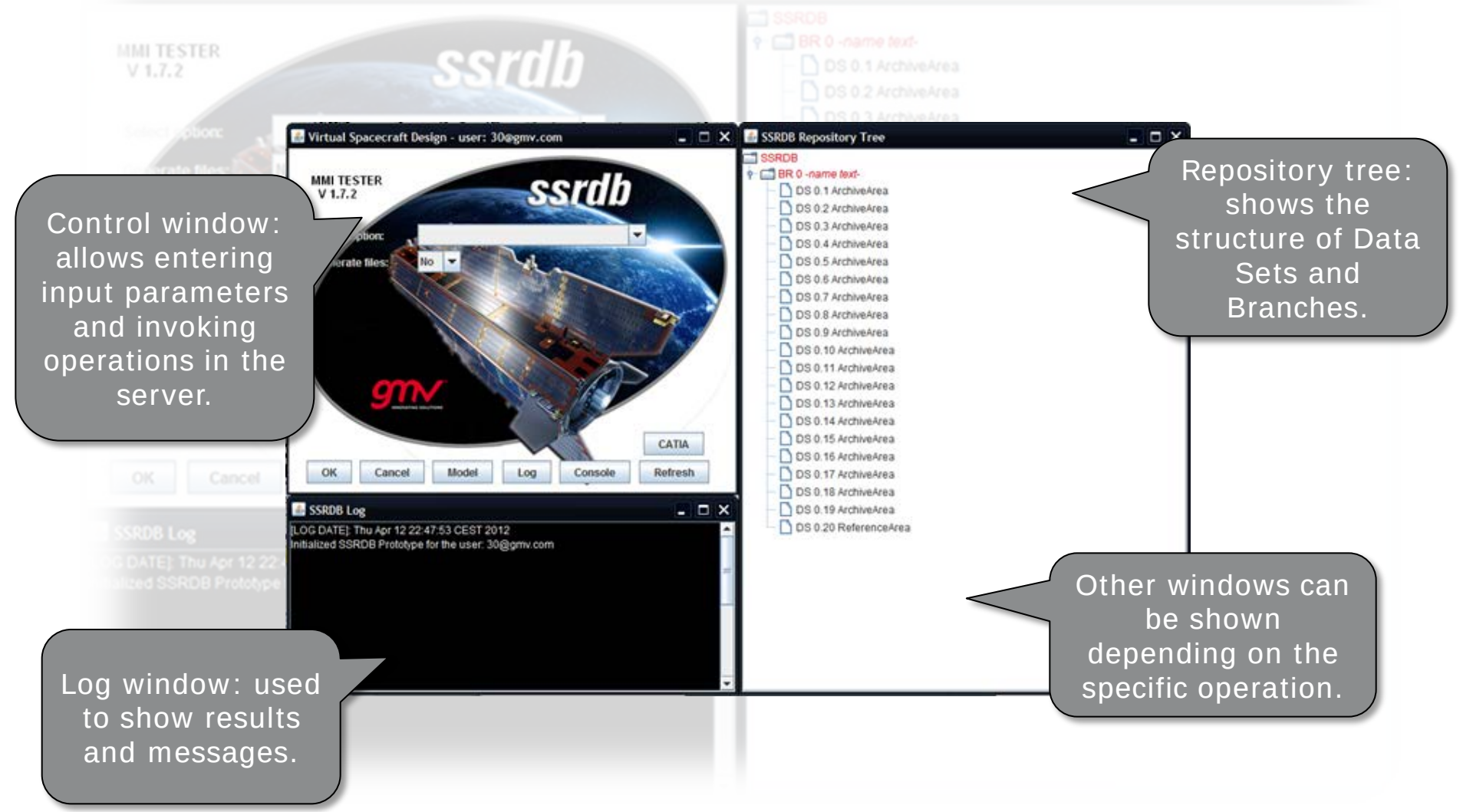
The OSGi console accepts commands to manage the Equinox container, e.g. for starting, stopping, adding, removing, or listing the installed bundles.

The console also shows messages from background processes.





SSRDB MMI



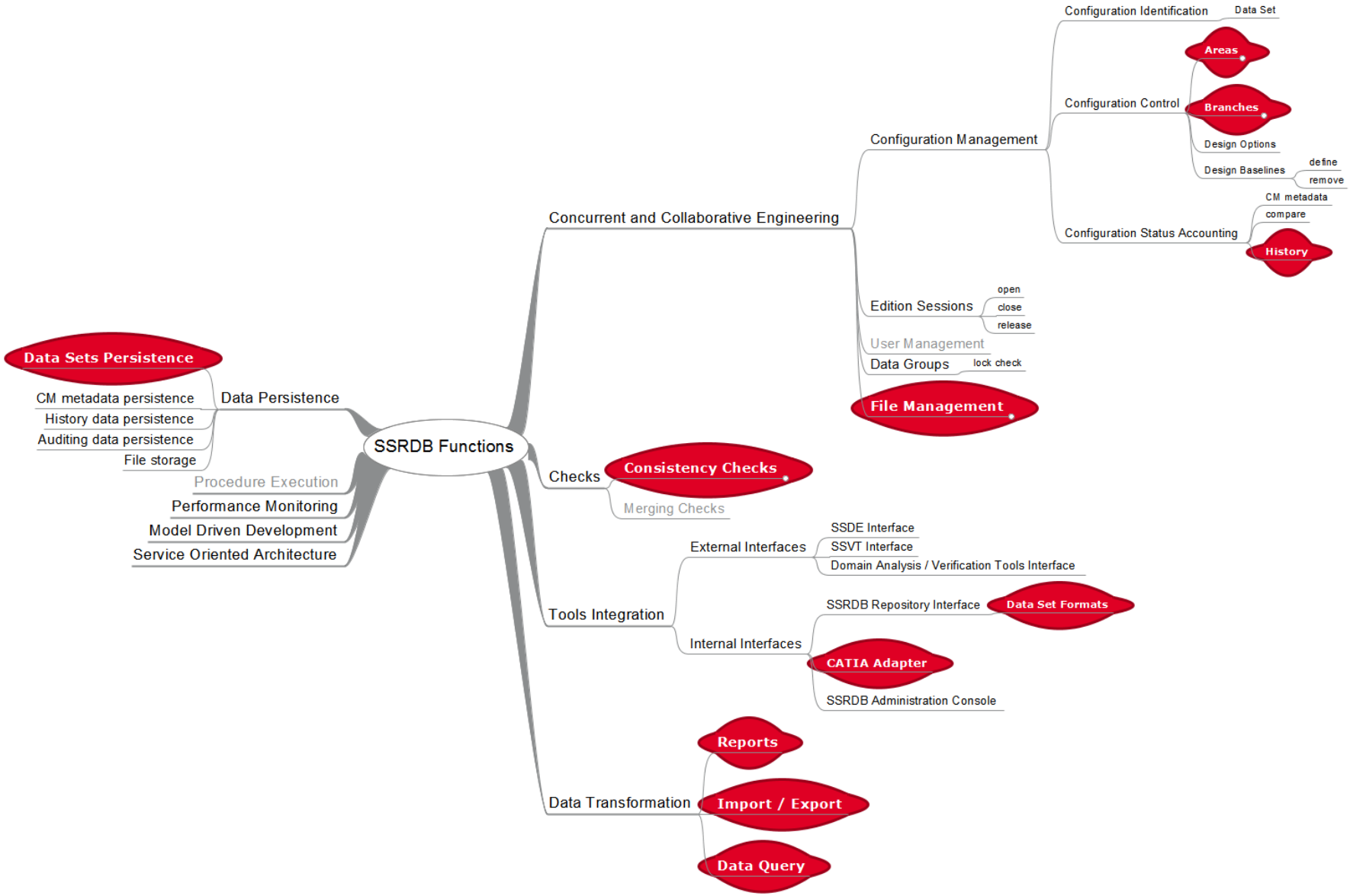
Control window: allows entering input parameters and invoking operations in the server.

Repository tree: shows the structure of Data Sets and Branches.

Log window: used to show results and messages.

Other windows can be shown depending on the specific operation.

SSRDB KEY FUNCTIONS



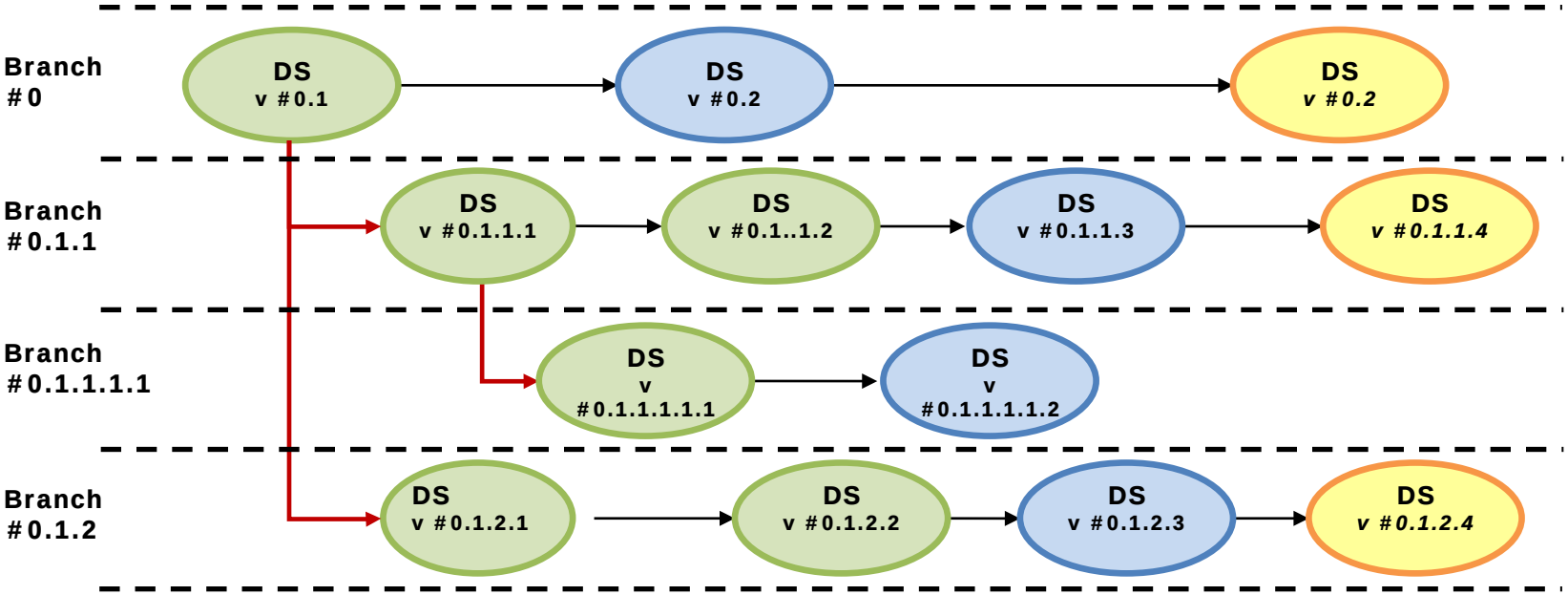
SSRDB KEY FUNCTIONS
Persistence

Obviously one of the key functions in SSRDB is to persist data. There are many types of data persisted by SSRDB:

- Data Sets (file system and BaseX)
  - In three formats: XMI, EMF Binary and QDBM (Estore).
  - Transformations are automatic: the Data Set can be stored in one format and retrieved in another different format.
- Engineering Data Files (file system)
  - External files referred to in the Data Set, such as CATIA model files.
- Configuration Management Metadata (H2 RDBMS)
  - To track the configuration status (versions, branches, available formats, etc).
- History Data (H2 RDBMS)
  - To track changes in Data Sets along the time.
- Auditing Data (H2 RDBMS)
  - To trace the duration of the operations.

SSRDB KEY FUNCTIONS
Configuration Control

- Responsible for enforcing the Data Sets life cycle (check-in, check-out, commit, discard…), providing versioning.
- Concurrent Engineering support by means of Branches (split/merge) and Edition Sessions (locking).
- Configuration Status Accounting (metadata about versions, branches, etc) can be requested by the client.



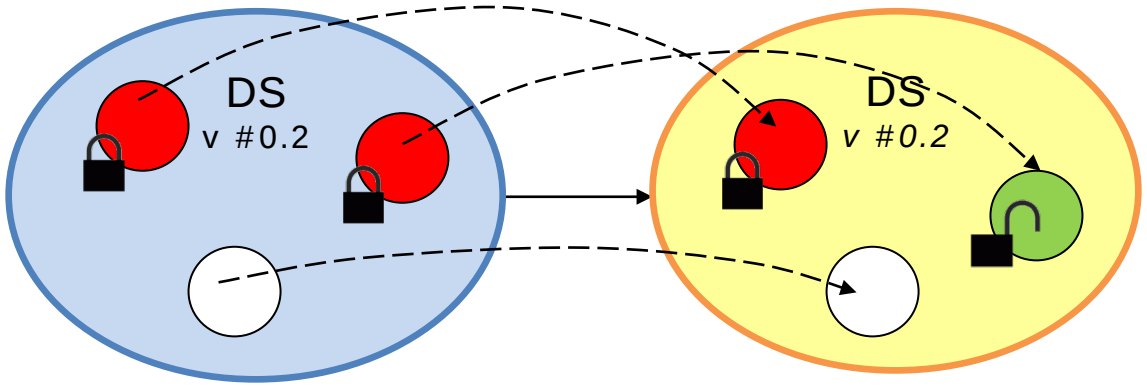
SSRDB KEY FUNCTIONS
Configuration Control

Video (7’ 38’’) showing most of the CM features of SSRDB:

- Create trunk
- Edit DataSet
- Commit DataSet
- Check-in DataSet
- Check-out DataSet
- Split Branch
- Merge Branch
- Compare DataSets
- Discard DataSet

SSRDB KEY FUNCTIONS
Ownership Tracking

- By means of Data Groups, subsets of a Data Set can be marked.
- Some operations, such as Import or CATIA Adapter mark the data they obtain in order to keep track of its origin.
- Data Groups can be locked so that SSRDB can check whether a locked Data Group has been modified between two versions.



SSRDB KEY FUNCTIONS
History

- The History function is in charge of providing information regarding changes in VPVs along the time (list of Data Sets).
- Accepts as input a list of EDIs, a list of VPs (per EDI) and a list of Data Sets.
- Produces as output an Excel file showing ‘gaps’ when no VPV exists for the relevant dimensions, and marking in color changes in VPV values.
- History data is extracted in a background process, and stored separately for later use.

	A	B	C	D	E
1	HISTORY		VERSION	0.1	0.2
2	ENGINEERING DATA ITEM	VALUE PROPERTY	CATEGORY	VALUE PROPERTY VALUE	VALUE PROPERTY VALUE
3	Acceleration Velocity Test	VerificationStage	PerformedVerification	Acceptance	Acceptance
4	Acceleration Velocity Test	VerificationLevel	PerformedVerification	01-Spacecraft	01-Spacecraft
5	ASMN	faultVoltageEmssionMin	ASMIF	-1.0	-1.0
6	ASMN	nominalVoltageOutMax	ASMIF		5.0
7	ASMN	nomnialVoltageOutMin	ASMIF		0.0
8	ASMN	faultVoltageToleranceMin	ASMIF		-18.0
9	ASMN	faultVoltageToleranceMax	ASMIF	18.0	18.0
10	ASMN	faultVoltageEmissionMax	ASMIF	16.0	16.0
11	ASMN	outputImpedance	ASMIF	5000.0	5000.0
12	Attach with the Screws	IsCritical	Criticality	true	true
13	BaseHalfPanel1	LocalReferenceSystemPosition	Position Properties	[0.0,0.0,0.0]	[0.0,0.0,0.0]
14	BaseHalfPanel1	LocalReferenceSystemCosines	Position Properties	[[0.005175956093753899,0.004350755846686	[[0.005175956093753899,0.004350755846686
15	BaseHalfPanel1	IsThermallyModeled		true	true
16	BaseHalfPanel1	Volume	EquipmentCategory	0.0266133975	0.0266133975
17	BaseHalfPanel1	CATIA Mapping	CATIA Properties	GOCE::Platform::Primary Structure::BaseHa	GOCE::Platform::Primary Structure::BaseHa
18	BaseHalfPanel1	CATIA Instance Name	CATIA Properties	"BaseHalfPanel1"	"BaseHalfPanel1_test"
19	BaseHalfPanel1	CATIA Part Number	CATIA Properties	"BaseHalfPanel1"	"BaseHalfPanel1_test"
20	BaseHalfPanel1	Thermal Capacity	Element Thermal Properties	10565	10565

SSRDB KEY FUNCTIONS
History

Video (3’ 29’’) showing a History example:

- Based on Data Set with data imported from CATIA
- 20 versions where mass properties have been modified
- SSRDB initialized with all 20 versions already checked-in
- History report shows modifications of values and removing/addition of EDI

SSRDB KEY FUNCTIONS
File Management

Very simple way to store in SSRDB the physical files referred to in the Data Set.

- Files are uniquely identified by an URI (vsee://...), can be attached to a Data Set or not.
- Provided functions are:
  - Upload File
  - Exists File
  - Get Checksum (sha-256)
  - Compare Files (based on checksum)
  - Download File
  - Delete File
- Other operations such as Merge Branch or Check-out take the files into account.

SSRDB KEY FUNCTIONS
Consistency Checks

The Consistency Checks are aimed to check the contents of a Data Set.

- Checks can be added or removed without restarting.
- Checks can be used on SSRDB or on SSDE without modifications, giving the same results for the same Data Set.
- User can select a set of checks to run.
- The Data Set is modified by the checks: inconsistency data is annotated and also a CheckReport is included into the Data Set gathering all the annotations produced by the check.
- Checks can be implemented in OCL or Java (EMF Validate)

SSRDB KEY FUNCTIONS
Consistency Checks

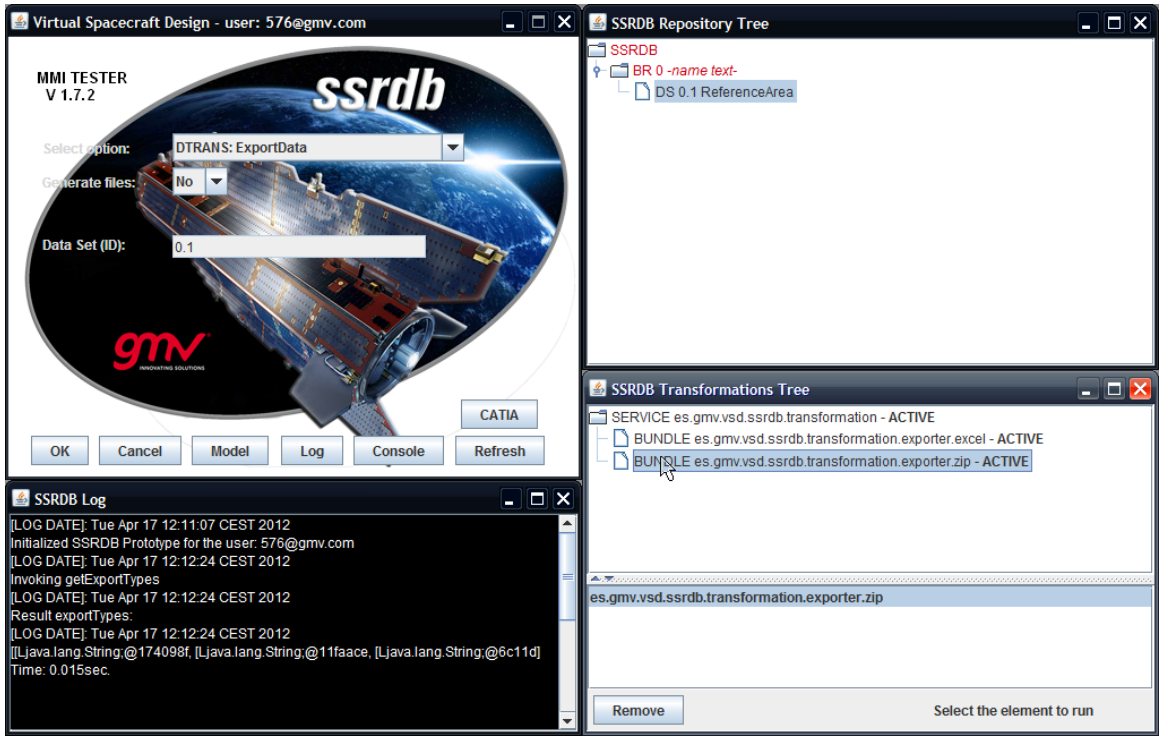
Video (4’ 26’’) showing the following aspects:

- Deployment of a check from the client into the server.
- Addition and removing of a check in the server without shutdown.
- Execution of the check and inspection of the resulting DataSet.

SSRDB KEY FUNCTIONS
Import/Export

SSRDB allows to add import and export implementations, and run them on demand.

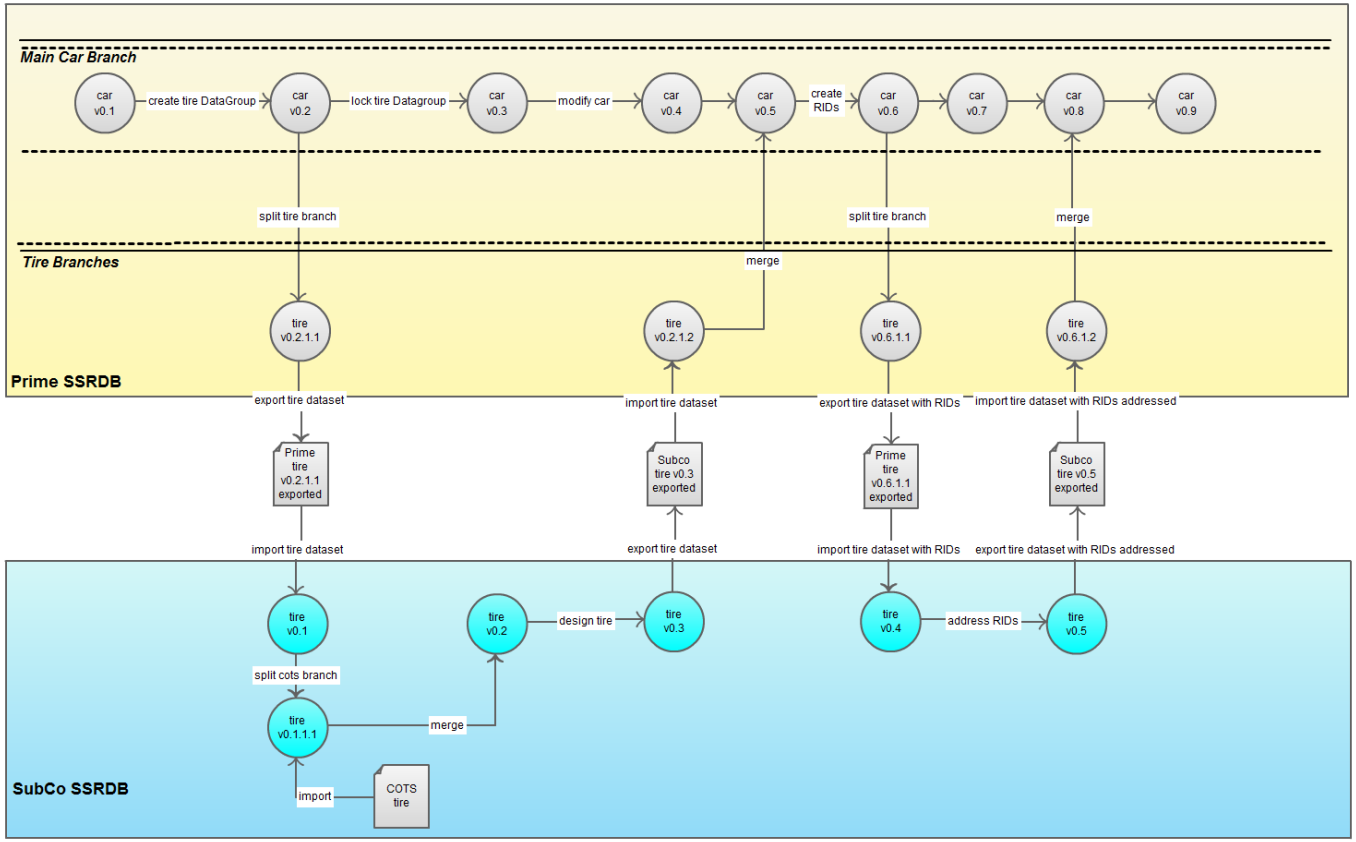
- Exports are able to transform the data in a Data Set into something else.
- Imports are able to transform something into a Data Set that is stored in the repository.
  - The imported data can be marked in order to keep trace of its origin.



SSRDB KEY FUNCTIONS
Import/Export

Main use case for this function is the exchange of Data Sets in zip archive format between two SSRDB installations (e.g. prime and supplier).

- The zip archive also includes the external files.



SSRDB KEY FUNCTIONS
Reports

Reports are able to transform the data in a Data Set into documentation (Word, Excel, PDF…).

- Each report is able to perform one transformation.
- SSRDB allows to add reports and run them on demand.
- Examples of existing reports: Auditing, VCD, Mass Budget, Power Budget.

SSRDB KEY FUNCTIONS
Reports

- VCD example (PDF)

Reqm't ID	Requirement Title & Text	SoC (i.e. Status of Compilance)	Compliance (RFW,RFD)	Verification Levels/ Methods			Qual. (Q) / Accept. (A)	Execution Doc. (e.g. test procedure)	Reporting Doc. / Para. (e.g. test report)	VCB (Verification Control Board)		
				SY	SS	EQ				Remarks	VCB Ref.	APPR
4.3.1.1	CPM Attitude Constraints General When in Coarse Pointing the satellite attitude shall be maintained within the proper domain in order to assure: – power availability to cope with satellite demand and battery recharging – orbit altitude decay such to be compatible with an 8 days ground outage – capability of initiating an orbit altitude raise without needing attitude reorientation			R			A	S/C Architecture/ Design Review				
				A			A	DFACS FPM Analysis				
4.3.1.2	Sun Aspect Angle When in Coarse Pointing the angle between the sun vector and the spacecraft Y-axis shall be less than 40 degree half-cone			T			A	DFACS CPM Test				
				R			A	S/C Architecture/ Design Review				
				A			A	CPM Analysis				
4.3.1.3	CPM Attitude Constraints - X-axis Pointing Domain When in Coarse Pointing the angle between the orbital velocity vector and the spacecraft X-axis shall be less than 10 degree half- cone			T			A	DFACS CPM Test				
				R			A	S/C Architecture/ Design Review				
				A			A	CPM Analysis				

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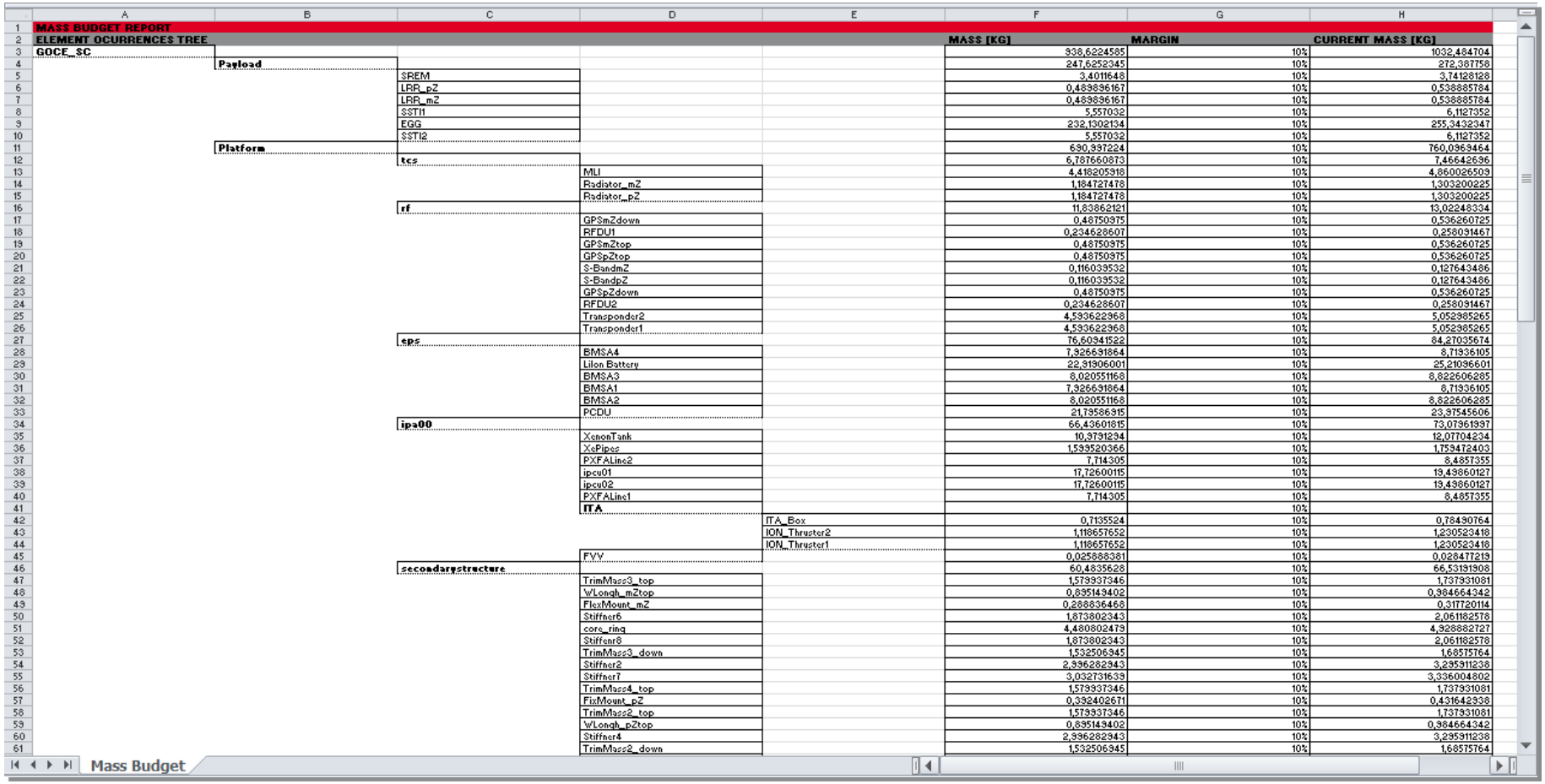
SSRDB KEY FUNCTIONS
Reports

- Mass Budget (Excel XML)

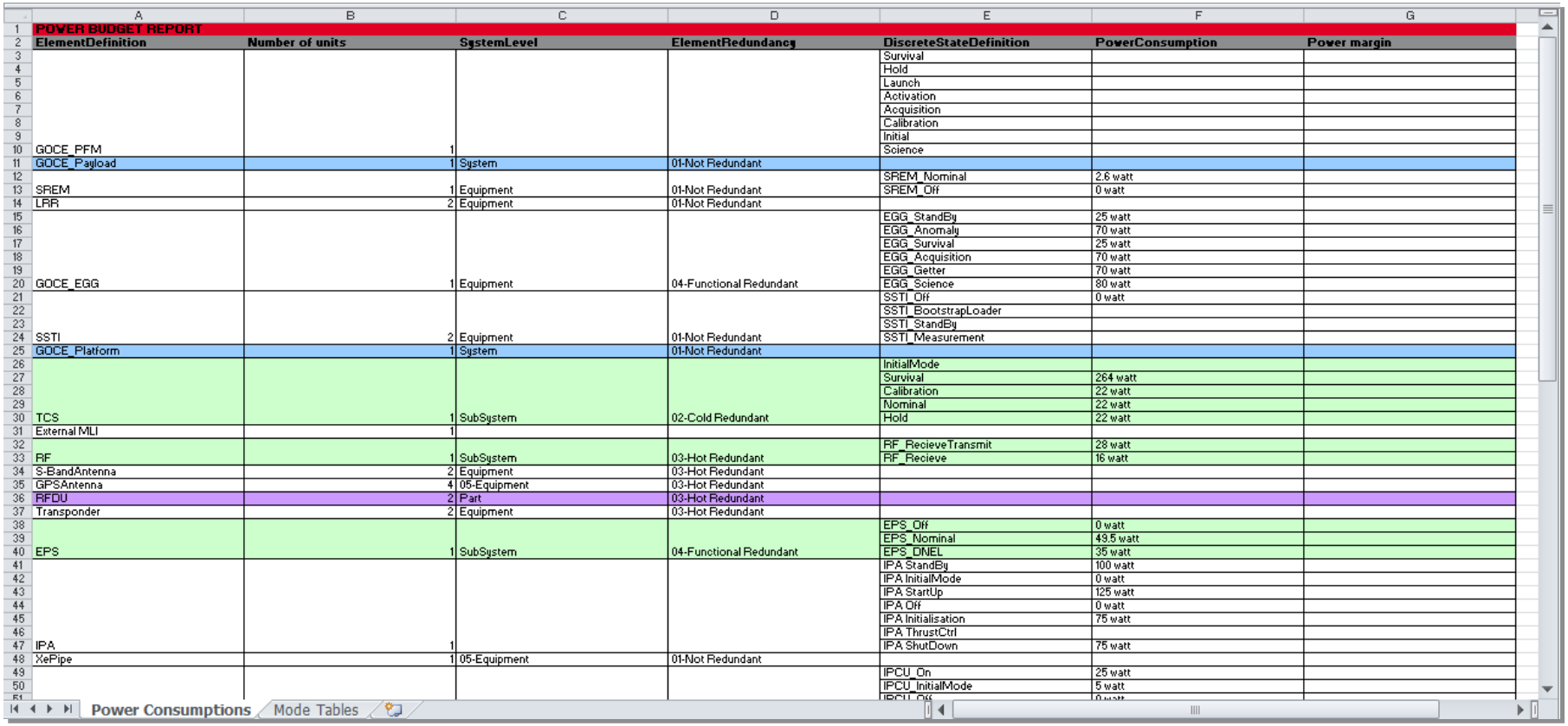


					MASS [KG]	MARGIN	CURRENT MASS [KG]
MASS BUDGET REPORT							
ELEMENT OCURRENCES TREE							
GOCE_SC					338,6224585	10%	1032,484704
	Payload				247,6252345	10%	272,387758
		SREM			3,4011648	10%	3,74128128
		LRR_pZ			0,489836167	10%	0,538885784
		LRR_mZ			0,489836167	10%	0,538885784
		SSTI1			5,557032	10%	6,1127352
		EGG			232,1302134	10%	255,3432347
		SSTI2			5,557032	10%	6,1127352
	Platform				630,337224	10%	760,0363464
		tcs			6,787660873	10%	7,466642636
			MLI		4,418205318	10%	4,860026509
			Radiator_mZ		1,184727478	10%	1,303200225
			Radiator_pZ		1,184727478	10%	1,303200225
		rf			11,83862121	10%	13,02248334
			GPSmZdown		0,48750375	10%	0,536260725
			RFDU1		0,234628607	10%	0,258091467
			GPSmZtop		0,48750375	10%	0,536260725
			GPSpZtop		0,48750375	10%	0,536260725
			S-BandmZ		0,116039532	10%	0,127643486
			S-BandpZ		0,116039532	10%	0,127643486
			GPSpZdown		0,48750375	10%	0,536260725
			RFDU2		0,234628607	10%	0,258091467
			Transponder2		4,533622368	10%	5,052385265
			Transponder1		4,533622368	10%	5,052385265
		eps			76,60941522	10%	84,27035674
			BMSA4		7,326631864	10%	8,71936105
			Lilon Battery		22,31906001	10%	25,21036601
			BMSA3		8,020551168	10%	8,822606285
			BMSA1		7,326631864	10%	8,71936105
			BMSA2		8,020551168	10%	8,822606285
			PCDU		21,79586315	10%	23,97545606
		ipa00			66,43601815	10%	73,07961997
			XenonTank		10,9791234	10%	12,07704234
			XePipes		1,539520366	10%	1,759472403
			PXFALine2		7,714305	10%	8,4857355
			ipcu01		17,72600115	10%	19,49860127
			ipcu02		17,72600115	10%	19,49860127
			PXFALine1		7,714305	10%	8,4857355
			ITA			10%	
				ITA_Box	0,7135524	10%	0,78490764
				ION_Thruster2	1,118657652	10%	1,230523418
				ION_Thruster1	1,118657652	10%	1,230523418
			FVV		0,025888381	10%	0,028477219
		secondarystructure			60,4835628	10%	66,53191908
			TrimMass3_top		1,579337346	10%	1,737931081
			WLongh_mZtop		0,895143402	10%	0,984664342
			FlexMount_mZ		0,288836468	10%	0,317720114
			Stiffner5		1,873802343	10%	2,061182578
			core_ring		4,480802479	10%	4,928882727
			Stiffenr8		1,873802343	10%	2,061182578
			TrimMass3_down		1,532506345	10%	1,68575764
			Stiffner2		2,936282343	10%	3,229911238
			Stiffner7		3,032731639	10%	3,336004802
			TrimMass4_top		1,579337346	10%	1,737931081
			FixMount_pZ		0,392402671	10%	0,431642938
			TrimMass2_top		1,579337346	10%	1,737931081
			WLongh_pZtop		0,895143402	10%	0,984664342
			Stiffner4		2,936282343	10%	3,229911238
			TrimMass2_down		1,532506345	10%	1,68575764

Mass Budget

SSRDB KEY FUNCTIONS
Reports

- Power Budget (Excel XML)



	A	B	C	D	E	F	G
1	POWER BUDGET REPORT						
2	ElementDefinition	Number of units	SystemLevel	ElementRedundancy	DiscreteStateDefinition	PowerConsumption	Power margin
3					Survival		
4					Hold		
5					Launch		
6					Activation		
7					Acquisition		
8					Calibration		
9					Initial		
10	GOCE_PFM	1			Science		
11	GOCE_Payload	1	System	01-Not Redundant			
12					SREM_Nominal	2.6 watt	
13	SREM	1	Equipment	01-Not Redundant	SREM_Off	0 watt	
14	LRR	2	Equipment	01-Not Redundant			
15					EGG_StandBy	25 watt	
16					EGG_Anomaly	70 watt	
17					EGG_Survival	25 watt	
18					EGG_Acquisition	70 watt	
19					EGG_Getter	70 watt	
20	GOCE_EGG	1	Equipment	04-Functional Redundant	EGG_Science	80 watt	
21					SSTI_Off	0 watt	
22					SSTI_BootstrapLoader		
23					SSTI_StandBy		
24	SSTI	2	Equipment	01-Not Redundant	SSTI_Measurement		
25	GOCE_Platform	1	System	01-Not Redundant			
26					InitialMode		
27					Survival	264 watt	
28					Calibration	22 watt	
29					Nominal	22 watt	
30	TCS	1	SubSystem	02-Cold Redundant	Hold	22 watt	
31	External MLI	1					
32					RF_RecieveTransmit	28 watt	
33	RF	1	SubSystem	03-Hot Redundant	RF_Recieve	16 watt	
34	S-BandAntenna	2	Equipment	03-Hot Redundant			
35	GPSAntenna	4	05-Equipment	03-Hot Redundant			
36	RFDU	2	Part	03-Hot Redundant			
37	Transponder	2	Equipment	03-Hot Redundant			
38					EPS_Off	0 watt	
39					EPS_Nominal	49.5 watt	
40	EPS	1	SubSystem	04-Functional Redundant	EPS_DNEL	35 watt	
41					IPA StandBy	100 watt	
42					IPA InitialMode	0 watt	
43					IPA StartUp	125 watt	
44					IPA Off	0 watt	
45					IPA Initialisation	75 watt	
46					IPA ThrustCtrl		
47	IPA	1			IPA ShutDown	75 watt	
48	XePipe	1	05-Equipment	01-Not Redundant			
49					IPCU_On	25 watt	
50					IPCU_InitialMode	5 watt	

Power Consumptions | Mode Tables

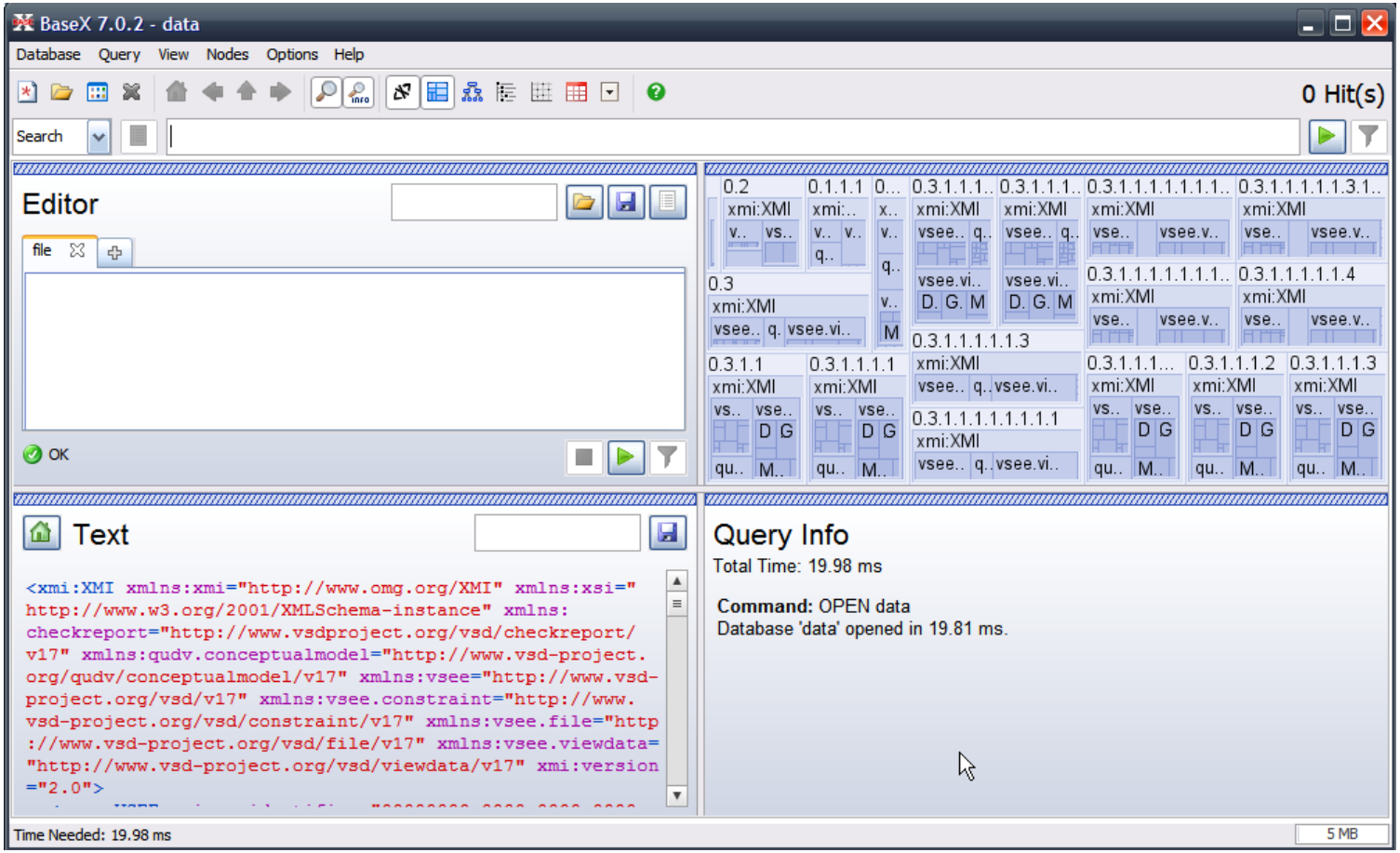
SSRDB KEY FUNCTIONS
Data Query

- Allows extraction of any data using a query language.
- The query can involve one or several Data Sets stored in SSRDB.
- The query language is XQuery.
- A background process creates an XML database from the XMI files.
- Alternative to the current History implementation.

 Video (3’ 11’’) showing extraction of data from one and several Data Sets.

SSRDB KEY FUNCTIONS
Data Query

Alternatively, the BaseX MMI could be used for querying data.

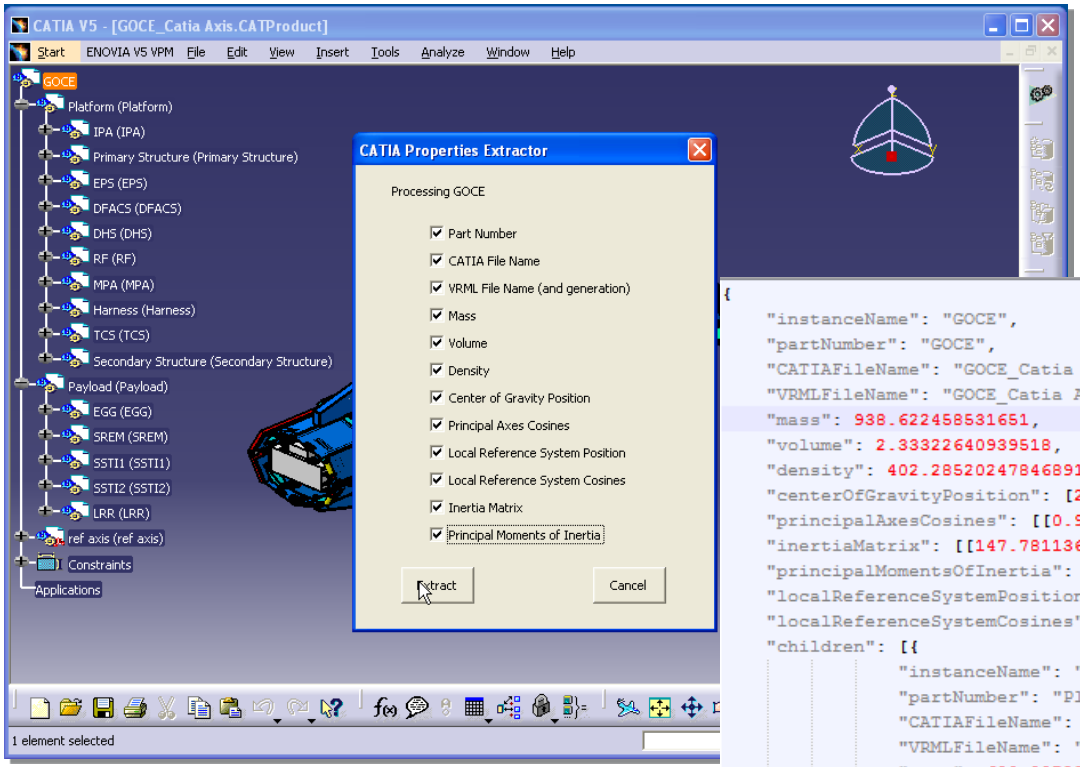


SSRDB KEY FUNCTIONS
CATIA Integration

The purpose of the CATIA Integration is to incorporate into a Data Set Value Property Values coming from properties defined in the CATIA model.

- The CATIA Properties Extractor extracts properties from the CATIA model into a JSON file. It also export VRML files.
- The CATIA Mapper transforms the properties in the JSON file into VPVs that are integrated into a Data Set.
  - The correspondence between the CATIA product structure and the VSEE topological hierarchy is defined by the user by means of a CATIA Mapper MMI developed by ScopeSET.

SSRDB KEY FUNCTIONS
CATIA Integration




```
{
    "instanceName": "GOCE",
    "partNumber": "GOCE",
    "CATIAFileName": "GOCE_Catia Axis.CATProduct",
    "VRMLFileName": "GOCE_Catia Axis.CATProduct.wrl",
    "mass": 938.622458531651,
    "volume": 2.33322640939518,
    "density": 402.28520247846891813770767796,
    "centerOfGravityPosition": [2.34515490514296, -3.97443158603925E-02, -4.52465929680076E-03],
    "principalAxesCosines": [[0.999966166466458, -8.19123482310493E-03, -7.54714812495164E-04], [-
    "inertiaMatrix": [[147.7811362266, 15.4004744258296, 1.38788274727982], [15.4004744258296, 202
    "principalMomentsOfInertia": [147.653935564876, 1998.11465966052, 2027.96892567953],
    "localReferenceSystemPosition": [0, 0, 0],
    "localReferenceSystemCosines": [[1, 0, 0], [0, 1, 0], [0, 0, 1]],
    "children": [{
            "instanceName": "Platform",
            "partNumber": "Platform",
            "CATIAFileName": "Platform.CATProduct",
            "VRMLFileName": "Platform.CATProduct.wrl",
            "mass": 690.997224001076,
            "volume": 1.59601997704026,
            "density": 432.95023492280850288004116234,
            "centerOfGravityPosition": [2.44967048769484, -5.44865283386639E-02, -7.5243033917
            "principalAxesCosines": [[0.999975772450636, -6.7099850722509E-03, -1.852191157679
            "inertiaMatrix": [[124.99997931012, 11.866312896715, 3.21752703743745], [11.866312
            "principalMomentsOfInertia": [124.914394979093, 1865.36939856517, 1893.69343224095
            "localReferenceSystemPosition": [4.9737991503207E-13, 1.4210854715202E-13, 2.27373
            "localReferenceSystemCosines": [[1.88149734507703E-16, -1, -4.59701721133854E-17],
            "children": [{
                    "instanceName": "IPA",
```

Thank you

J. Pacios

Email: jpacios@gmv.com

www.gmv.com

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