

# Collaborative Assistive Tool To Enable Novel Solutions (CATTENS) DE Expansion

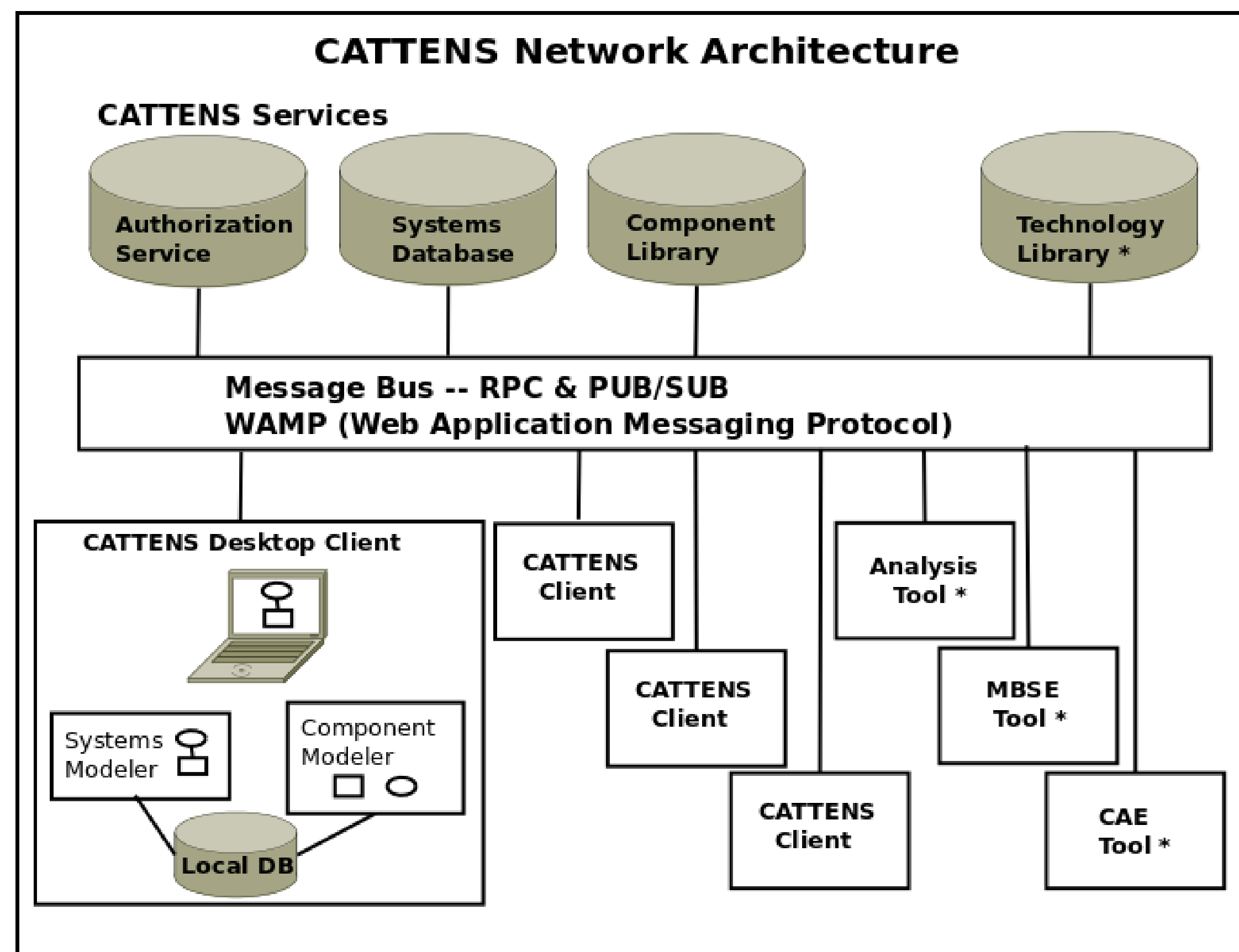
Stephen Waterbury / Code 585

CATTENS is a model-based, multi-disciplinary concurrent engineering tool ...

... whose purpose is to enable engineers and scientists to collaborate in defining and developing a mission or system concept. CATTENS has just completed its second year of development as an IRAD project and is currently scheduled for deployment in February 2018. The initial deployment target for CATTENS is the GSFC Mission Design Laboratory (MDL), but CATTENS will be made available to all GSFC engineers and scientists.

## CATTENS Digital Engineering (DE) Features

- **System Modeler** with expansion & navigation of a full system / subsystem assembly tree
- **Component Library** with reusable library items, sortable by parameters, filterable by product types
- **Component / Assembly Modeler** with drag and drop of Components into the Block Diagram (SysML IBD), drag and drop addition of Ports, and drag and drop connection of Ports (Flows)
- **Generates a Master Equipment List (MEL)** from a System assembly tree in GSFC standard Excel format
- **Tools:**
  - **CAD Viewer** imports a 3D MCAD model from any STEP (ISO 10303) file
  - **Optical Error Budget Tool** extracts structure and sensitivities from a **Linear Optical Model (LOM)**
  - **42 Input Tool** creates formatted input files for the **42 Attitude Control System Simulator**



## Component Library

Id	Name	Product Type	Mass [CBE] (kg)	Power [CBE] (W)
Board-0000675	Mustang Low Voltage Power Converter	Board	1.7	10.2
Board-0000680	Mustang Solar Array Module	Board	1.42	4.7
Board-0000678	Mustang Segment Module	Board	1.1	1.743
Board-0000717	Mustang Communication Card	Board	1.017	2.5
Board-0000716	Mustang Processor Card	Board	0.986	12.6
Board-0000719	Mustang Engine Valve Driver Card	Board	0.983	2.82
Board-0000679	Mustang Data Storage Board	Board	0.97	5.6
Board-0000718	Mustang Housekeeping Card	Board	0.9	2.3
Board-0000681	Mustang ACS IO Card	Board	0.76	13.9
Board-0000721	Mustang Output Module Card	Board	0.755	1.6
Board-0000677	Mustang Heater Module	Board	0.755	1.41
Board-0000676	Mustang Deployment Card	Board	0.7395	0.7
Board-0001029	Moog Broad Reach DC-DC regulated low voltage	Board	0.473	7.9
Board-0000741	Moog AJEET	Board	0.46	11.7
Board-0000814	Moog GCE Motor Driver Card	Board	0.41	4.0
Board-0001030	Camera Multi-Operational Analog Board (CMOAB)	Board	0.378	8.0
Board-0000738	Moog SACI	Board	0.352	6.0
Board-0000740	MOOG McLASI	Board	0.35	5.3
Board-0001017	Moog Broad Reach McLASI Card	Board	0.34	5.0
Board-0001046	Standard Multi-Operational Analog Board (SMOAB)	Board	0.322	5.7
Board-0000818	Moog GCE Controller Card	Board	0.31	2.5
Board-0001045	Analog Multi-Operational Avionics Board (AMOAB)	Board	0.31	4.6
Board-0000801	SEAKR SA/Battery Charger Card	Board	0.0	0.0
Board-0000812	SEAKR MAU Switch Card	Board	0.0	0.0

## Component / Assembly Modeler

The interface shows a block diagram of the **DSM B Attitude Control System** with components like Laser Ranger, Star Tracker, DTU STA, and IRU. Below the diagram is a **Mini MEL** table:

System/Subsystem Name	Id	Level	Qty	Mass [CBE] (kg)	Mass [MEV] (kg)	Power [CBE] (W)	Power [MEV] (W)	Data Rate [CBE] (bit/s)	Data Rate [MEV] (bit/s)	Vendor	Cost (\$)	TRL
DSM B Attitude Control System	DSM-ACS-0001066	1	1	10.31	30.0%	13.4	48.92	30.0%	63.6	0	0	0
[Alignment Sensors 2] DPS_ACS4	ACS-0001053	2	1	0.01	30.0%	0.013	0.3	30.0%	0.39	0	0	0
[Alignment Sensors 1] DPS_ACS3	ACS-0001079	2	1	0.01	30.0%	0.013	0.3	30.0%	0.39	0	0	0
[CSS] Adcole Coarse Sun Sensor	DSM-CSS-0001035	2	12	0.16	30.0%	0.208	0.01	30.0%	0.013	0	0	0
[Camera] Alignment Camera	DSM-Instrument-0001255	2	1	1.0	30.0%	1.3	1.0	30.0%	1.3	0	0	0
[IRU] Northrop_IRU	DSM-IRU-0001056	2	1	7.1	30.0%	9.23	43.0	30.0%	55.9	0	0	0
[Laser Ranger] Laser Ranger	DSM-OpticalComp-0001256	2	1	0	0	0	0	0	0	0	0	0
[Ranging Sensors] DPS_ACS2	DSM-ACS-0001065	2	1	0.01	30.0%	0.013	0.3	30.0%	0.39	0	0	0

## System Modeler

The System Modeler interface displays a **Systems Dashboard: SounderSat-2** with a table of system parameters:

System	Mass [CBE] (kg)	Mass [MEV] (kg)	Power [CBE] (W)	Power [MEV] (W)	Data Rate [CBE] (bit/s)	Data Rate [MEV] (bit/s)	Vendor	Cost (\$)	TRL			
[Observatory] SounderSat Observatory	674.6	15.6	779.9	597.1	21.4	724.7	0.0	9,231,000.0	30.0	12,000,000.0	0.0	0
[Instrument 1] Generic SounderSat Instrument	76.52	30.0	100.0	250.0	30.0	300.0	0.0	9,231,000.0	30.0	12,000,000.0	0.0	0
[DC 1] SounderSat-2 Spacetrack	597.7	13.8	676.9	366.3	15.9	424.7	0.0	0.0	30.0	0.0	0.0	0
[Attitude Control System] ACS Subsystem	34.77	10.2	38.33	95.44	10.0	105.0	0.0	0.0	30.0	0.0	0.0	0
[ECADH] Avionics Subsystem	11.2	10.0	12.32	49.0	30.0	79.3	0.0	0.0	30.0	0.0	0.0	0

Below the dashboard is a block diagram showing the **SounderSat-2 Spacetrack** with subsystems like Avionics, Electrical Power, Mechanical, and Thermal.

## Tools: Optical Error Budget Tool, CAD Viewer

The **Linear Optical Model for Instrument, v.0** interface shows a block diagram of optical components: PCS, Optical Stop, PRIMARY, SECONDARY, FOLD 1, and EAP. Below is a table of optical surface parameters:

Optical Surface Name	dRMS_dRBM_dx	dRMS_dRBM_dy	dRMS_dRBM_dz	dRMS_dRBM_rx	dRMS_dRBM_ry	dRMS_dRBM_rz	dRMS_dRoC	
1 PCS	4.653e-10	4.617e-10	4.655e-10	0.6226	0.6236	0.007882	0.0	
2 Optical Stop	1.646e-07	1.707e-07	2.051e-09	4.467e-10	4.609e-10	4.845e-10	0.0	
3 PRIMARY	0.2138	0.2139	0.02308	1.228	1.229	4.592e-10	0.01147	
4 SECONDARY	0.1801	0.1802	0.02393	0.2378	0.2382	4.896e-10	0.008149	
5 FOLD 1	0.0	0.0	0.04887	0.02275	0.01848	4.721e-10	0.0	
6 EAP	0.0	4.2e-10	2.864e-10	4.583e-10	4.469e-10	4.61e-10	0.0	
7 FOLD 2	0.0	8.66e-14	0.01597	0.05147	0.04875	4.581e-10	0.0	
8 TERTIARY	0.06676	0.06642	0.01295	0.1108	0.1102	4.63e-10	0.009196	
9 IDA-EXP	0.0	0.0	3.698e-10	4.623e-10	4.598e-10	4.655e-10	0.0	0.0
10 FILTER Mask	0.0	0.0	3.596e-10	4.577e-10	4.6e-10	4.677e-10	0.0	0.0
11 FILTER S1	0.006867	0.006946	0.0009495	0.01042	0.0103	4.737e-10	5.434e-05	0.0
12 FILTER S2	0.006788	0.006867	0.0009748	0.0103	0.01018	4.642e-10	5.307e-05	0.0
13 FPA	0.0324	0.03277	0.01101	0.009031	0.001225	0.003891	0.0	0.0

The **3D CAD Model Viewer** shows a 3D rendering of the instrument's optical path, including a red sphere, a yellow lens, and a blue detector.

## CATTENS Architecture

CATTENS consists of 3 components:

1. A Desktop Client that can operate in either stand-alone or networked mode.
2. A Repository Service that holds the Systems Database and Component Library.
3. A Message Bus ("Crossbar") that enables Remote Procedure Calls (RPCs) and near-real-time Publish/Subscribe (Pub/Sub) messaging between the Desktop Client and services (Crossbar also supports peer-to-peer communication among clients; that has not yet been used in CATTENS but may be in the future).

CATTENS utilizes an Authorization Service, "Omnipotent Management Backend" or OMB, which has been developed by Michael Plante of Code 585 under the CATTENS IRAD.