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A Smart Thermal Block Diagram Tool

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Outline



- Problem Statement
- Solution Approach & Requirements
- Tool Overview Using a Simple Example
- Conclusions



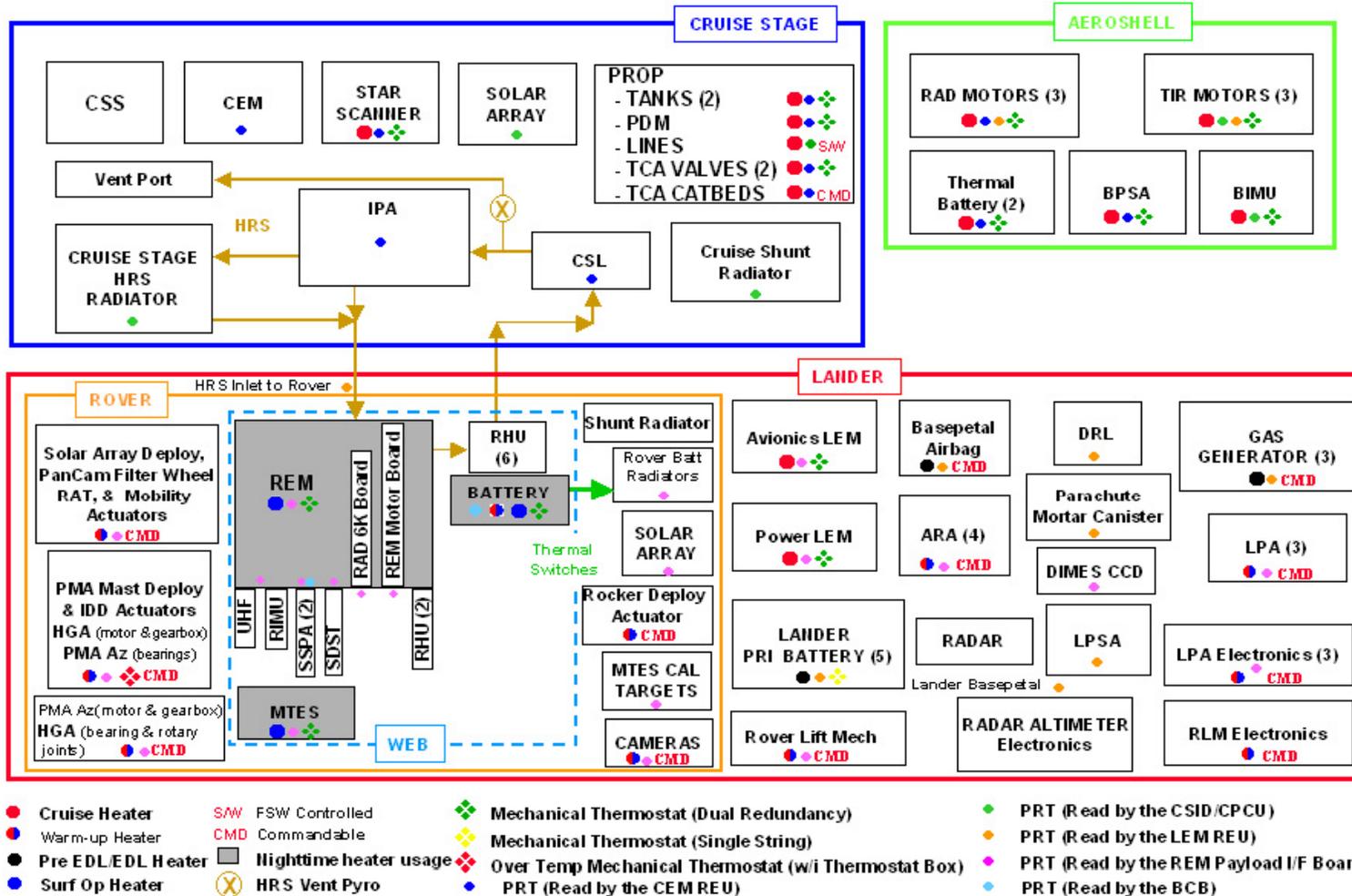
Problem Statement (1/2)



- A critical tool for identifying subsystem architecture is the block diagram
- No associative database capability to define types and quantities of subsystem resources.
- A protracted and manual process must occur to tabulate these resources and transfer them to appropriate cost estimating tools.



Problem Statement (2/2)





Solution Approach (1/3)



- Block diagram templates for typical JPL missions and instruments (e.g., Orbiters, Landers, Rovers) will be developed
- User will have capability to select thermal subsystem resources as icons and locate each icon in appropriate engineering subsystem or payload element



Solution Approach (2/3)



- User will have capability to edit thermal block diagram as needed
- Block diagram tool produces graphical depiction of thermal subsystem, compiles thermal subsystem resources, and determines mass & cost estimates using a JPL Thermal Cost Database



Requirements (1/2)

- Use existing COTS software that can be adapted to our purpose
 - MS Visio is an example of such software
- The tool shall be compatible with Team X workstations
- Block diagram development shall consider typical JPL missions & instruments (e.g., Orbiters, Landers, Rovers)
- References to engineering subsystems & payload elements shall be consistent with the JPL standard WBS



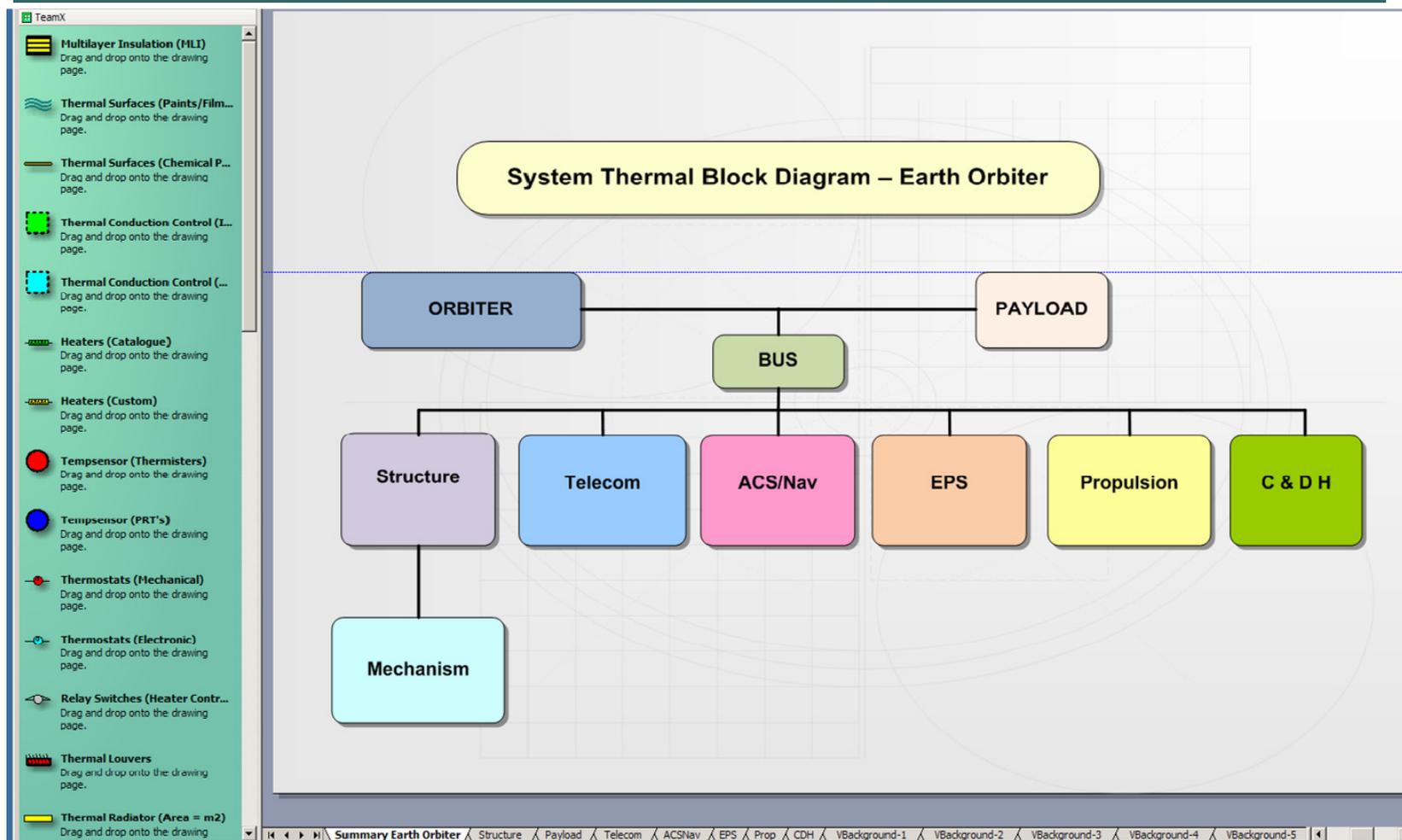
Requirements (2/2)



- Thermal subsystem resources shall be mapped one-to-one with the existing JPL Thermal Cost Database
- Output shall be directly usable or importable into the Thermal Cost Estimating Tool



System Sheet for Earth Orbiter





Telecom Subsystem Sheet



Search for elements

Type your search here

TeamX

- Multilayer Insulation (MLI)**
Drag and drop onto the drawing page.
- Thermal Surfaces (Paints/Film...)**
Drag and drop onto the drawing page.
- Thermal Surfaces (Chemical P...)**
Drag and drop onto the drawing page.
- Thermal Conduction Control (L...)**
Drag and drop onto the drawing page.
- Thermal Conduction Control (...)**
Drag and drop onto the drawing page.
- Heaters (Catalogue)**
Drag and drop onto the drawing page.
- Heaters (Custom)**
Drag and drop onto the drawing page.
- Tempensor (Thermistors)**
Drag and drop onto the drawing page.
- Tempensor (PRT's)**
Drag and drop onto the drawing page.
- Thermostats (Mechanical)**
Drag and drop onto the drawing page.
- Thermostats (Electronic)**
Drag and drop onto the drawing page.
- Relay Switches (Heater Contr...)**
Drag and drop onto the drawing page.
- Thermal Louvers**
Drag and drop onto the drawing page.

Export

System Thermal Block Diagram – Earth Orbiter – Telecom

Legend

●	2	Tempensor (Thermistors)
+	1	Thermostats (Mechanical)
-	1	Heaters (Catalogue)
■	1	Multilayer Insulation (MLI)

← Back

Summary Earth Orbiter | Structure | Payload | **Telecom** | ACSNav | EPS | Prop | CDH | VBackground-1 | VBackground-2 | VBackground-3 | VBackground-4 | VBackground-5



Telecom Subsystem Thermal Control Elements Used



Components	
<i>Master Name</i>	<i>Quantity</i>
Heaters (Catalogue)	1
Multilayer Insulation (MLI)	1
Tempensor (Thermisters)	2
Thermostats (Mechanical)	1



Thermal Cost Tool Hardware Mass & Power Required



			Power Consuming ?	Mass	Contingency	CBE + Contingency
		Unit	(Y/N)	[kg]	%	[kg]
TOTAL				41.22	29%	53.06
Thermal (Spacecraft only)				41.22	29%	53.06
Multilayer Insulation (MLI)		1.0	N	34.28	30%	44.56
Thermal Surfaces			N	1.33	30%	1.73
Paints/Films		0.0				
Chemical Processes		0.0				
Thermal Conduction Control			N	1.69	30%	2.19
Isolation G-10		0.0				
High Cond		0.0				
Heaters			Y			
Catalogue		1.0		0.05	15%	0.06
Custom		0.0		0.00	30%	0.00
Temperature Sensors						
Thermistors		2.0	Y	0.02	10%	0.02
PRT's		0.0		0.00	10%	0.00
2 Wire				0.00	10%	0.00
4 Wire				0.00	10%	0.00
Thermostats			Y			
Mechanical		1.0	Y	0.05	30%	0.07



Thermal Hardware Cost



- The same hardware tally information was imported into a JPL thermal hardware cost database & an estimate was computed
- Results were withheld due to the proprietary nature of this information



Conclusions



- A block diagram tool was developed & it produces graphical depiction of thermal subsystem, compiles thermal subsystem resources, and determines mass & cost estimates using the JPL Thermal Mass & Cost Databases
- This results in a rapid & controlled process for Pre-Phase A thermal design conceptual definition