

Capabilities Mapping

Utilizing Small Satellites

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Agenda

- Space Industry Faces a Dilemma
- Silver Lining Amongst the Challenges
- Method
- Operational Mission
- Conclusion

Dilemma

- Budgets are being reduced, costs are rising
- Needs are changing more rapidly
- Stakeholders want more in less time
- Commercial markets deliver more & faster
 - Creates a culture of,
“User want more capability now with a lower cost”

Opportunity

- Technology is evolving
 - Evolving at same rate needs are changing is questionable
- Satellite capabilities have increased while the SWaP has been reduced
- Standardized equipment is emerging
- Cubesats achieving successful on-orbit testing and experimentation
- Next phase of the evolution:

Operational Mission

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Commercial Market Has Evolved

Store,
retrieve,
process
information



Capture
image



Two-way
communication



Determine
directions

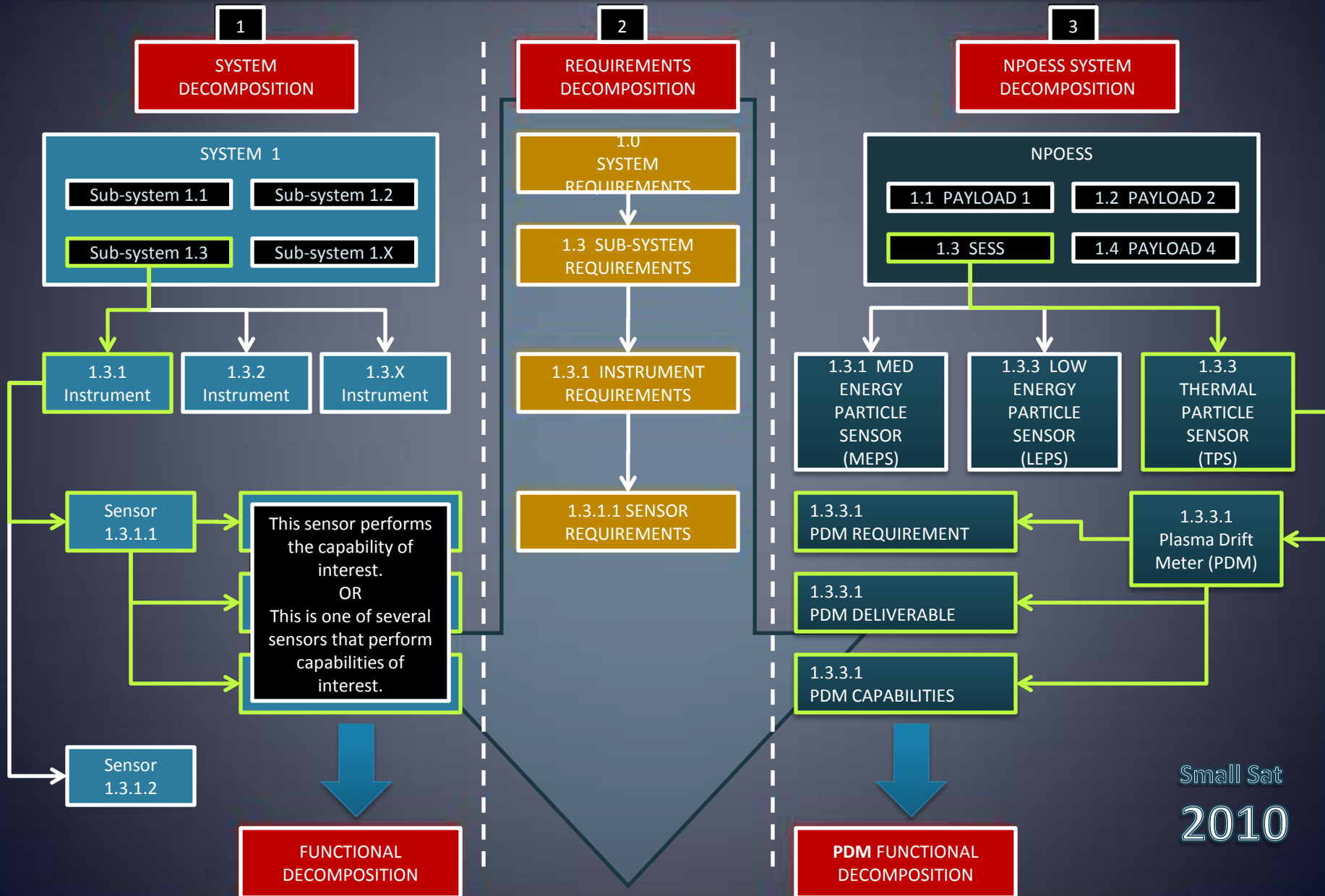


Play
audio/
video

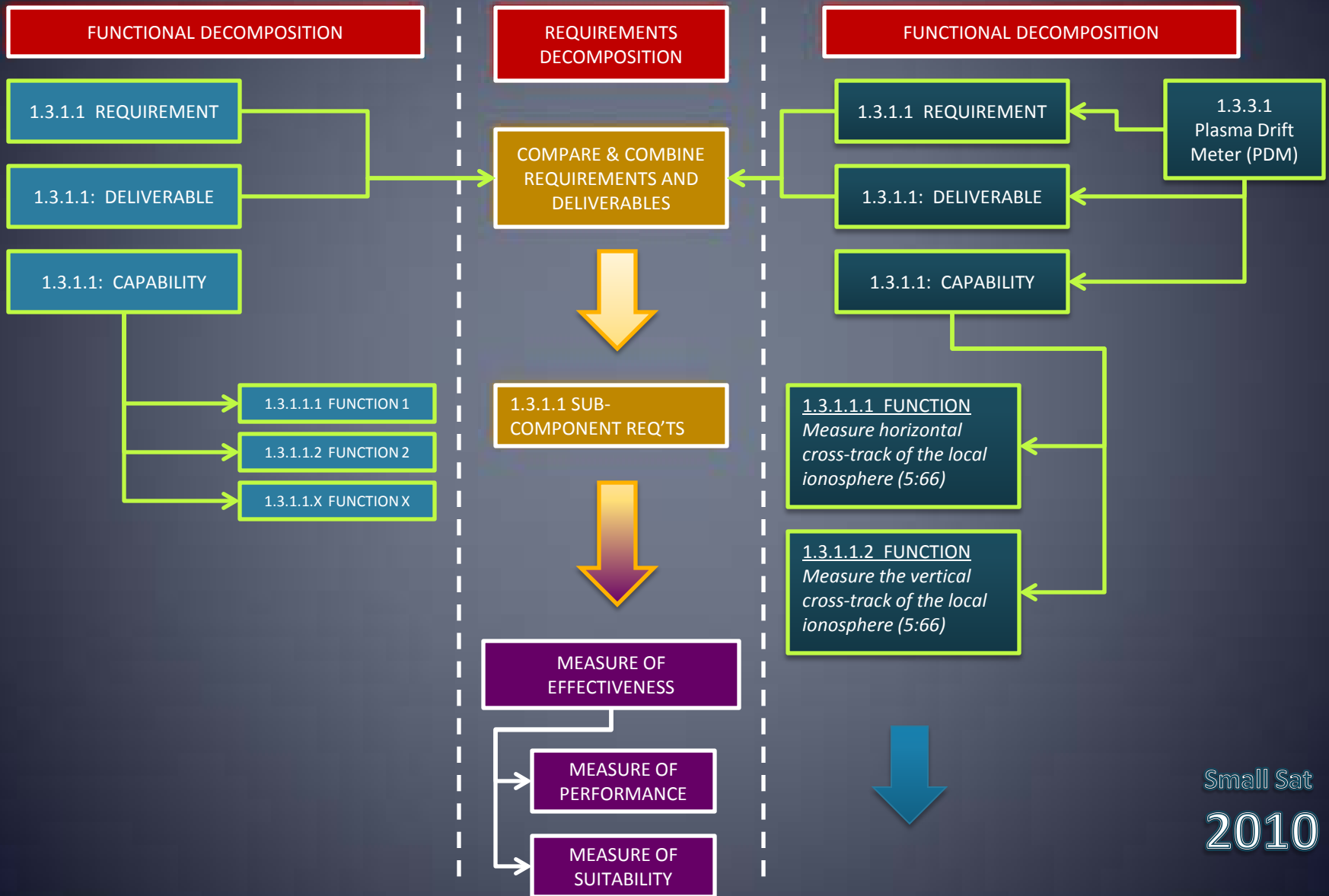


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Method – Identification



Method - Decomposition



Method – PDM Capability Mapping

1.3.1.1.1 FUNCTION
Measure horizontal cross-track of the local ionosphere (5:66)

1.3.1.1.2 FUNCTION
Measure the vertical cross-track of the local ionosphere (5:66)

PLASMA DRIFT METER MAPPING PROCESS

BASIC FUNCTIONS

1.3.1.1.1 FUNCTION

1.3.1.1.2 FUNCTION

COMPATIBLE SENSOR

1 WINCS

2 SENSOR

3 SENSOR

4 SENSOR

Define low SWaP

- Power < x watts
- Size:
 - <10cm x 10cm x 10cm
 - <10cm x 10cm x 20cm
- Mass < xx kg
- Research and list available sensors that are compatible with the CubeSat bus

MEASURE OF EFFECTIVENESS

METRICS

ANALYZE

METRICS

MEASURE OF EFFECTIVENESS

MEASURE OF PERFORMANCE

MEASURE OF SUITABILITY

MEASURE OF PERFORMANCE

MEASURE OF SUITABILITY

Method – Analysis

1.3.1.1.1 FUNCTION
Measure horizontal cross-track of the local ionosphere (5:66)

1.3.1.1.2 FUNCTION
Measure the vertical cross-track of the local ionosphere (5:66)

SENSOR 1.3.1.1 MOE

1 SENSOR: WINCS

WINCS MOE

ANALYZE

MOE: Electric Field EDR

Parameter	Threshold	Objective
Measurement Range	0 to ±150 mV / m	0 to ±250 mV / m
Horizontal Cell Size	10 km	1 km
Horizontal Reporting Interval	10 km	1 km
Horizontal Coverage	Global	Global
Measurement Uncertainty	3.0 mV / m	0.1 mV / m
Measurement Precision	2.0 mV / m	0.1 mV / m

NPOESS Technical Requirements Document Version 7 – 24 January 2002

MOE: WINCS Ion Velocity Parameter

Meets /
Does Not Meet

Cross-Track Vertical Drift	MEETS
Cross-Track Horizontal Drift	MEETS
In-Track Horizontal Drift	MEETS
Ion Densities	MEETS
Ion Temperature	MEETS

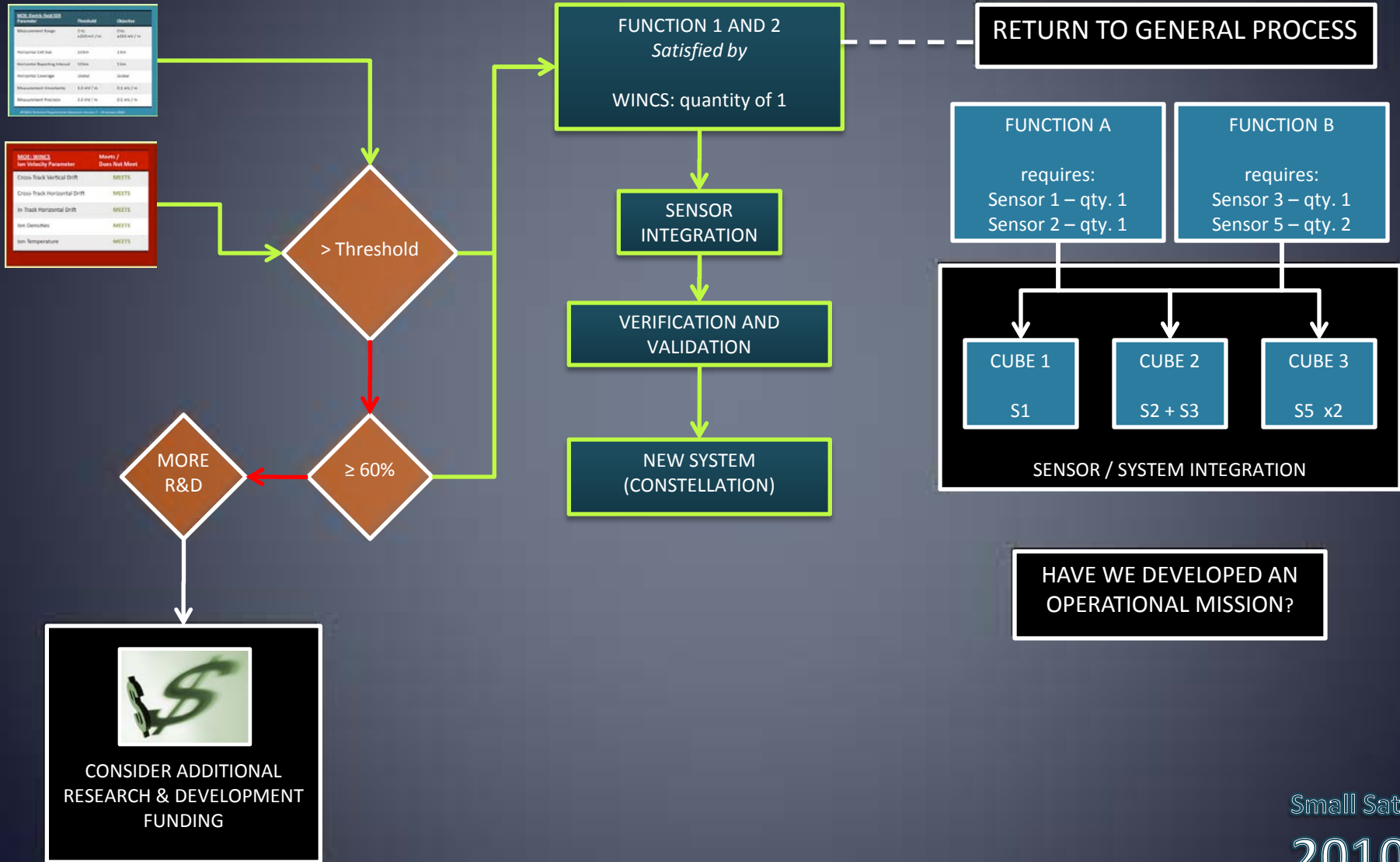
Electric Field and Ion Velocity are complimentary measurements using $\mathbf{E} = -\mathbf{V} \times \mathbf{B}$

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Method – Decision

MODEL_WINDS	Feedback	Objective
Measurement Range	1 to 430000 ft/m	0 to 430000 ft/m
Measurement Unit Size	0.001m	0.001m
Collocated Reporting Interval	0.001m	0.001m
Measurement Coverage	00000	00000
Measurement Resolution	0.0 m/s / m	0.1 m/s / m
Measurement Precision	0.0 m/s / m	0.1 m/s / m

MODEL_WINDS	Model / Parameter	Meets / Open-Loop Meas
	Cross-Track Vertical Drift	MEETS
	Cross-Track Horizontal Drift	MEETS
	In-Track Horizontal Drift	MEETS
	In-Track Deviations	MEETS
	In-Track Temperature	MEETS



Operational Mission

- Operational mission for CubeSats is a reality
- Quantitative data supports the mapping process and supports the decisions
- Utilize known information, requirements
- Numerous CubeSat experiments in progress
- Expand this process to include PnP concept
- Operational mission would advance CubeSat evolution ... positive attention, more funding

Capabilities Mapping



Questions