

GPS III System Architecture Requirements Definition

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SUMMARY

- ◆ **GPS III Program Overview**
- ◆ **System Architecture Requirements Definition**
 - ◆ **Contractor Trade Study Teams**
 - ◆ **SARD Government Team**
 - ◆ **Trade Study Process and Products**
 - ◆ **GPS III and Galileo**
- ◆ **GPS III Capability Goals**
- ◆ **Conclusion**



GPS III Purpose

- ◆ Plan and grow system capabilities to meet future user needs for precise positioning and timing services
 - GPS ORD objective values as the target
- ◆ Procure most cost-effective system to meet future military and civilian requirements through 2030
 - Sustain GPS Service
 - Reduce Total Ownership Costs
 - Conscientious cost - benefit analyses for future requirements
- ◆ Make optimal use of system augmentations and complementary systems
- ◆ Re-look at entire GPS system architecture
 - Identify system-level trades for all system segments - space, control segment and user equipment

Ensure best GPS system for the nation for the next 30 years



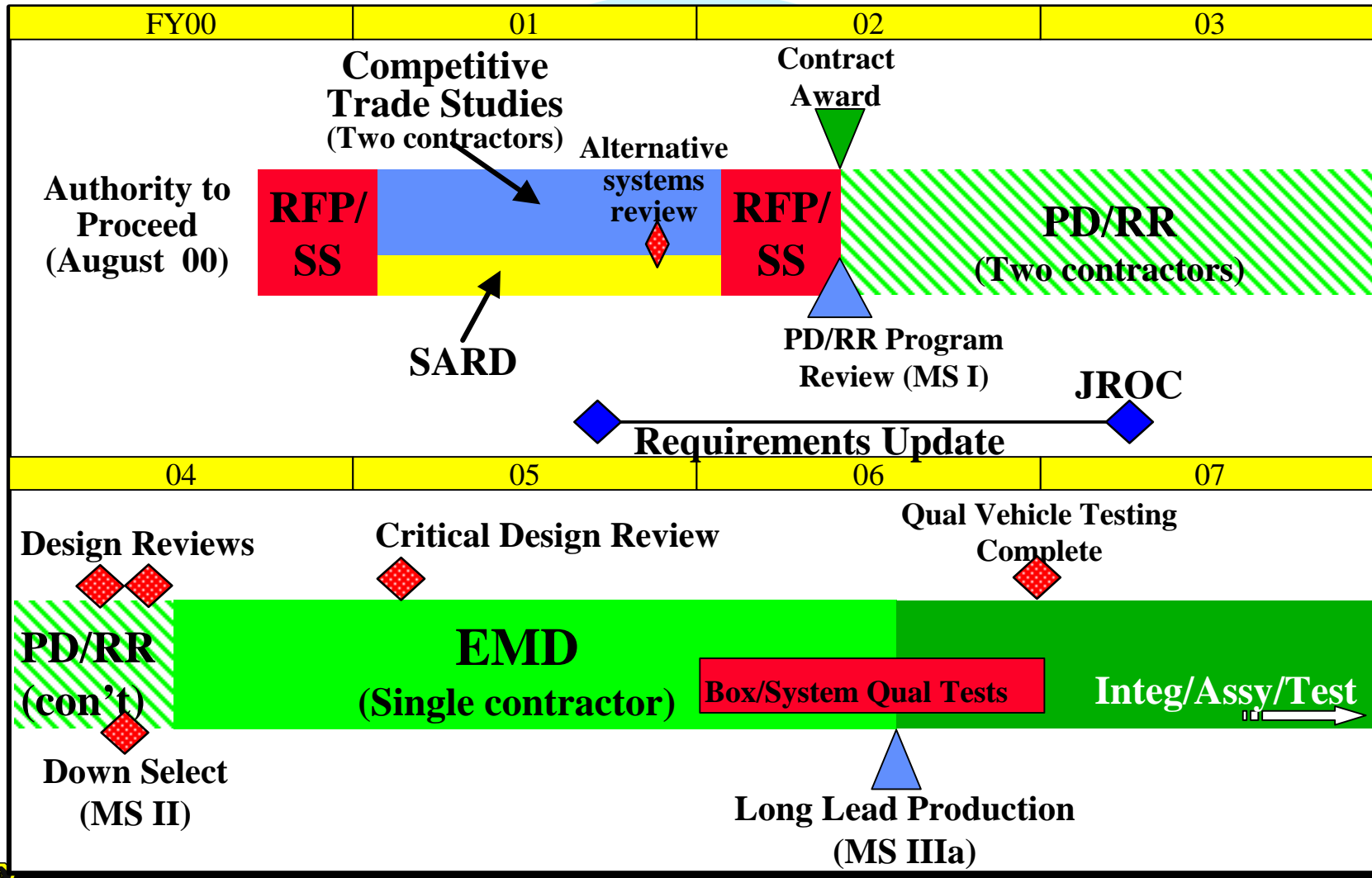
GPS-III Program Approach

- ◆ **System Architecture Investigation Studies leading to System Requirements Review - November 2000**
 - Architectural trade space definition
 - Competitive contractor architecture definition
 - Comprehensive system requirements document
- ◆ **Preliminary Design & Risk Reduction - Early 2002**
 - Competitive Source Selection
 - Two qualified sources will compete for system design to reduce design/production risk
- ◆ **Design/Production - Mid-year 2004**
 - Down-select to single contractor at Preliminary Design Review

Three phase approach - flexible, allows future changes, reduces risk



GPS III Acquisition Strategy



GPS III SARD Phase - Purpose

- ◆ **Assess system wide architectural alternatives to:**
 - Meet ORD requirements
 - Reduce total ownership costs
 - Provide flexibility and robustness to meet evolving military and civil requirements for the next 30 years
- ◆ **Principal product of the SARD is a set of suggested requirements**
- ◆ **Only the alternative(s) approved by the Government will lead to requirements**



GPS III SARD Phase - Study Teams

- ◆ **Competitive selection of two contractor teams**
 - Proposals reviewed in September and October
 - Two 12 month Study Contract winners announced on November 9th
- ◆ **Government SARD Team**
 - JPO lead ensemble with military and civil agency participation
 - Review and blend contractors' analysis and other government studies
 - Form the final baseline and alternatives to be presented to the Defense Acquisition Board (DAB)



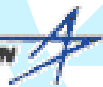
Competitive Contractor Study Teams



Boeing Government Info & Comm Systems

Boeing Satellite Systems (Hughes Space & Comm)
Computer Sciences Corporation
Lockheed Martin Management & Data Systems
Raytheon Company

LOCKHEED MARTIN



Lockheed Martin Space Systems

ITT Industries
Rockwell Collins
Ball Aerospace



Government SARD Team

- ◆ **Government Technical Oversight**
 - U.S. Air Force GPS Joint Program Office
 - Additional Input from IGEB Agencies
- ◆ **Principal Technical Support**
 - The Aerospace Corporation
 - MITRE Corporation
 - Command, Control, Communications & Intelligence (C3I)
 - Center For Advanced Aviation Systems Design (CAASD)
- ◆ **Additional Technical Support**
 - National Security Agency
 - US Naval Observatory
 - Systems Engineering Technical Assistance (SETA) Contractors



The Questions to Answer

- ◆ What can be added to a system that delivers PNT services, that, for some marginal additional cost, will yield much greater benefit?
- ◆ How can the existing needs be met with greater reliability, margin and quality at lower cost and within schedule?
- ◆ How (and when) can the new capabilities/architectural elements be transitioned from the current configuration?
- ◆ What synergies with other systems can be utilized to achieve all of the above?

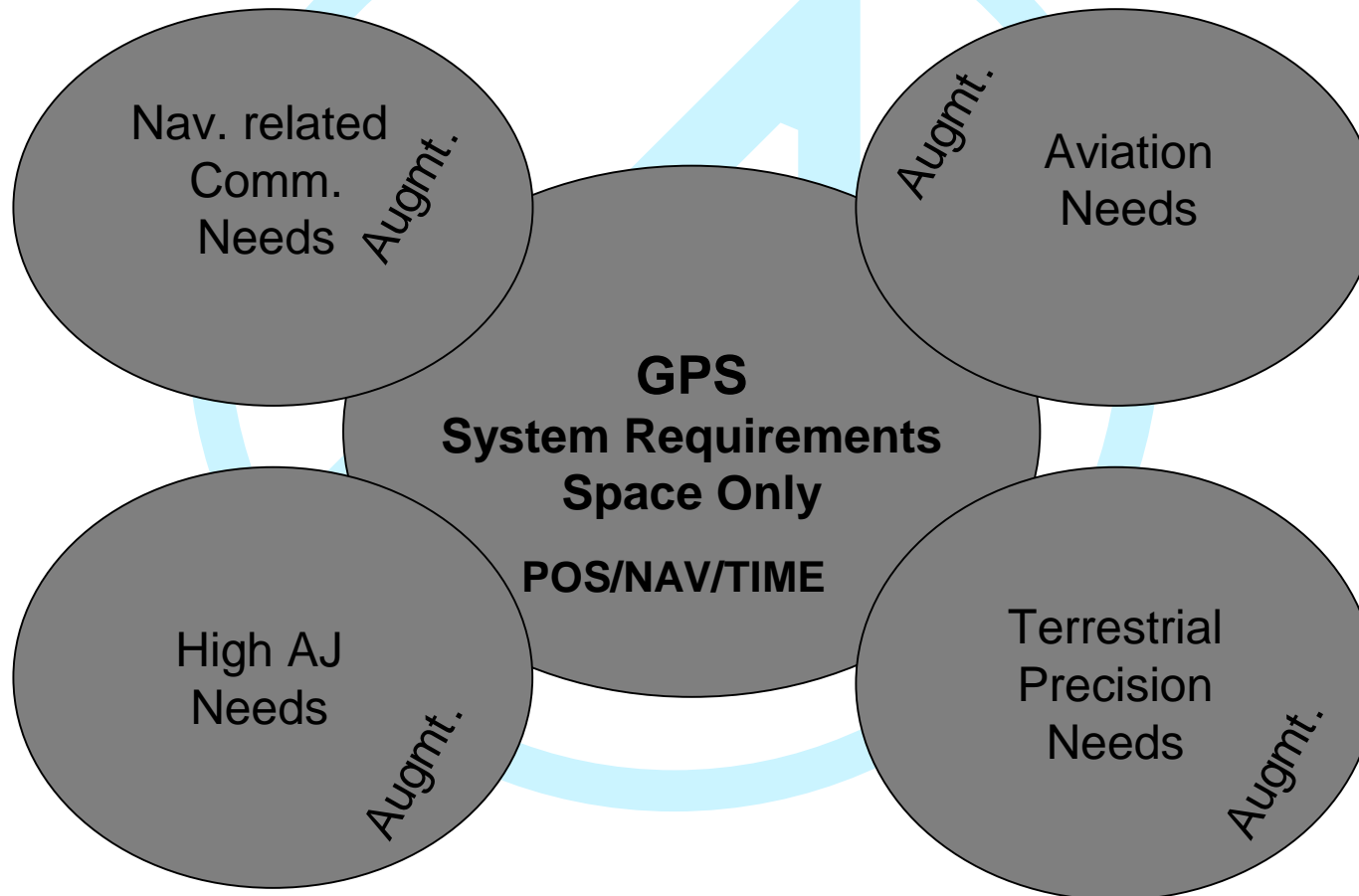


Alternative Futures

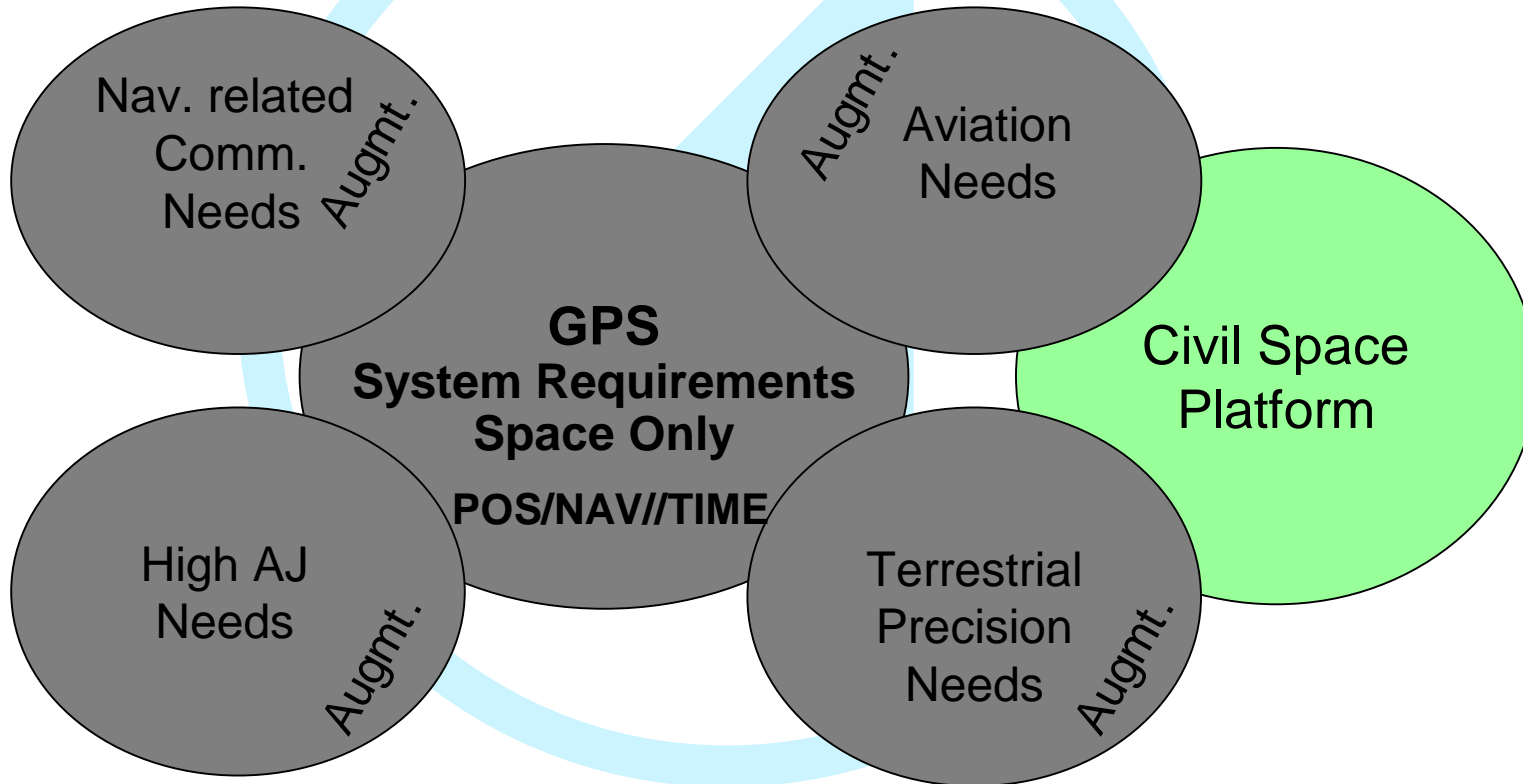
- ◆ **Technical/programmatic alternatives motivated by economic and policy-related considerations**
- ◆ **Civil possibilities include:**
 - Current -- core GPS plus external augmentations
 - GPS program managing augmentations
 - Enhanced core incorporating augmentations
 - GPS incorporating or partnering with future civil satellite navigation elements
- ◆ **Military possibilities include**
 - GPS/NDS only
 - Multi-mission platform
 - Shared functions with other platforms



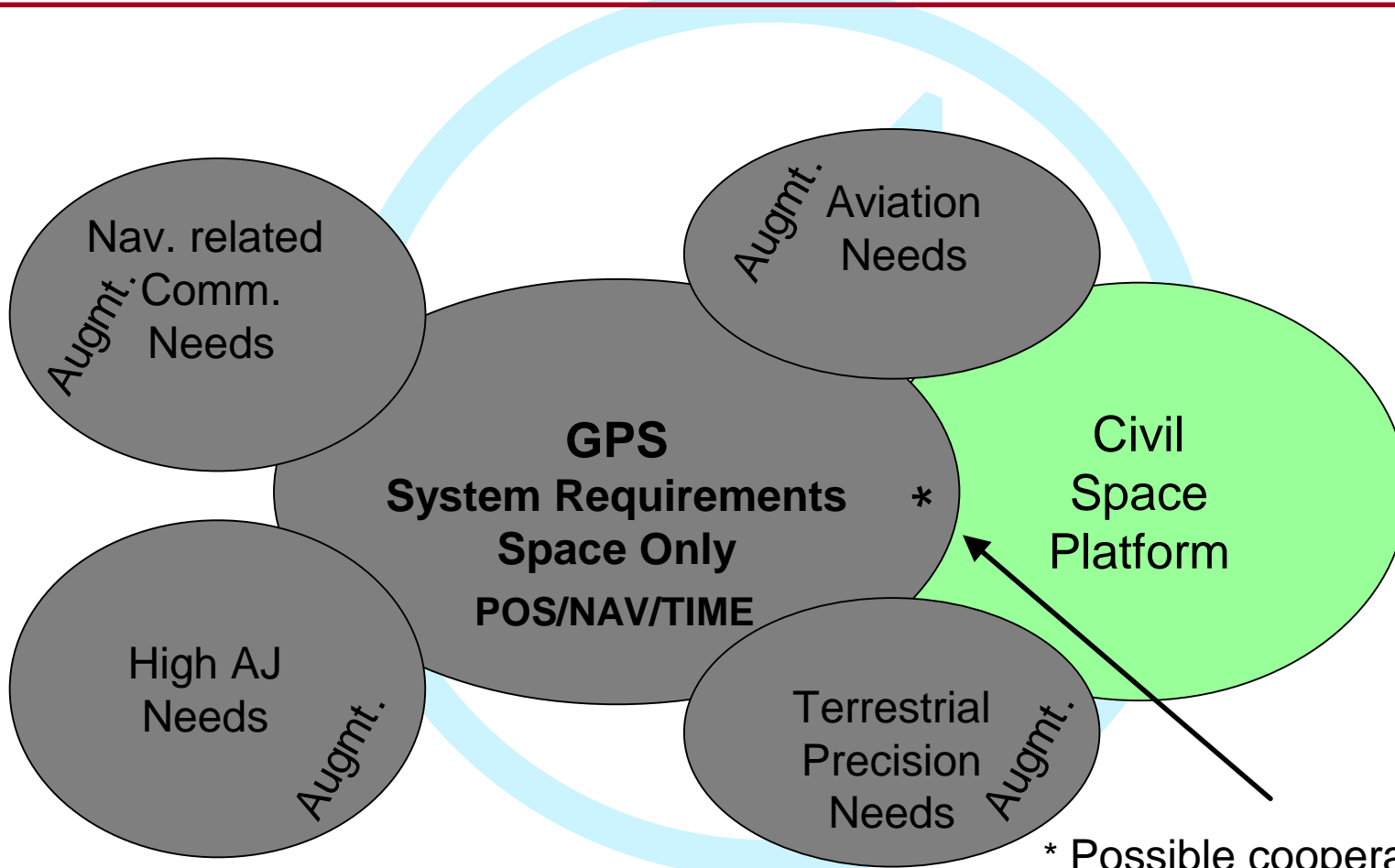
GPS Space-Only Solution with User Based Augmentations



GPS/Civil Independent Space-Only Solution with User Based Augmentations



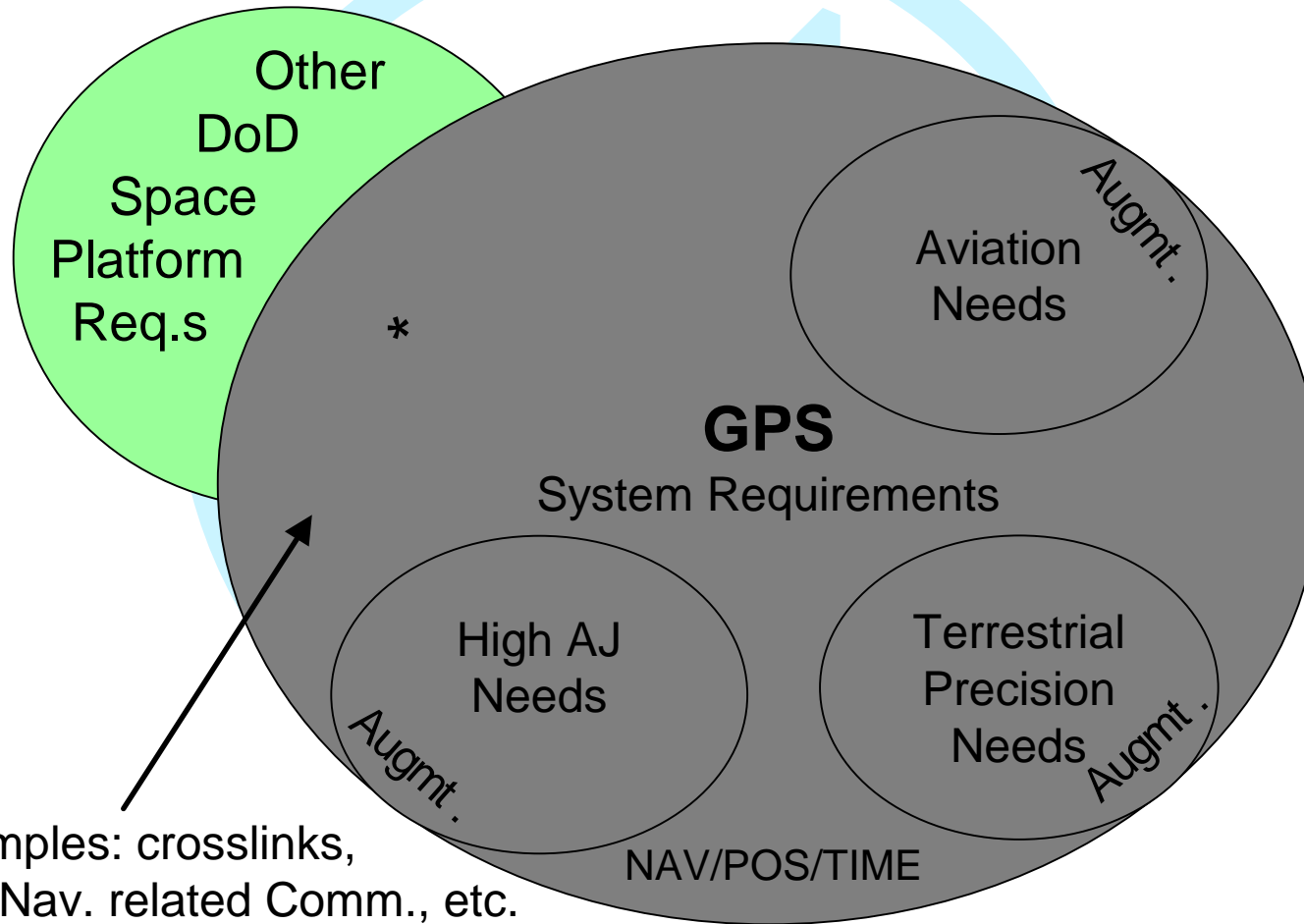
GPS/Civil Interoperable Space-Only Solution with User Based Augmentations



* Possible cooperative monitoring, crosslinks, satellite control, etc...



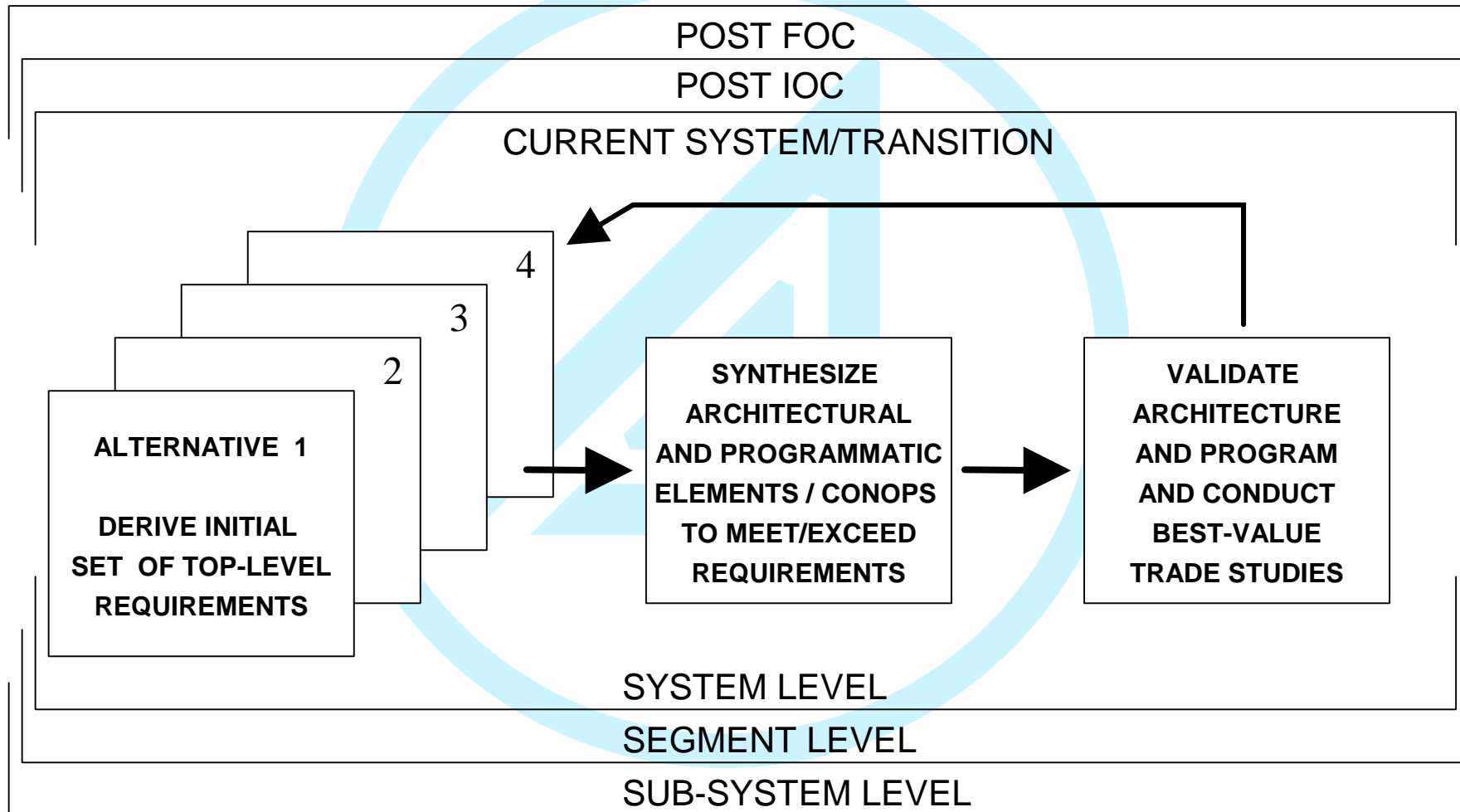
GPS Total Solution Augmentations and Additional Missions



* Examples: crosslinks, SAR, Nav. related Comm., etc.



Outline of the SARD Process



The SARD Phase Product

- ◆ **Comprehensive System Requirements that are performance-based**
 - System Requirements Document
 - Technical Requirements Document
- ◆ **Used to Develop a Request for Proposal**
 - Competitive Source Selection to award two contracts to enter the Preliminary Design & Risk Reduction Phase - October 2001



GPS III and Galileo

- ◆ **USG is postured to cooperate with Europe in pursuing a fully interoperable GNSS based on:**
 - Agreement to principles outlined in a draft agreement provided to the European Commission
 - A decision by Europe to go ahead with Galileo
- ◆ **However:**
 - GPS III architectural solutions should stand on their own
 - Premature to incorporate Galileo concepts into the GPS III architecture as EU has not yet made a decision
 - Advantageous to US Government to understand benefits of potential future systems like Galileo
- ◆ **GPS III contractors may seek insight into the Galileo concepts by contacting potential Galileo contractors**



GPS III Capability Goals

System Characteristic	2000 GPS ORD		Civil PNT (Appendix F - 2000 ORD)
	Threshold	Objective	
Accuracy			
Horizontal	6.3m (95%) 30.0m (99.9%)	1.0m (95%) – civilian 2.1m (95%) – military	0.01m
Vertical	13.6m (95%) 40.0m (99.9%)	4.0m (95%)	0.04m
Timing	20.0nsec (95%)	10.0nsec (95%)	0.3 nanosecond (threshold) 1.0 picosecond (objective)
Availability	90.0%	99.9%	100.0%
Integrity			
PHMI	TBD	TBD	1-2x10 ⁻⁹ per approach
Time-to-alarm	TBD	TBD	1 second
Continuity of Service	TBD	TBD	1-10 ⁻⁴ per hour <u>and</u> 1-8 x 10 ⁻⁶ per 15 sec <u>and</u> 1-6x10 ⁻⁶ per 30 sec



CONCLUSION

- ◆ **GPS III will follow Block IIR and IIF modernization**
 - Three phase approach -- System Architecture Requirements Definition Studies; Preliminary Design & Risk Reduction; Design/Production
- ◆ **SARD Studies will assess system wide architectural alternatives resulting in system/technical requirements to achieve Objective Operational Requirements**
 - Two Contractors and a Government Team are in place
 - SARD phase will consider potential future satellite navigation systems but it is premature to incorporate specific system characteristics into architectural alternatives

The Goal -- Procure a cost-effective system to sustain GPS services and meet future military and civil PNT requirements through 2030

