



National Position Navigation and Timing Architecture and SatNav Backup Study ICNS Conference

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Overview



- PNT Architecture Background
- Architecture Development
- Recommendations
- SatNav Backup Study
- Way Forward





Why A PNT Architecture?



- PNT is the silent infrastructure enabler
- PNT is essential to EVERY human enterprise
 - Without PNT, things we rely on will not work
 - *Transportation, communication, national security...*
 - Quality of PNT → Quality of operations
- PNT is not just GPS
 - GPS is global and uniform but cannot do it all
 - GPS is cornerstone but augmentation/complements are necessary for robust, continuous PNT
- Architecture provides blueprint for way ahead



U.S. Economy & Security DEPEND on PNT





PNT Architecture Background



- Study requested by
 - Assistant Secretary of Defense for Networks and Information Integration
 - Under Secretary of Transportation for Policy
 - National Space-based PNT Executive Committee
- Justification - PNT Strategic Landscape is Changing
 - Gaps in current capabilities
 - Insufficient unity of effort towards future PNT capabilities
- Products
 - 20 year strategic outlook to guide near and mid-term decisions on PNT capabilities

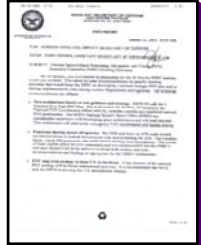




Foundations

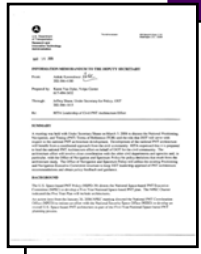
- RITA 
- FAA 
- JPDO 
- FHWA 
- FRA 
- DOC 
- NIST 
- DHS 
- USCG 
- DOI 
- State 
- NASA 
- NCO 

ASD/NII Memo
23-Jan-2006



“NSSO develop a National PNT Architecture”

DOT/RITA Memo
14-Mar-2006



“RITA will lead effort on behalf of DOT for the civil community”

NPEC Action Items
26-Jan-2006



“NPCO will initiate an effort with NSSO”

PNT Architecture TOR
11-Jul-2006



-  NII
-  S&T
-  PBFA
-  JS
-  USA
-  USN
-  USMC
-  USAF
-  SAF/USA
-  NGA
-  NSA
-  STRAT
-  SMDC
-  AFSPC
-  USNO
-  NRL
-  SMC
-  NSSO

More Effective & Efficient PNT and an Evolutionary Path for Government Provided Systems & Services



National PNT Architecture Scope



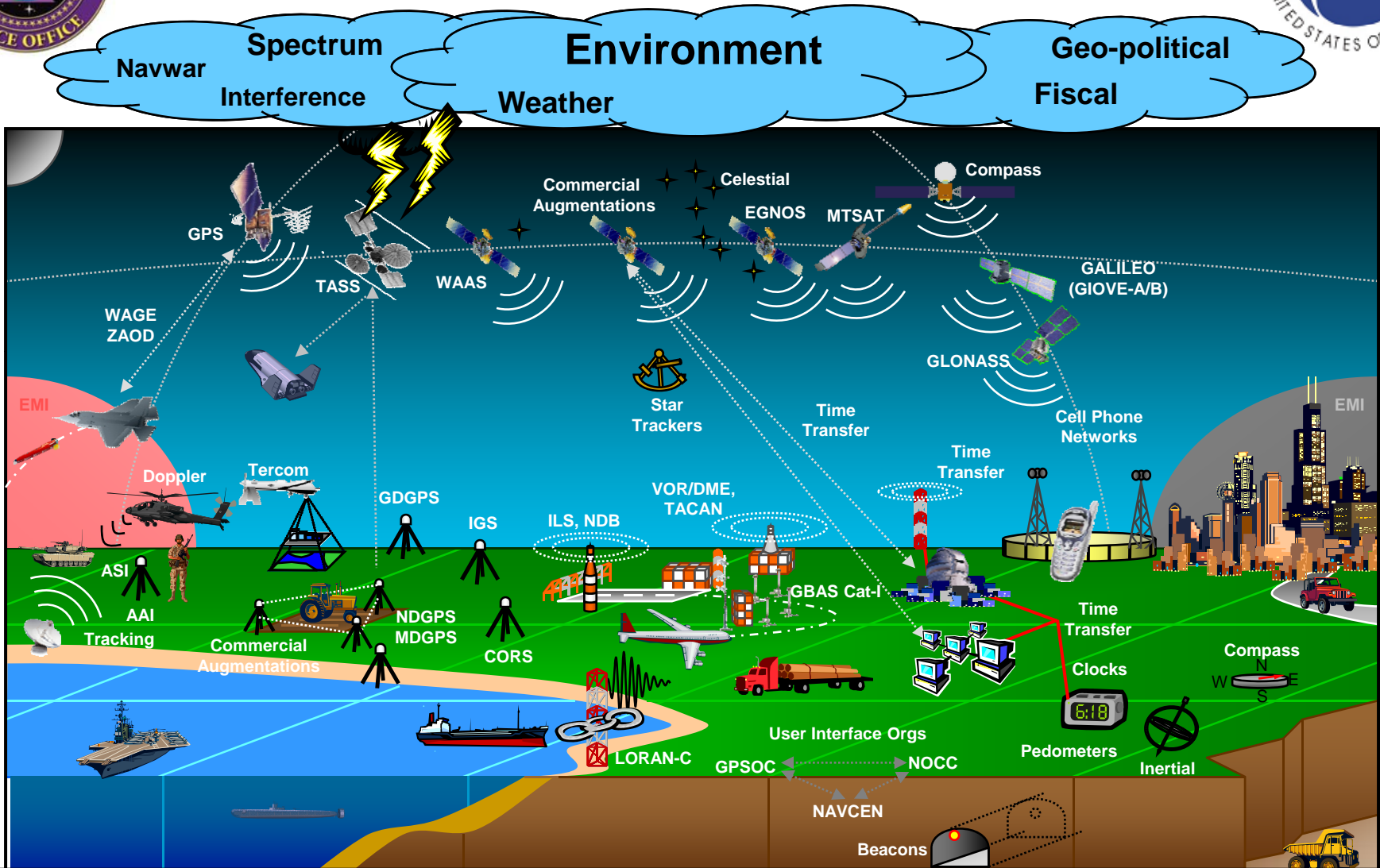
USERS	DOMAIN	MISSIONS	SOURCES	PROVIDERS
Military	Space	Location Based Services	GNSS	Military
Homeland Security		Tracking	GNSS Augmentation	Civil
Civil	Air	Survey	Terrestrial NAVAIDS	
Commercial	Surface	Scientific	Onboard / User Equip	
	Sub-Surface	Recreation	Networks	International
		Transportation		
Individual		Machine Control		
		Agriculture		
		Weapons		
		Orientation		
		Communications and Timing		

Broad Scope Requires Innovative Approaches and Focused Analysis Efforts





“As-Is” PNT Architecture Graphic (2008)



Standards	Reference Frames	Cryptography	Science & Technology	USNO	NIST	NGA	NGS
Star Catalogs	Launch	ENABLERS & INFRASTRUCTURE		NSA	Industrial Base		
Electro Optical Info.	Modeling	Mapping/Charting/Geodesy	Laser Ranging Network		Policies	Testing	

Version 21 Aug 2007



Primary PNT Gaps



- **Physically Impeded Environments**
 - Areas including indoors, urban canyons, underground, underwater, and under dense foliage
- **Electromagnetically Impeded Environments**
 - Operations during spoofing, jamming and unintentional interference
- **Higher accuracy with integrity**
 - 10cm accuracy for Intelligent Transportation System applications
- **Hazardously Misleading Info (Integrity)**
 - As short as 1 sec in some situations
- **High Altitude/Space Position and Orientation**
 - Current star catalog degrading; Precise positioning at GEO and beyond
- **Geospatial information - access to improved GIS data (regarding intended path of travel)**
 - Users require access to timely geospatial information to help navigate through impeded environments
- **Insufficient modeling capability**
 - Model PNT capabilities in all environments and modeling integration of multiple phenomenologies

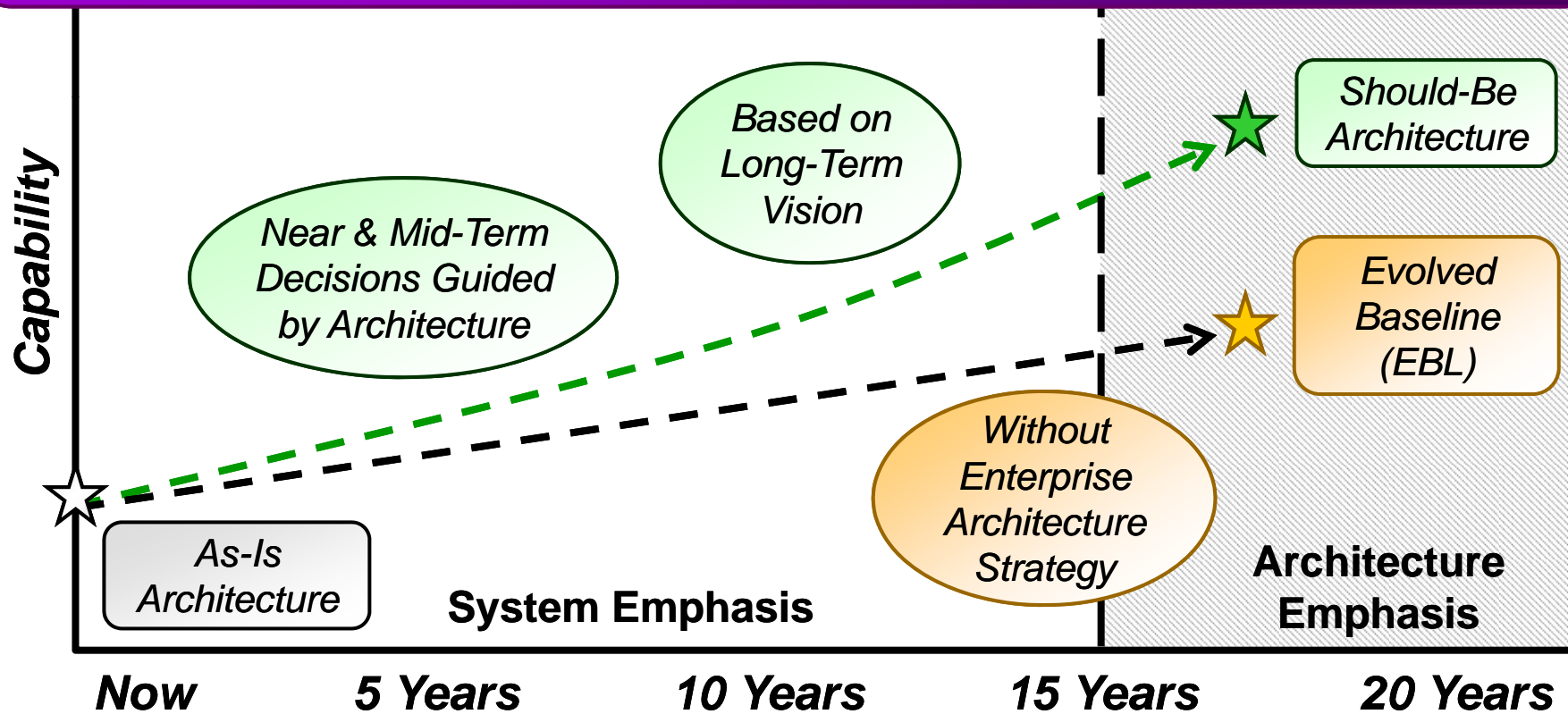




Primary Objective of the Architecture



“...provide more effective and efficient PNT capabilities focused on the 2025 timeframe and an evolutionary path for government provided systems and services.” -- Terms of Reference





Guiding Principles

VISION

US Leadership in Global PNT

STRATEGY

Greater Common Denominator

PRIMARY VECTOR

Multiple Phenomenologies

PRIMARY VECTOR

Interchangeable Solutions

SUPPORTING VECTOR

Synergy of PNT with Communications

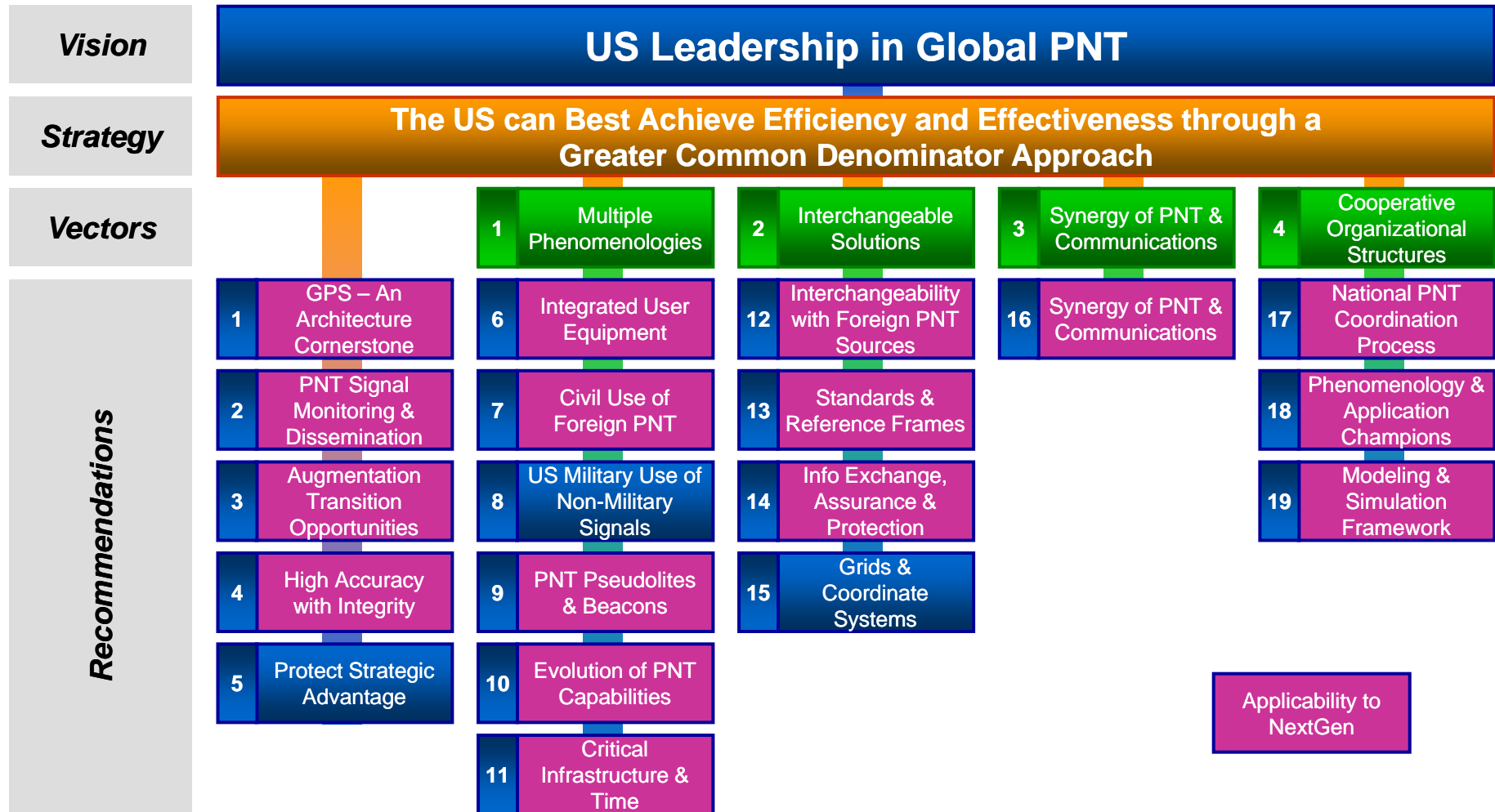
SUPPORTING VECTOR

Cooperative Organizational Structures





National PNT Architecture Recommendation Tree





Focus Areas Applicable to NextGen

- 1 GPS – An Architecture Cornerstone
- 2 PNT Signal Monitoring & Dissemination
- 3 Augmentation Transition Opportunities
- 7 Civil Use of Foreign PNT
- 12 Interchangeability with Foreign PNT Sources

Evaluation of GPS III and foreign GNSS to meet aviation needs and potentially reduce the need for augmentation systems (address performance and certification issues)

Perform Cost/Benefit analyses for augmentations and alternatives.

- 10 Evolution of PNT Capabilities
- 9 PNT Pseudolites & Beacons
- 6 Integrated User Equipment

Investigation of the evolution of space and terrestrial radionavigation systems in light of the Greater Common Denominator Strategy

Development of performance standards for integrated user equipment (avionics)

- 16 Synergy of PNT & Communications
- 13 Standards & Reference Frames
- 14 Info Exchange, Assurance & Protection
- 11 Critical Infrastructure & Time

Evaluation of current and future communication systems used onboard aircraft as a source for positioning and timing.

Investigate any modifications to comm systems that may be needed for use as a reliable and secure PNT source.

- 17 National PNT Coordination Process
- 18 Phenomenology & Application Champions
- 19 Modeling & Simulation Framework

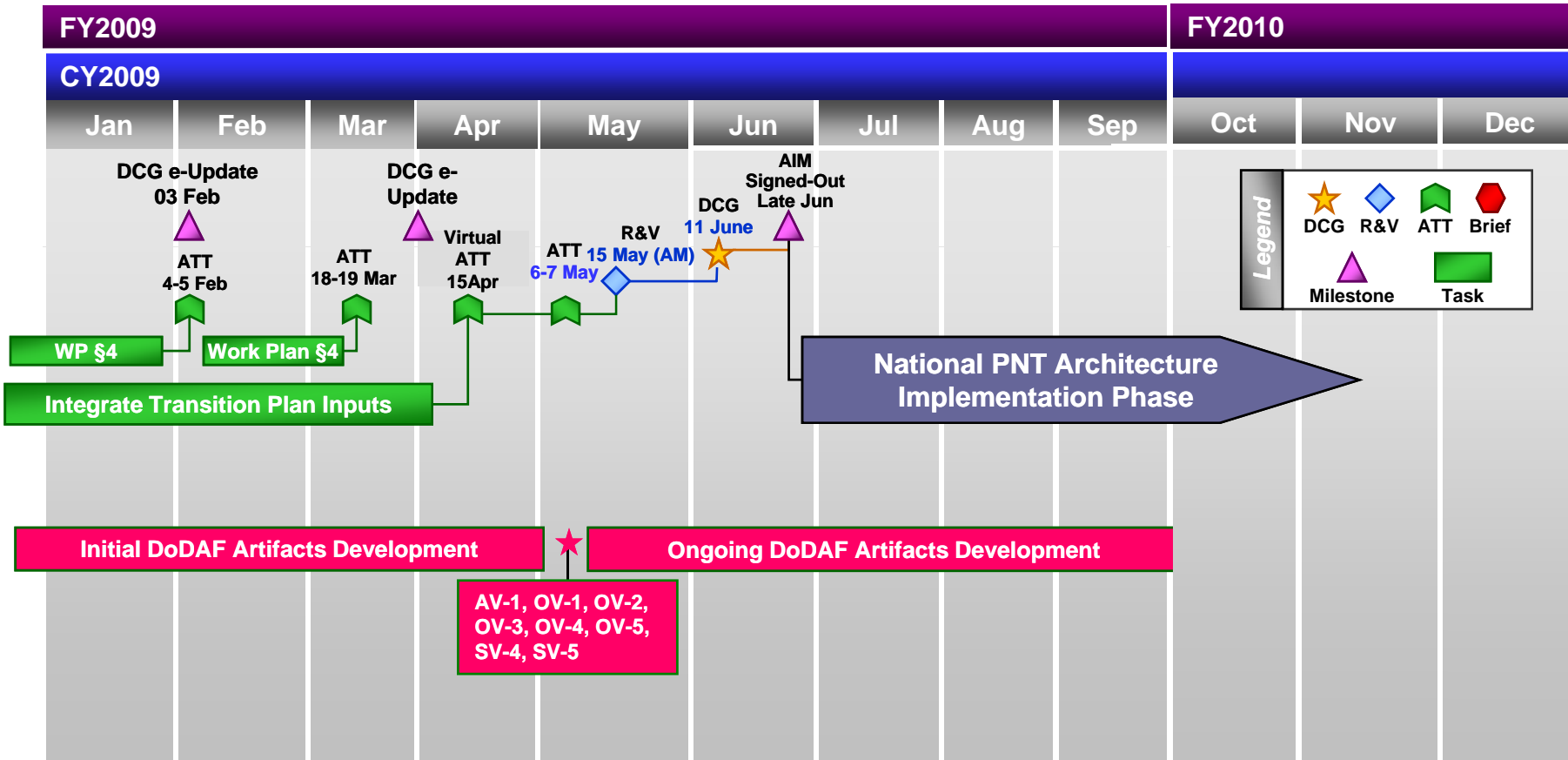
Participate in coordinating and leveraging R&D and implementation programs for all of PNT (space, terrestrial, and autonomous) sources.

Coordinate analysis models to support implementation of PNT architecture recommendations



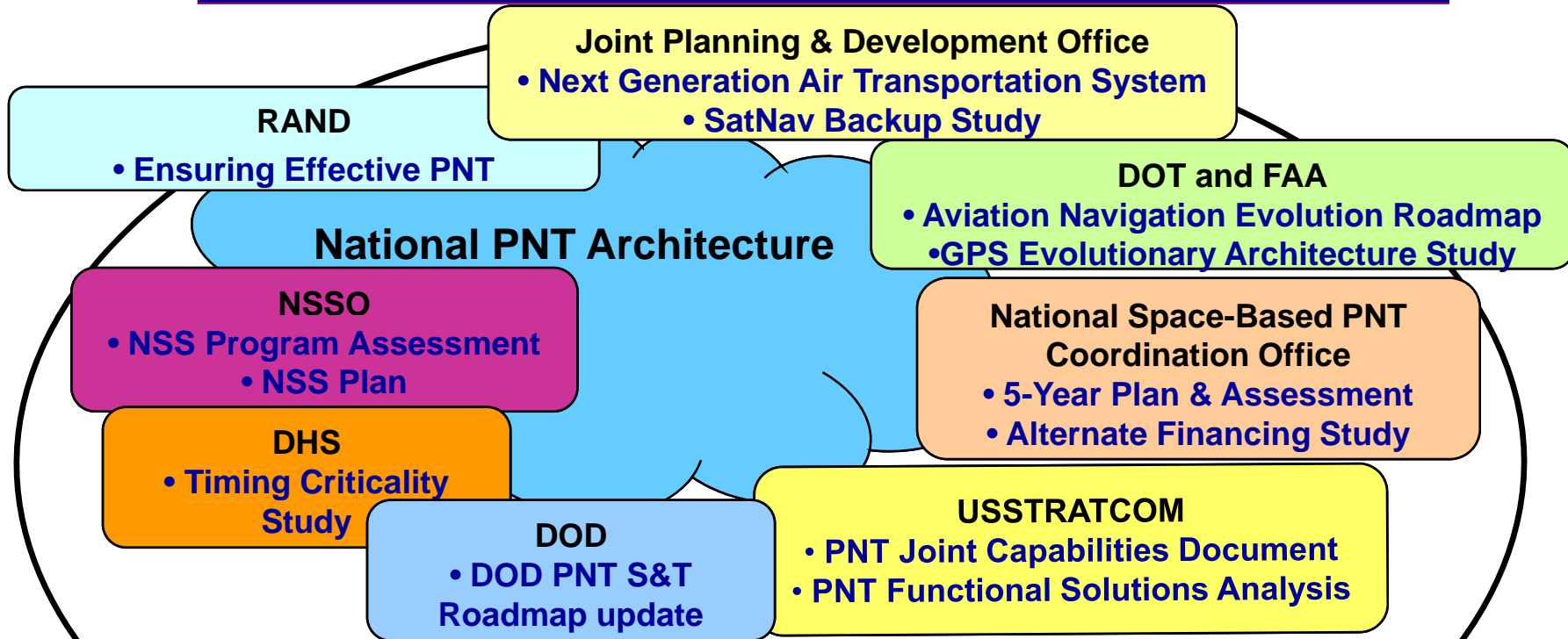


National PNT Architecture Next Steps





Related Efforts & Upcoming Decisions



- Recent & Upcoming Decisions
 - Future of Loran-C/eLORAN
 - Future of NDGPS and High Accuracy NDGPS
 - Backup PNT Needs (ADS-B, NextGen, Timing Infrastructure)
 - GPS III and OCX Acquisition

MAINTAIN SHARED SITUATIONAL AWARENESS



Summary



- National PNT Architecture effort seeks to develop and implement a more effective and efficient architecture—improvement over current USG approach
- It's aim is set at closing the capability gaps identified by DoD and DoT
- The architecture is flexible enough to take advantage of new opportunities or changing environment as they arise





Points of Contact



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