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***National Positioning Navigation and Timing
Architecture
Industry Day***

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Purpose

- To introduce the National Positioning, Navigation, and Timing (PNT) Architecture
- To discuss Architecture Transition Planning



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Overview



- PNT Architecture Brief
 - Background
 - Industry Day Input
 - Recommendations
- Transition Planning Phase
- Discussion Period



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Foundations

- RITA 
- FAA 
- FHWA 
- FRA 
- DOC 
- NIST 
- DHS 
- USCG 
- DOI 
- DOS 
- NASA 
- JPDC 
- NCO 

ASD/NII Memo
23-Jan-2006



DOT/RITA Memo
14-Mar-2006



NPEC Action Items
26-Jan-2006



“NSSO develop a National PNT Architecture”

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

“NPCO will initiate an effort with NSSO”

PNT Architecture TOR
11-Jul-2006



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

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

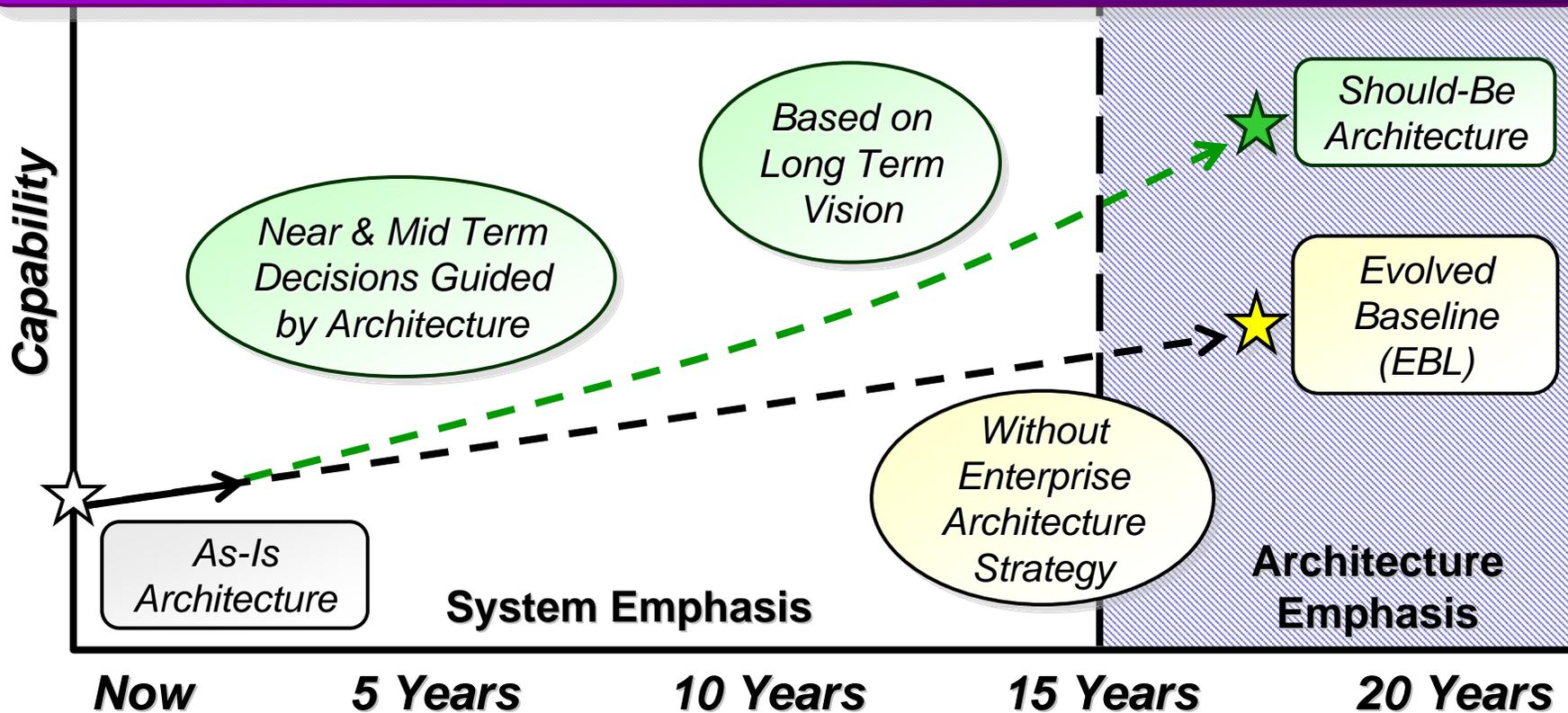


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Primary Objective

“...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





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Scope

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

Broad Scope Required Innovative Approaches and Focused Analysis Efforts



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Primary PNT Gaps

- Gaps primarily drawn from military's PNT Joint Capabilities Document, with additions and modifications from parallel civil community documents and discussions
 - Operations in Physically Impeded Environments
 - Operations in Electromagnetically Impeded Environments
 - Higher accuracy with integrity
 - Notification of Hazardously Misleading Info (Integrity)
 - High Altitude/Space Position and Orientation
 - Geospatial information - access to improved GIS data (regarding intended path of travel)
 - Insufficient modeling capability



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Cumulative Process

Data Gathering

Needs & Gaps

PNT User Perspectives (2025)

PNT Gap: Physically Impeded Environments

Functional Reference Model

PNT Evolved Baseline (2025)

Environment, Technology & Evolved Baseline

Concept Development

Trade Space, Features & Architectures

Example RA: Dependent Terrestrial

Job Aid - PNT Architecture Features

Hybrid Refinement Process

Hybrid A Concept

Guiding Principles

VISION
US Leadership in Global PNT

STRATEGY
Greater Common Denominator

VECTOR
Multiple Phenomenologies

VECTOR
Interchangeable Solutions

VECTOR
Synergy of PNT & Communications

VECTOR
Cooperative Organizational Structures

Community Involvement

**Architecture Development Team,
Subject Matter Experts,
Small Working Groups
& Industry**

Analysis & Assessment

Related Efforts & Upcoming Decisions

Preliminary Analysis - Feb 07

Hybrid Assessment Process

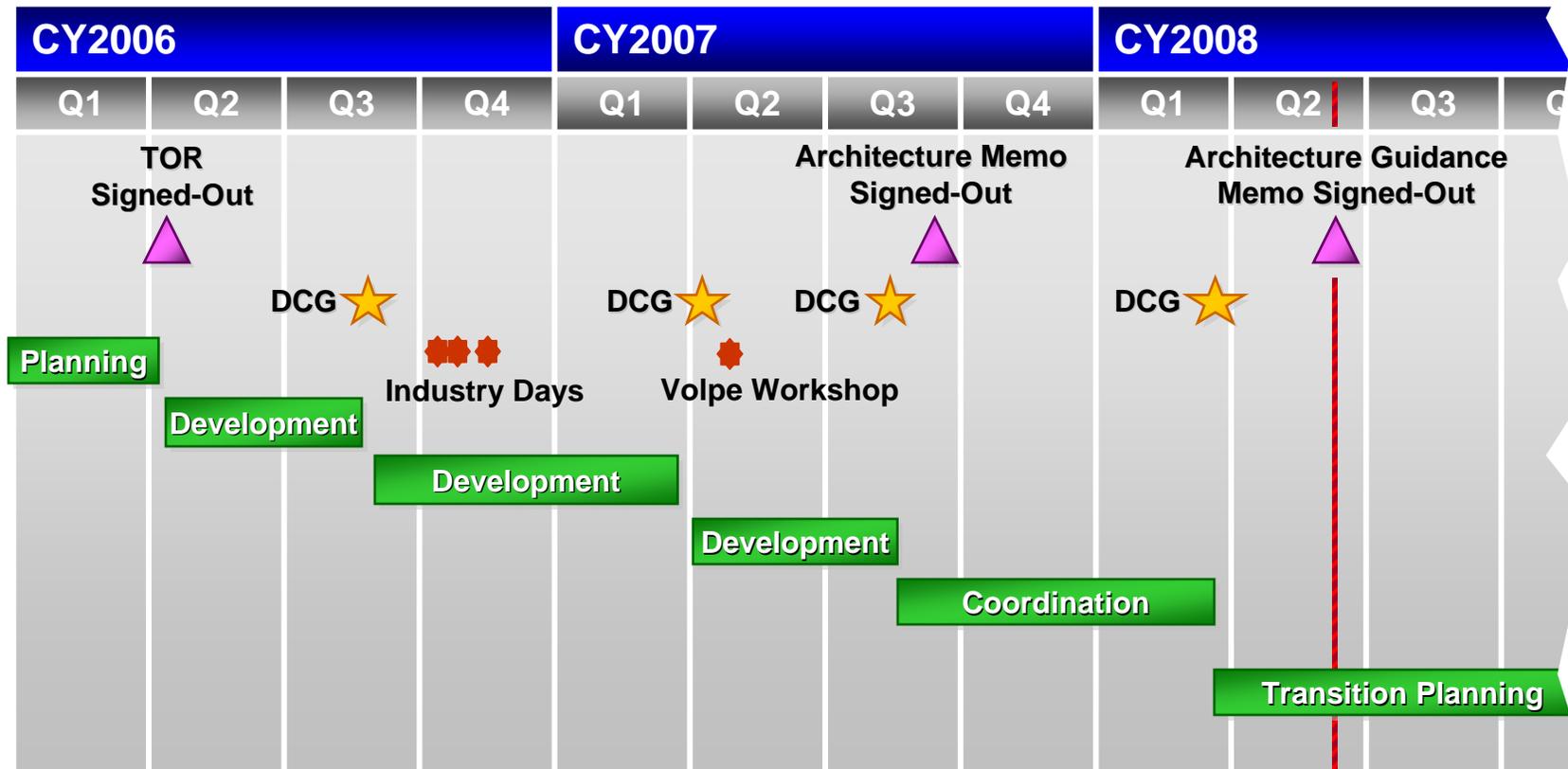
Analytical Framework



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Schedule



June 16

DCG = Decision Coordination Group (Senior level)



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Industry Participants

- A-B-Sea Research
- Advanced Navigation & Positioning Corporation
- Advanced Research Corporation
- AeroAstro
- AFRL – AFIT ANT
- Alion Science & Technology
- Analytical Graphics Incorporated
- Boeing Commercial Aircraft
- Boeing Navigation & Communication Systems
- Boeing Phantom Works
- Booz Allen Hamilton
- Chungnam National University
- Giftet Inc.
- GPS Industry Council
- GPS World Magazine
- Honeywell
- International Loran Association
- Institute of Navigation
- Jet Propulsion Lab
- Lockheed Martin IS&S
- Megapulse
- NavComTech
- NAVSYS Corp
- Oak Ridge National Labs
- Ohio University
- OmniStar
- On-Grid
- Penn State ARL
- Raytheon
- Rockwell Collins
- SiRF
- USGIC
- Viasat



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Industry Observations



- US Government Policy
 - Stable, long-term policies & enforced international agreements are critical
 - Fosters expansive technological & economic growth
 - Preserves US system utility (e.g. spectrum management)
 - Preserves US industry competitiveness (e.g. GNSS user equipment development)



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Industry Observations

- US Government Objectives
 - Preeminence in PNT among many international PNT providers
 - US Military dependence on US systems only
 - Maintain awareness of other PNT services
 - Civil uses will tend towards hybrid GNSS and Comm solutions & incorporate supporting services to make PNT available everywhere



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Industry Observations

- Government & Commercial Responsibilities
 - The government develops, operates, and sustains the PNT infrastructure; the commercial sector adds value for customer applications
 - The government is reluctant to furnish services beyond its own needs, however sound USG investment may yield a beneficial economic return
 - 2 views depending on business model:
 - Government should only provide the infrastructure and base capabilities
 - Government should provide as much as is economically feasible



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Industry Observations

- Government & Commercial Responsibilities (Cont)
 - Government recognition and deft standardization are critical to the efficient proliferation of local and regional systems (e.g. Real-Time Networks)
 - Interoperability of regional systems is no substitute for a Global Solution (e.g. commercial airlines adoption of GNSS-based solutions)



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Industry Observations



- “Desirements”
 - Accelerate GPS modernization, provide more satellites & power
 - The mass commercial market focuses on availability, time-to-first-fix, power, and sufficient accuracy
 - The PNT architecture must have a global perspective



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Industry Observations

- Future
 - Disruptive (game-changing) technologies are on the horizon (e.g. chip-scale atomic clocks, highly accurate optical clocks, low-cost MEMS IMUs, and extremely precise Interferometric INSs)
 - Consequences of a multi-GNSS environment
 - Can foster a cooperative international commercial environment
 - USG should fund GPS to be the best, the commercial sector will benefit as a result



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Guiding Principles

VISION

US Leadership in Global PNT

STRATEGY

Greater Common Denominator

VECTOR

Multiple Phenomenologies

VECTOR

Interchangeable Solutions

VECTOR

Synergy of PNT & Communications

VECTOR

Cooperative Organizational Structures



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Vision

US Leadership in Global PNT

- Based on a foundation of national policy
- Efficiently develop and field the best technologies and systems (e.g. cost, schedule, acceptable risks, user impact)
- Promulgate stable policies (commitment to funding, commitment to performance, advanced notice of change, etc)
- Foster innovation through competition within the commercial sector
- Ensure robust and enduring inter-agency coordination and cooperation
- Maximize the practical use of military, civil, commercial and foreign systems and technologies
- Judiciously develop and apply standards and best practices



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Strategy

The US can Best Achieve Efficiency and Effectiveness through a Greater Common Denominator Approach

- Recommendations
 - Maintain GPS as a cornerstone of the National PNT Architecture
 - Monitor PNT signals to verify service levels, observe environmental effects, detect anomalies, and identify signal interference for near real-time dissemination
 - Transition or divest US GNSS augmentation assets that are unnecessarily redundant after capability is available from GPS modernization or other methods
 - Continue to investigate methods to provide high-accuracy-with-integrity solutions for safety-of-life applications
 - Develop a national approach to protect military PNT advantage



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Vector: Multiple Phenomenologies

1

Use Multiple Phenomenologies to the Maximum Extent Practical to Ensure Robust Availability

- Recommendations
 - Encourage appropriate development and employment of equipment that integrates information from diverse sources and information paths
 - Assess the potential for the use of foreign PNT systems for safety-of-life applications and critical infrastructure users and, as appropriate, develop clear standards and criteria for their use
 - Continue military PNT exclusive use policy while studying development of capabilities to enable military use of other signals
 - Promote standards for PNT pseudolites and beacons to facilitate interchangeability and avoid interference
 - Study evolution of space-based and terrestrial PNT capabilities to support diversity in PNT sources and information paths
 - Ensure critical infrastructure precise time and time interval users have access to and take advantage of multiple available sources



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Vector: Interchangeable Solutions

2

Strive for Interchangeable Solutions to Enhance Efficiency and Exploit Source Diversity

- Recommendations
 - Use participation in international PNT-related activities to promote the interchangeability of PNT sources while assuring compatibility
 - Evolve standards, calibration techniques, and reference frames to support future accuracy and integrity needs
 - Identify and develop common standards that meet users' needs for PNT information exchange, assurance and protection
 - Establish common standards that meet users' needs for the depiction of position information for local and regional operations



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Vector: Synergy of PNT & Communications



3

Pursue, where Appropriate, Fusion of PNT with New and Evolving Communications Capabilities

- Recommendation
 - Identify and evaluate methods, standards and potential capabilities for fusion of PNT with communications



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Vector: Cooperative Organizational Structures



4

Promote Interagency Coordination & Cooperation to Ensure the Necessary levels of Information Sharing

- Recommendations
 - Develop a national PNT coordination process
 - Identify and leverage centers of excellence for PNT phenomenology and applications
 - Define, develop, sustain, and manage a PNT modeling and simulation core analytical framework



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Recommendation Tree





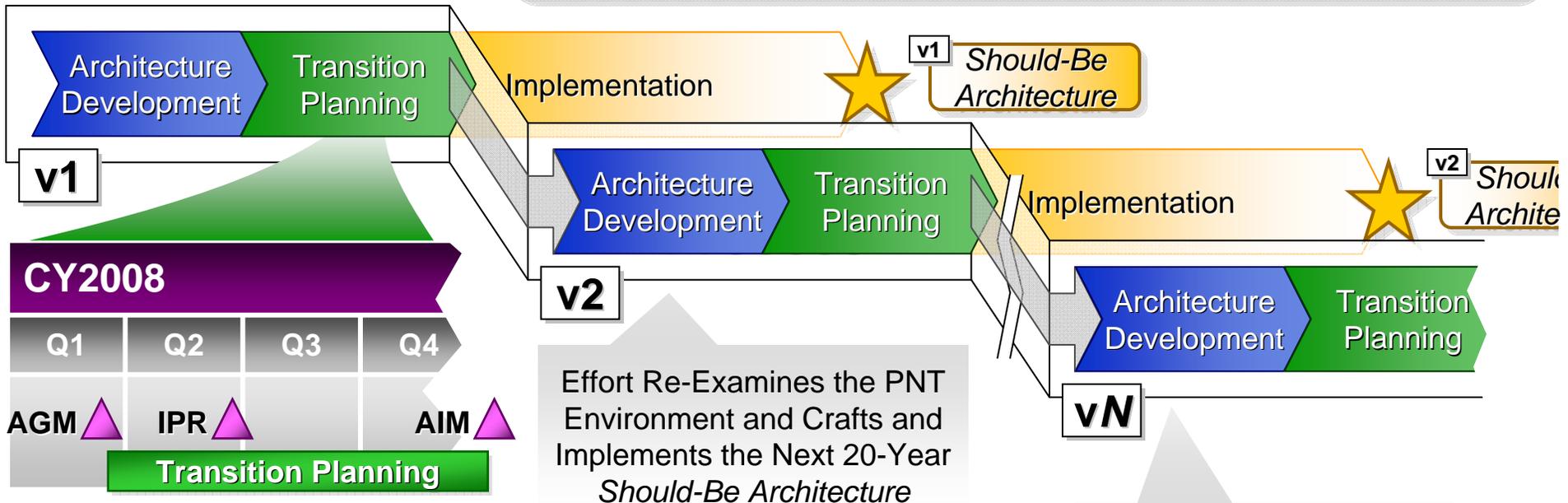
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Architecture Effort and Schedule

A Plan to Achieve the *Should-Be* Architecture is Produced & Implementation Begins

The National PNT Architecture Effort Employs an Iterative, Interagency Process to Plan US Leadership in Global PNT



Transition Plan provided to agencies



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Transition Workplan



- 1 Guiding Principles & Recommendation
2. Background
 - 2.1 Rationale
 - 2.2 Scope
- 3 Transition Planning
 - 3.1 Activities
 - 3.2 Relationship to other Recommendations
 - 3.3 Timeline
- 4 Implementation
 - 4.1 Tasks
 - 4.2 Relationship to other Recommendations
 - 4.3 Timeline
 - 4.4 Contribution to Architecture Capabilities
 - 4.5 Issues & Risks
 - 4.6 Investment Strategy
- 5 Membership



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Summary



- Architecture Development
- Industry Input
- Architecture Recommendations
- Architecture Transition Planning



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Points of Contact

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Questions?