CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT (CAASD)

En Route Automation Infrastructure In Transition

Presented at NEXTOR's
NAS Infrastructure in Transition Conference

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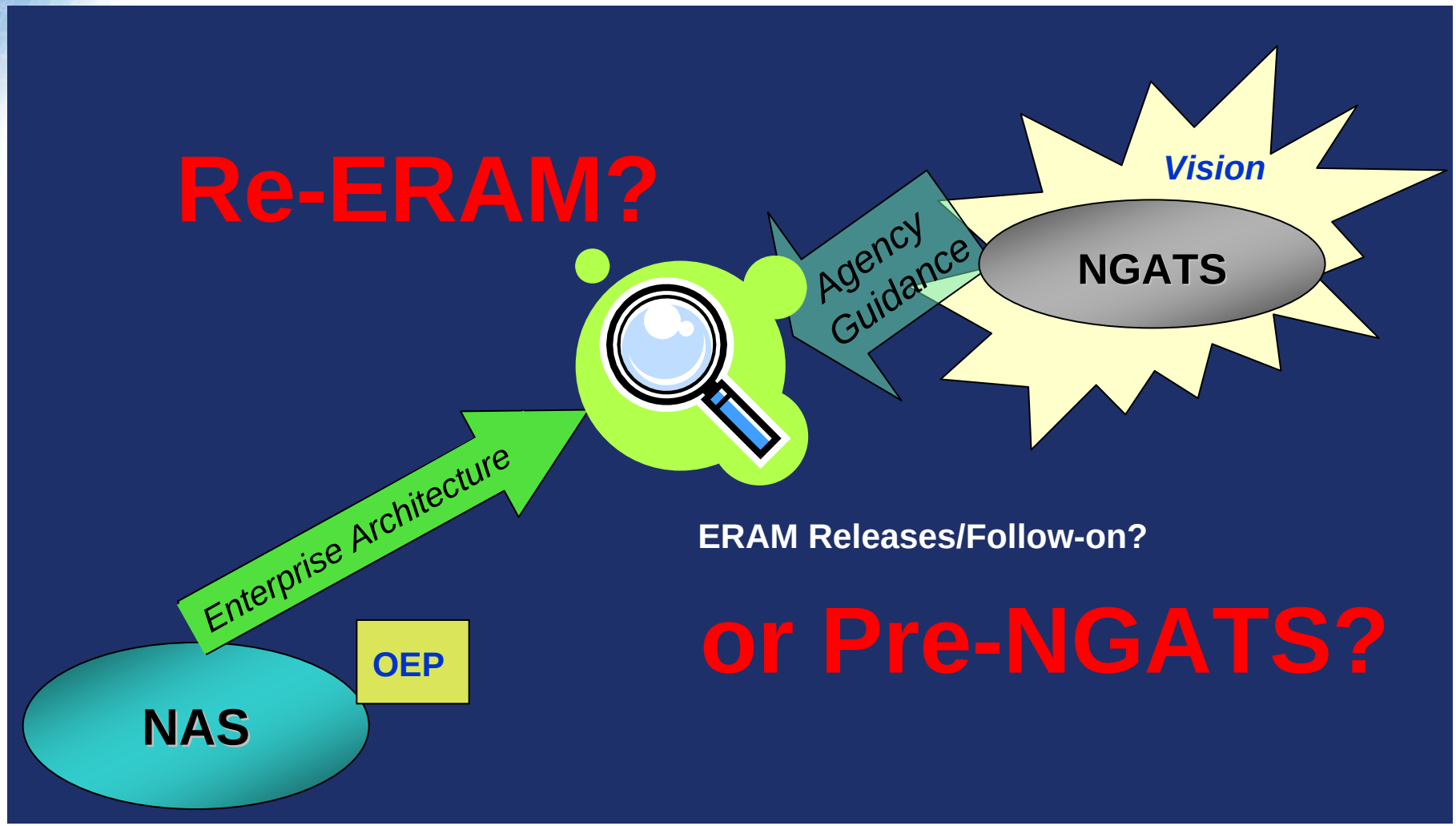
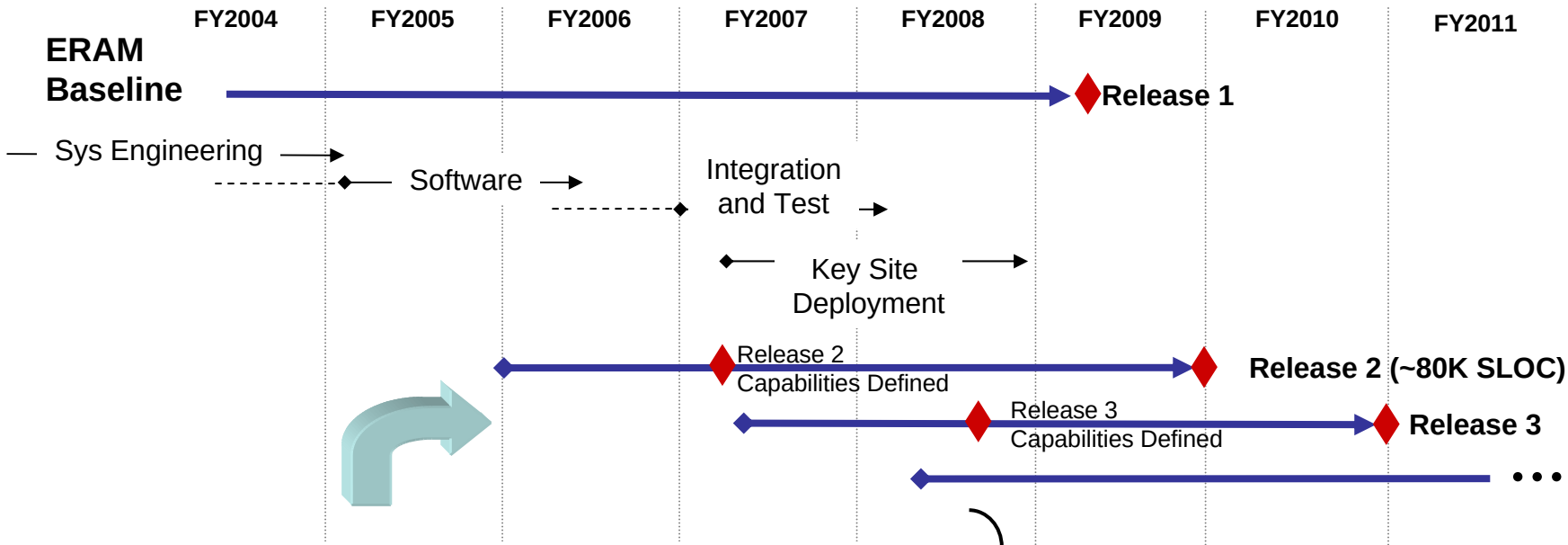
From NAS to NGATS: Much More Definition is Needed



ERAM Baseline and Releases



Some Candidate Functional Enhancements

- **ICAO Flight Plan Enhancements**
- **RNP/Advanced Airspace**
- **TFM Integration**
- **Advanced Simulation for Controller Training**
- **Decision Support / Integrated Sector Ops**
- **Datalink Services**
- **ADS-B Applications**
- **ERAM API Enhancements**
- **SWIM Integration**
- **Non-Radar**

Estimated at

> 1 Million SLOC

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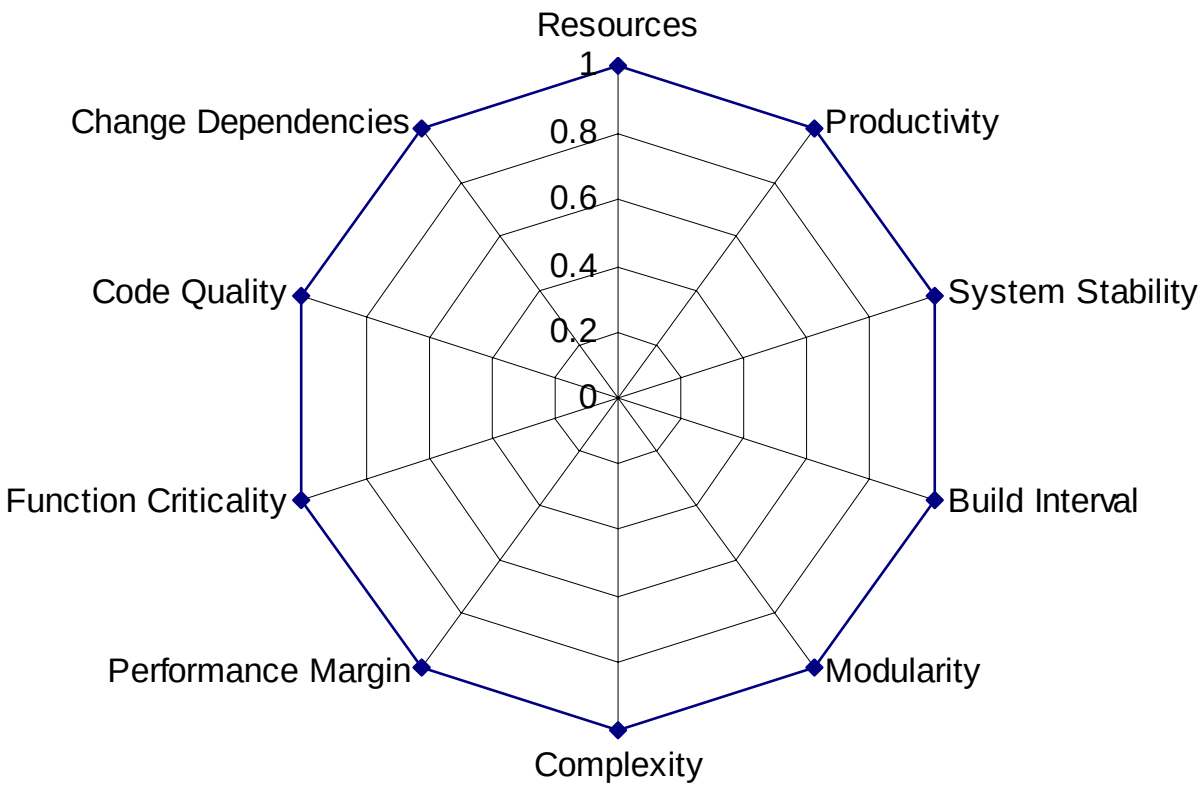
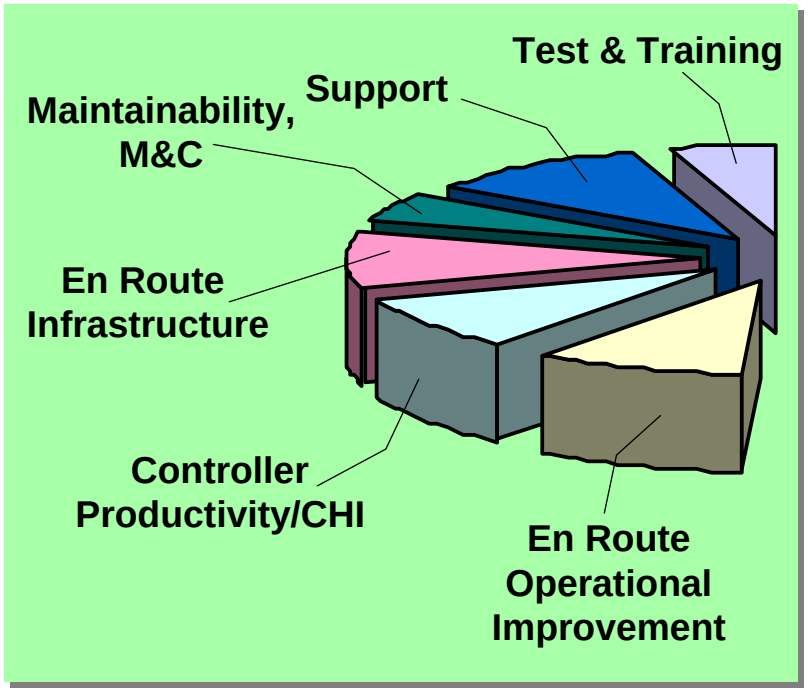
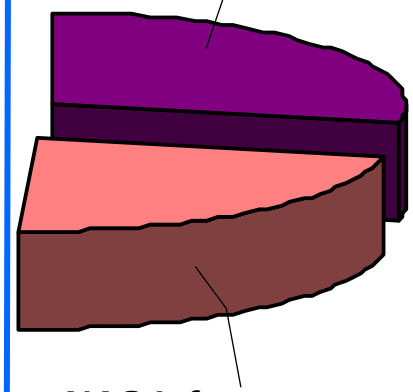
Factors Influencing Potential Change Magnitude



Estimated Relative Size of ERAM Release 2 Candidates (not prioritized) by Bin Categories

En Route Improvements ← → **NAS-Wide Improvements**





NAS Operational Improvement

- TFM Reroutes
- Temporary Flow Restrictions
- Mexico, Canada I/F
- ICAO flight plan
- Initial ADS-B Surveillance
- HAR/NAR – Adapted RNP separation
- A380

NAS Infrastructure

- SUA/SAA constraint access
- HADDS/SAFA replacement
- Flight Object – Route info expansion
- FDIO replacement
- SWIM integration

200K ± 50K SLOC Total*

*** CAASD Estimate**

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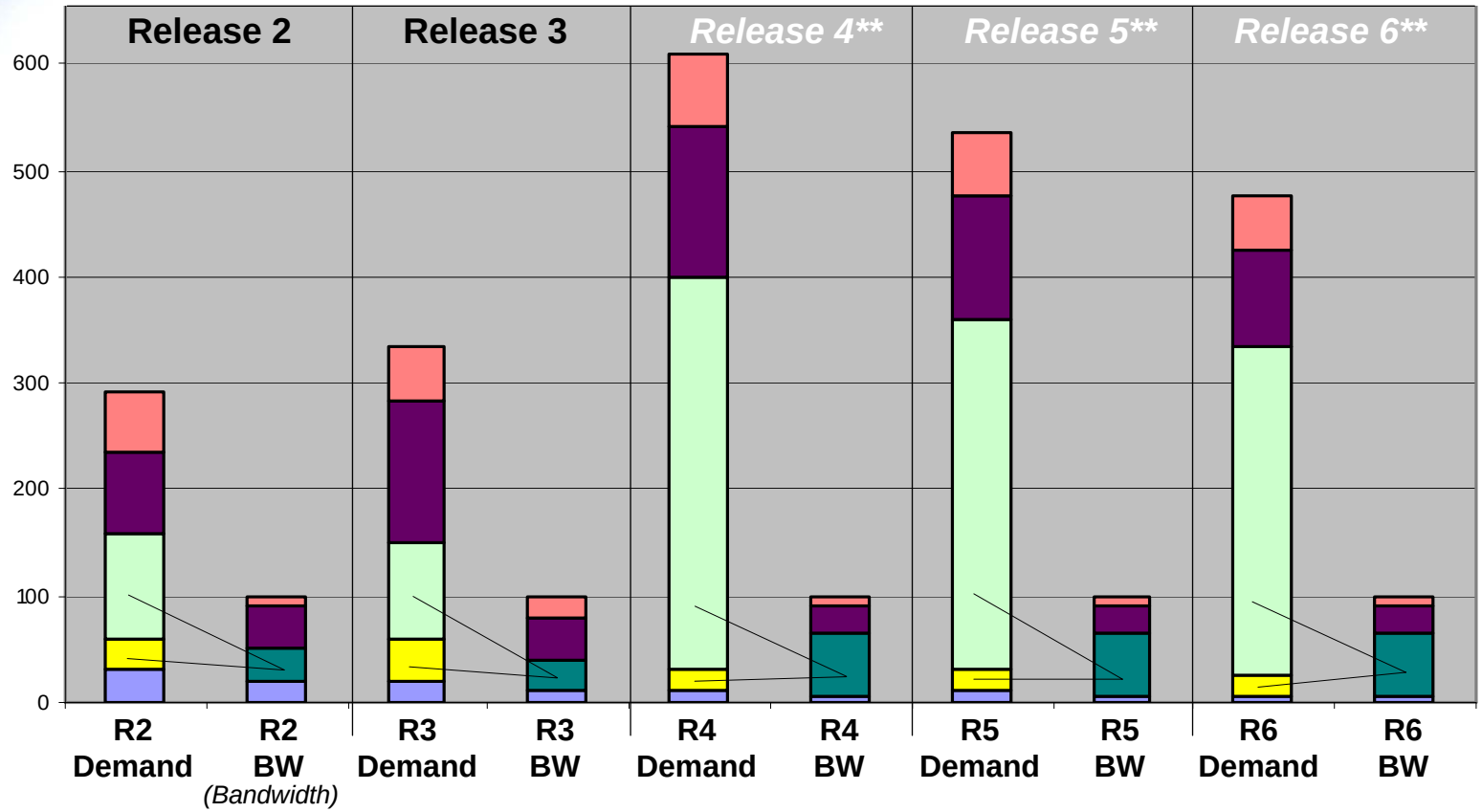
ERAM Releases
Estimated Demand & Proposed Bandwidth*



***Not part of the Existing ERAM Contract*

*** Upper Bound - based on CAASD experience & s/w design rules**

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ERAM Release Change Magnitude: The Message

- **Magnitude of potential change exceeds current planning and projected resources**
  - **ERAM resource planning includes 80K source lines of code (SLOC) of software development for <u>each</u> of the Releases (R2 and R3)**
    - **~ 40 KSLOC for enhancements**
    - **~ 40 KSLOC for fixes**
- **NAS-level prioritization, in line with NGATS objectives, is essential**
- **Need to examine the feasibility of increasing the bandwidth/capacity for development of new capabilities**
- **Need to start developing plans for implementing enhancements beyond Release 3**

Some Conventional Wisdom

- If you change more than ~ 1/3, you might as well start over
- Maximum change between builds ~ 20% (but not safety critical systems!)
- Annual change traffic is 10-15% for commercial systems
- Large system developments can take 4 years to stabilize; start to decay after 9 years*
  - Latent defect removal continues after deployment; performance is refined and optimized
  - After ~ 9 years, change magnitude exceeds scope & extensibility of original architecture/design; software technology/system paradigms move on
- At some point in time, expect replacement or major re-factoring

*Roetzheim, William, *Estimating and Managing Project Scope for Maintenance And Reuse Projects*, Crosstalk, December 2004

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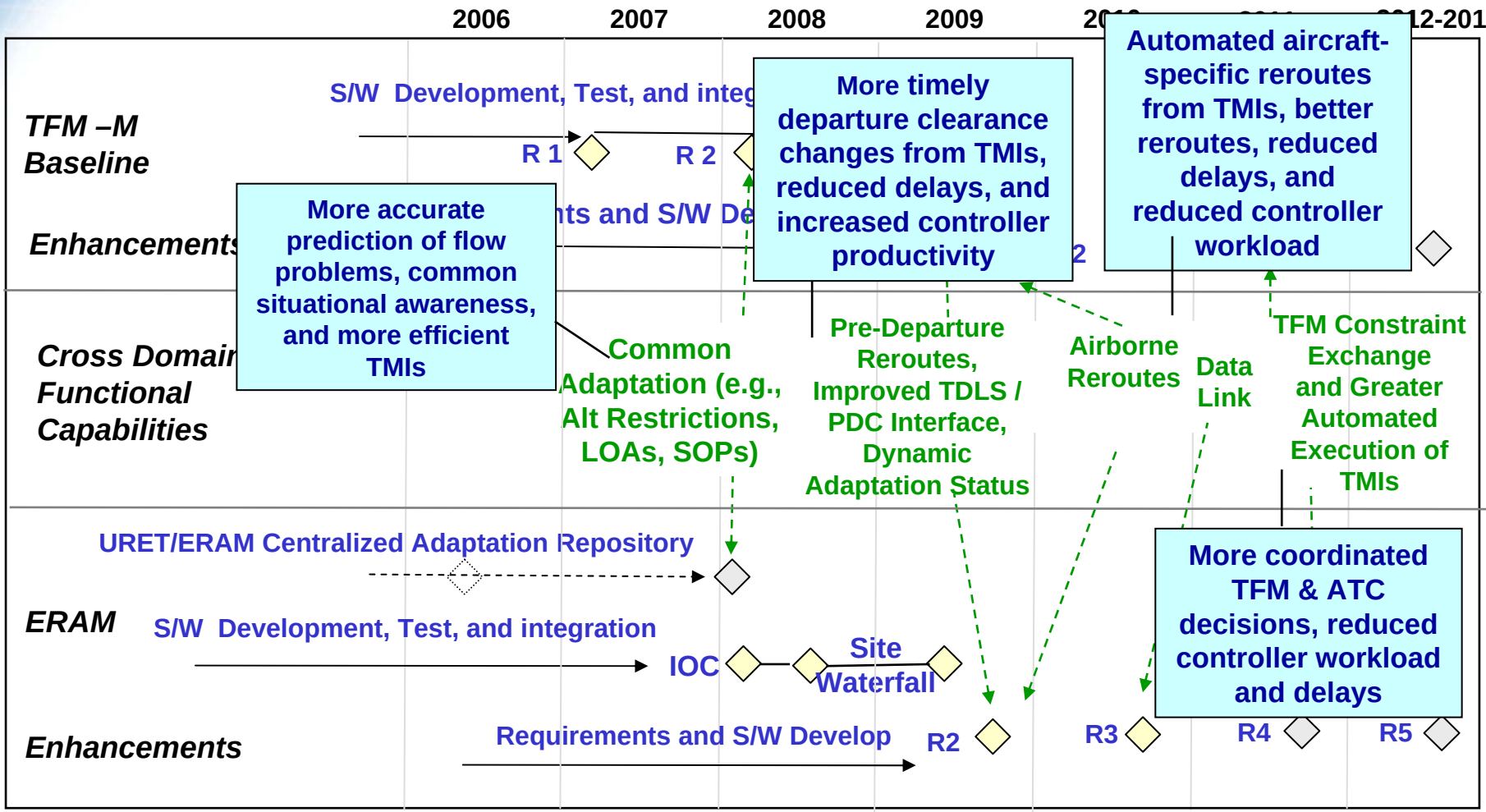
TFM / En Route Evolution: Integration Opportunities (1/3)



Note: Schedule dates are best information based on a mix of targets, and contractual dates

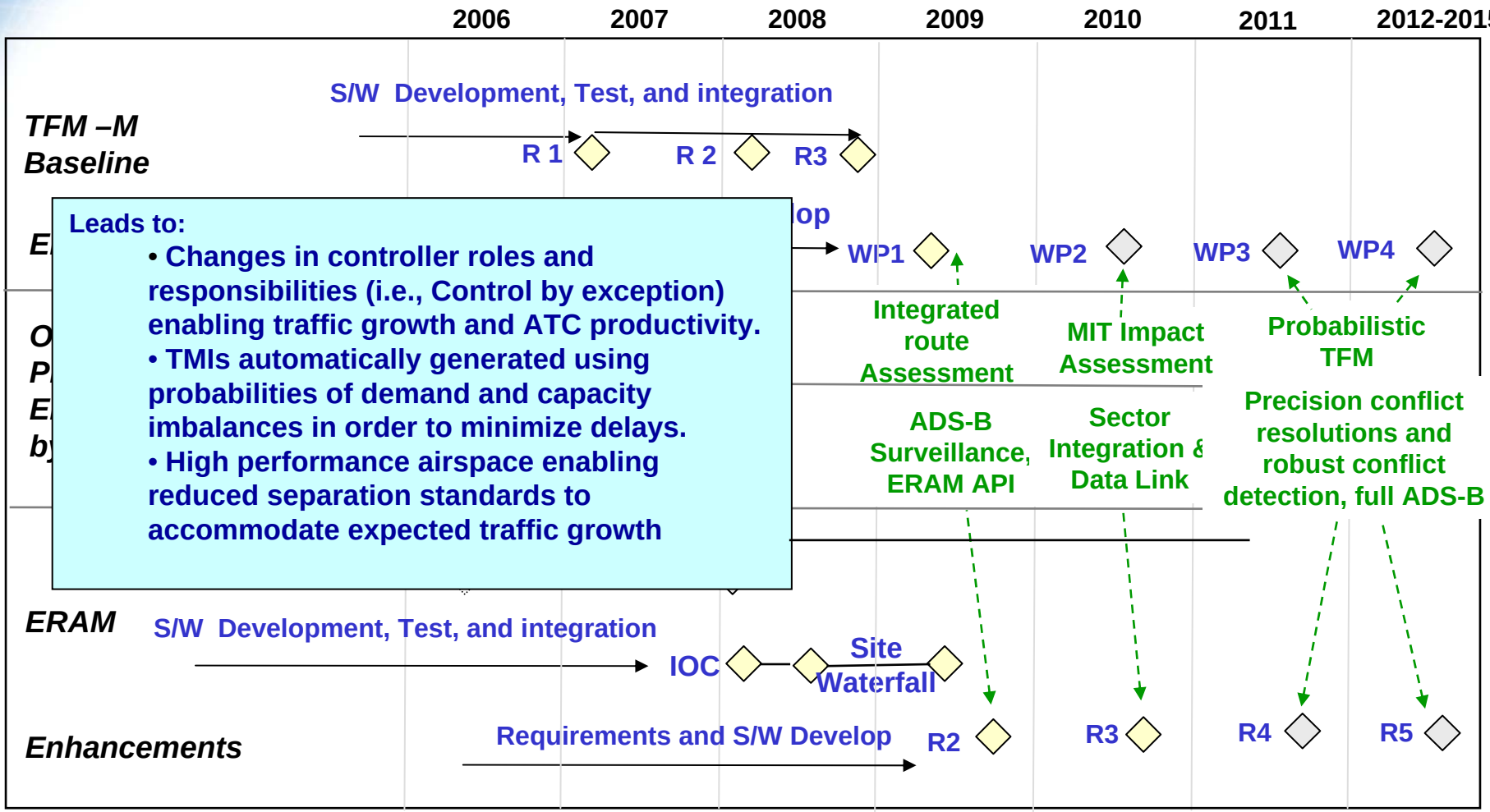
Decision Points

Planned Milestone

Estimated / Unplanned Milestone

Points of Integration

TFM / En Route Evolution: Integration Opportunities (2/3)



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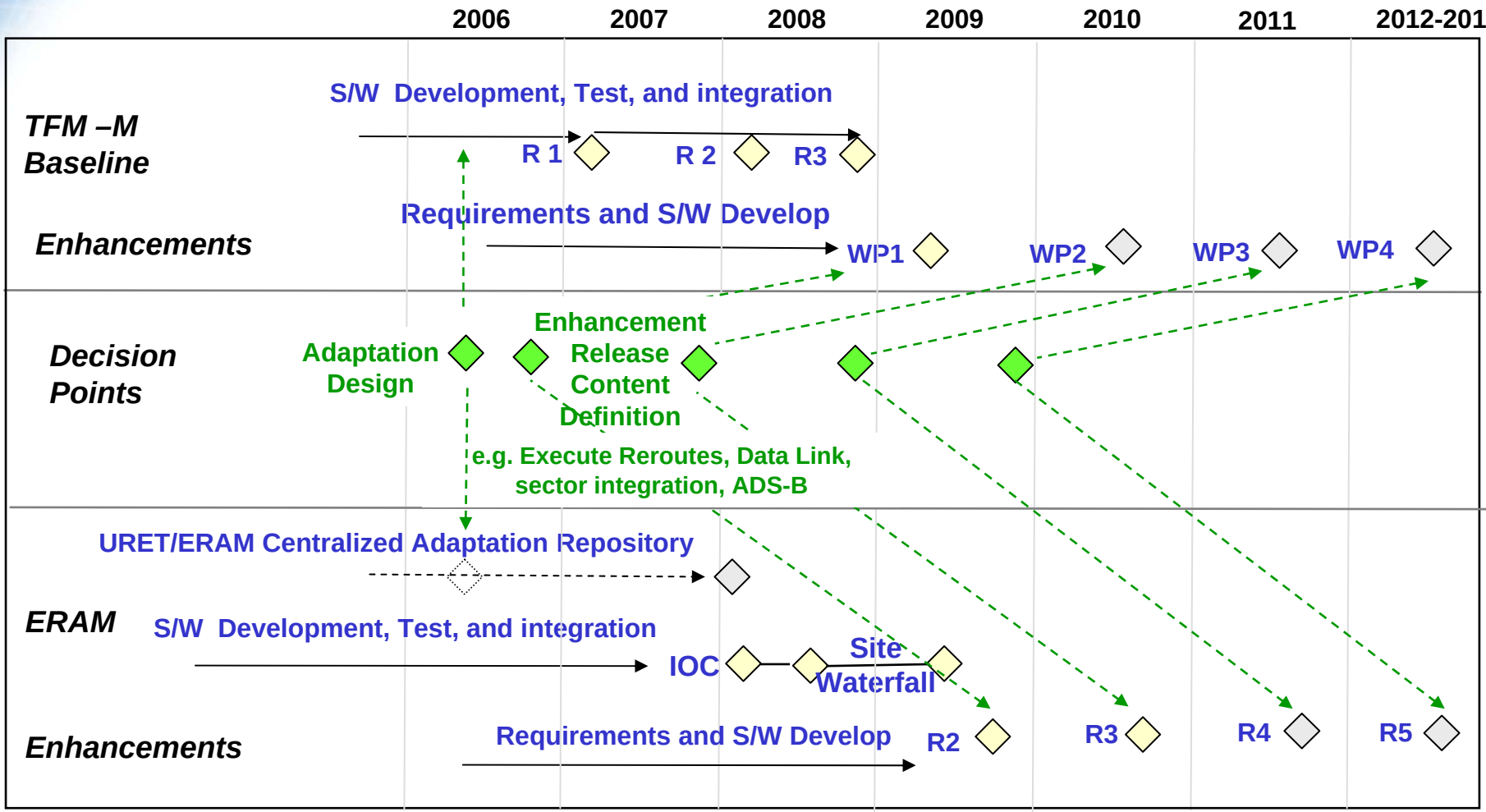
Decision Points

Planned Milestone

Estimated / Unplanned Milestone

Points of Integration

TFM / En Route Evolution: Integration Opportunities (3/3)



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