ULS Systems Research Roadmap

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March 2008

Roadmap Intent

Help evaluate the ULS systems relevance of existing or planned research

- The roadmap structure explicitly shows a ULS system perspective

Prioritize research funding

- The roadmap provides a basis for determining which research is most critical/relevant/impactful for achieving a future ULS systems capability

Framework for incorporating additional ULS systems research

Motivate Research

- The roadmap shows how an individual research initiative supports one or more ULS-system technical challenges

Put Research in Context

The Roadmap Root: A Warfighter Capability

The ULS System report mentioned six capabilities needed by the DoD

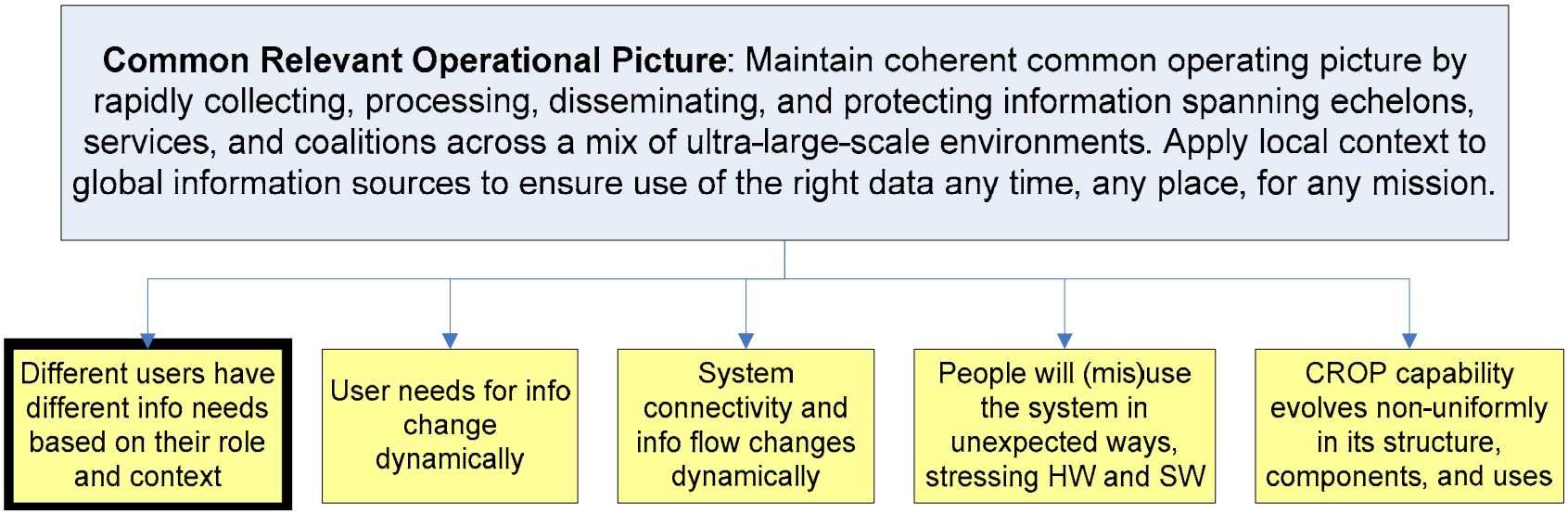
The roadmap combines two of them (C1/C6) into a single capability to show research relevance to desired military capabilities

- **Common Relevant Operational Picture (CROP)**: Maintain coherent common operating picture
  - across echelons, services, and coalitions in a mix of ultra-large-scale environments (C1)
  - applying local context to global information sources to ensure use of the right data any time, any place, for any mission (C6)

A Needed Warfighter Capability

Common Relevant Operational Picture: Maintain coherent common operating picture by rapidly collecting, processing, disseminating, and protecting information spanning echelons, services, and coalitions across a mix of ultra-large-scale environments. Apply local context to global information sources to ensure use of the right data any time, any place, for any mission.

Technical Observations



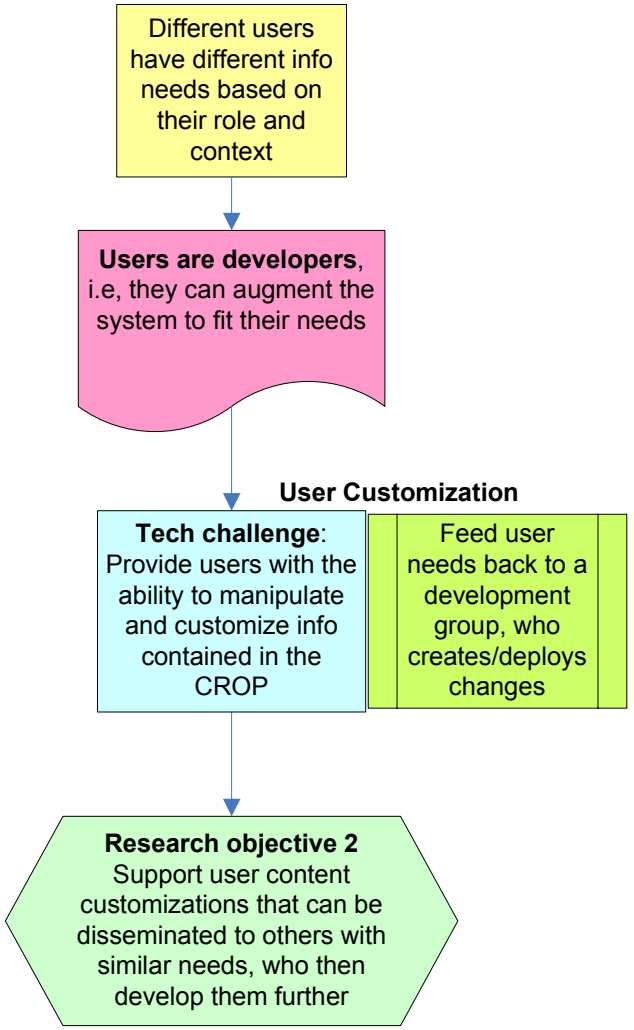
Roadmap Example

Observation

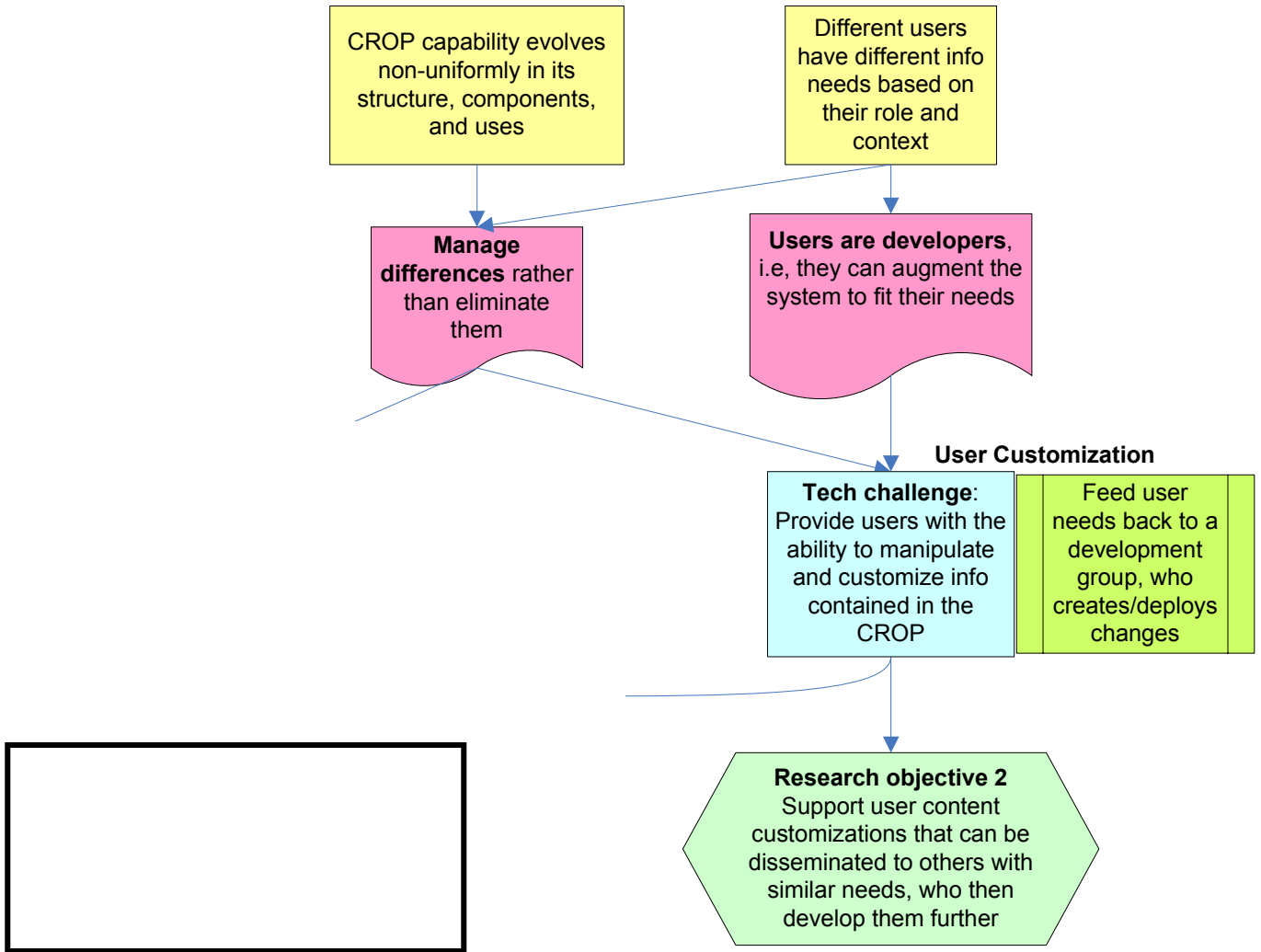
Different users have different info needs based on their role and context

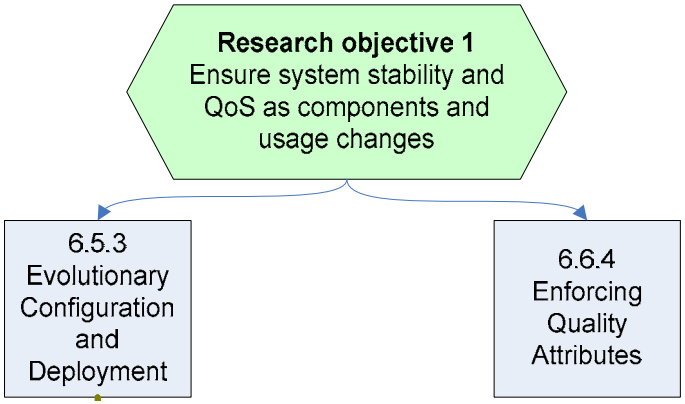
ULS System Perspectives

Previous Roadmap Example

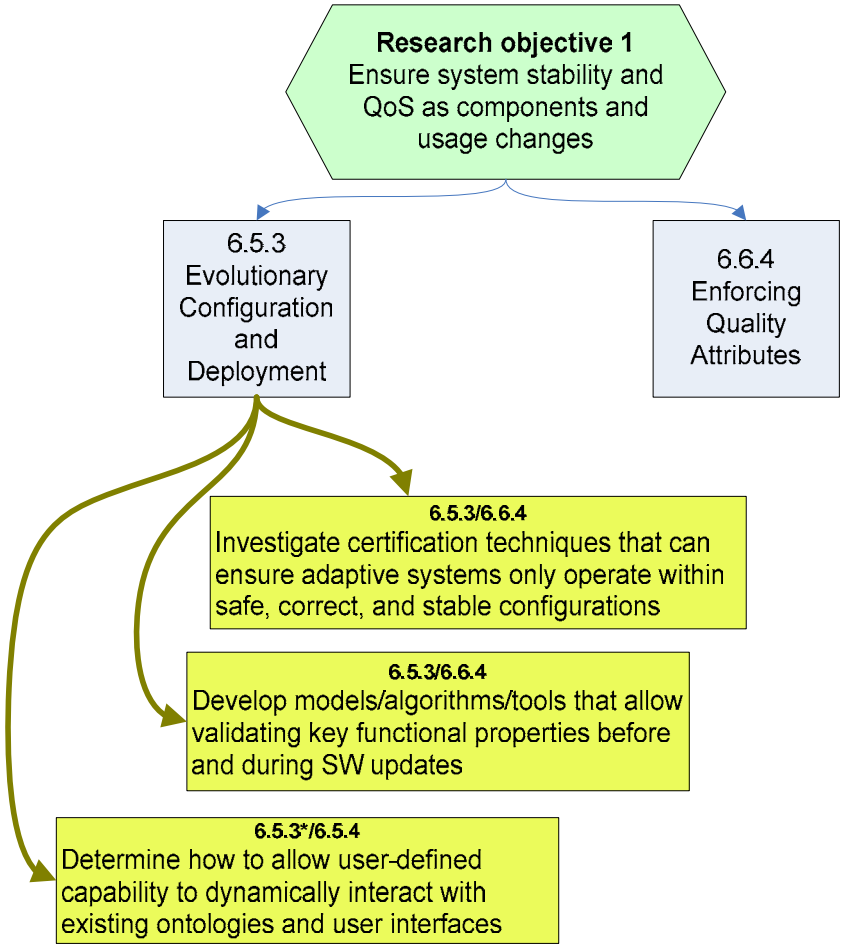


Augmented Roadmap Example

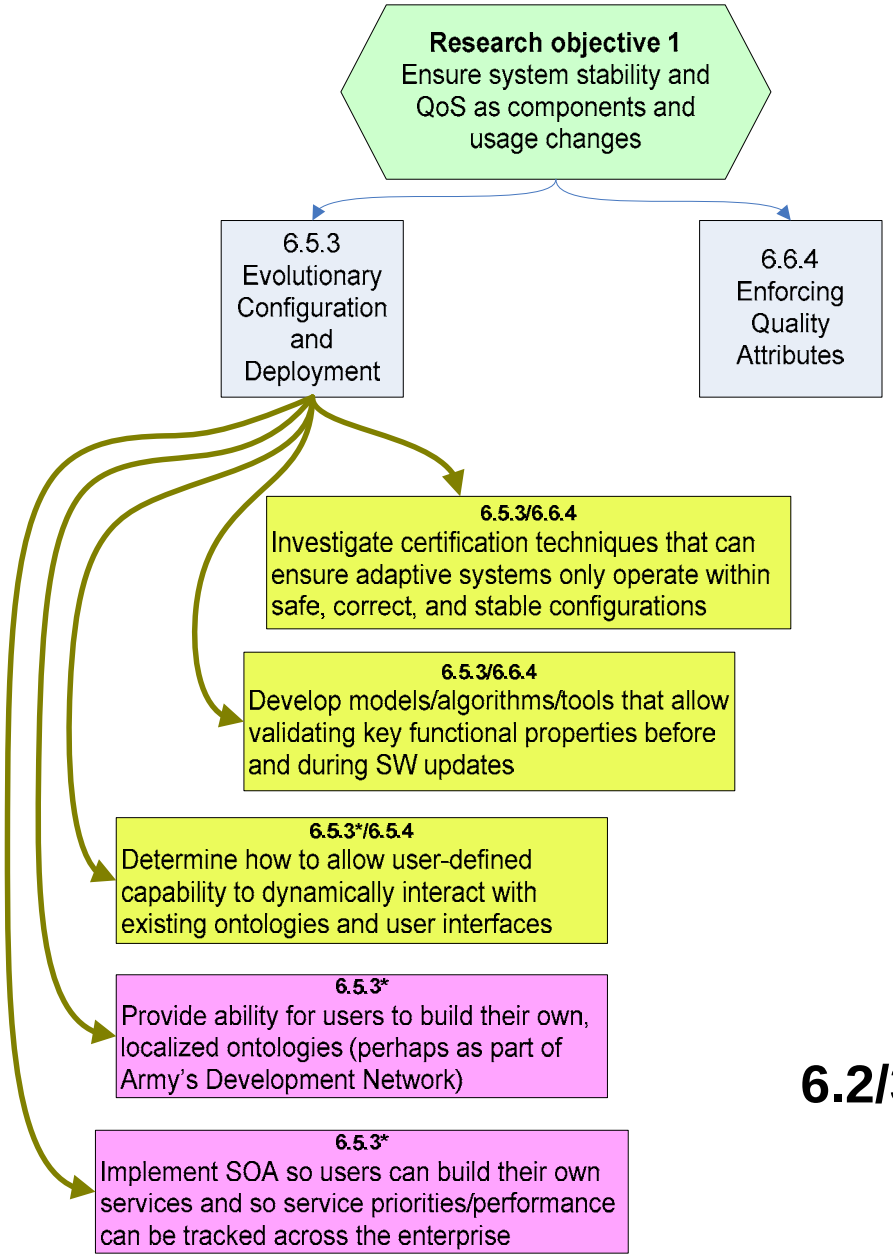




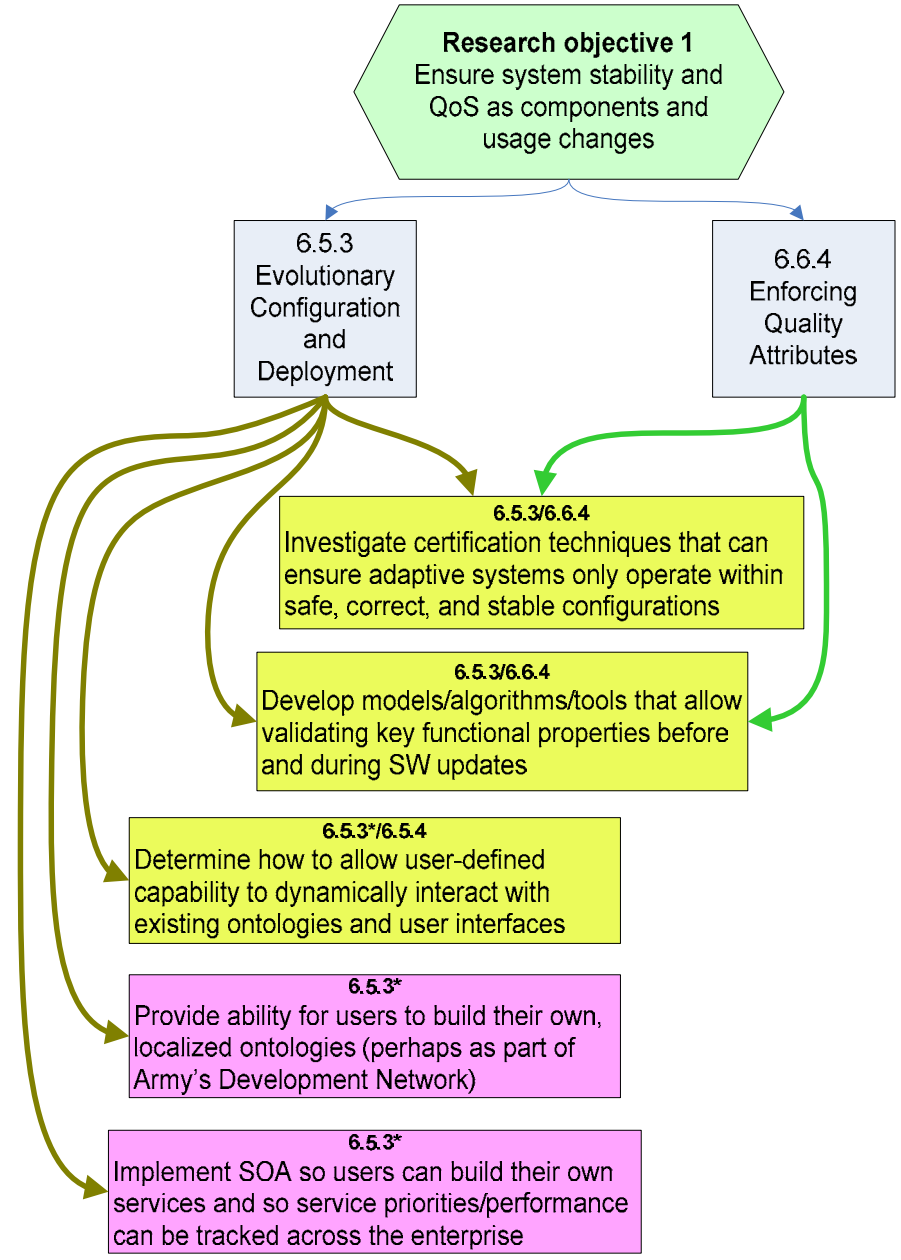
Research Topic from ULS Systems Report

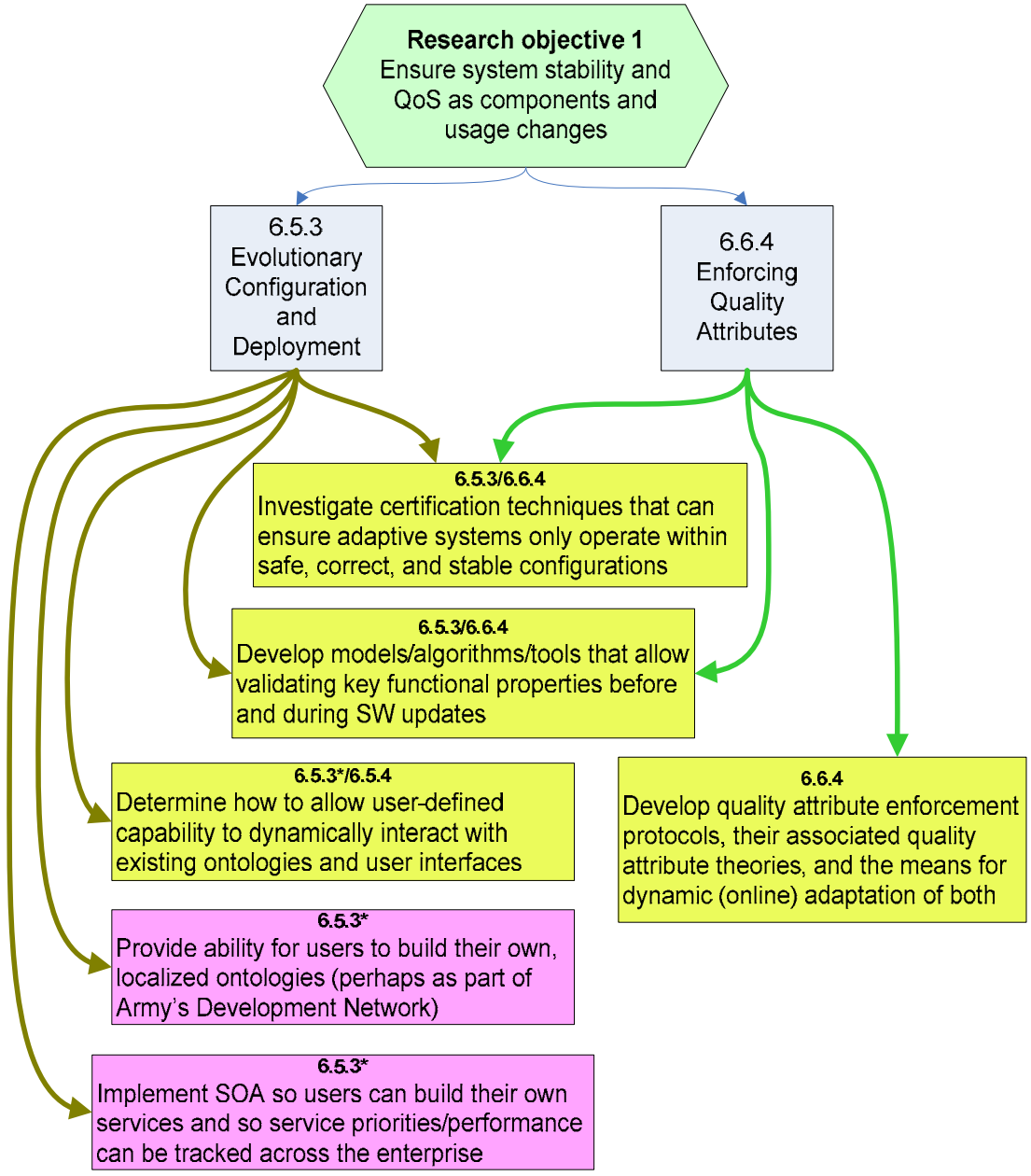


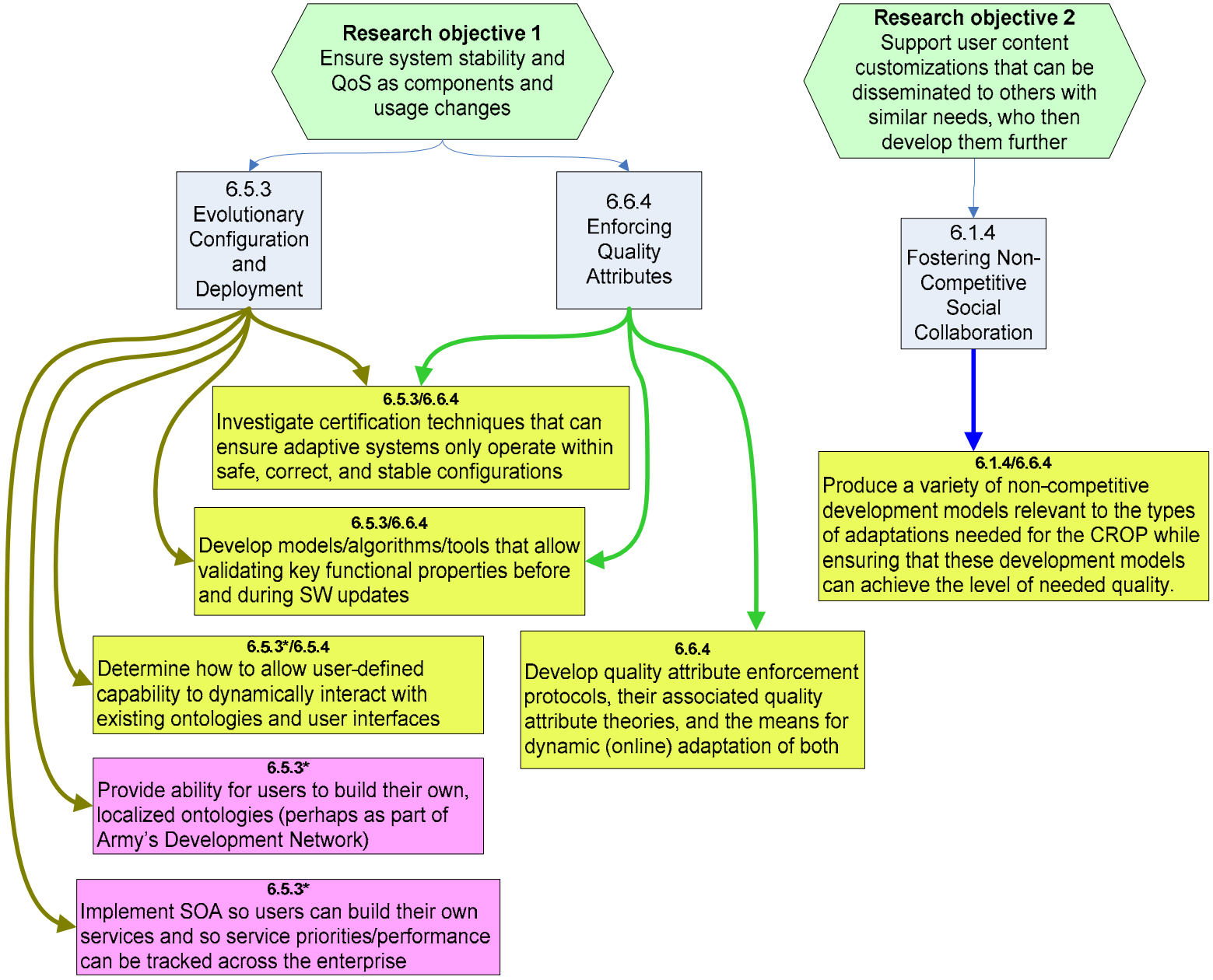
6.1 Research

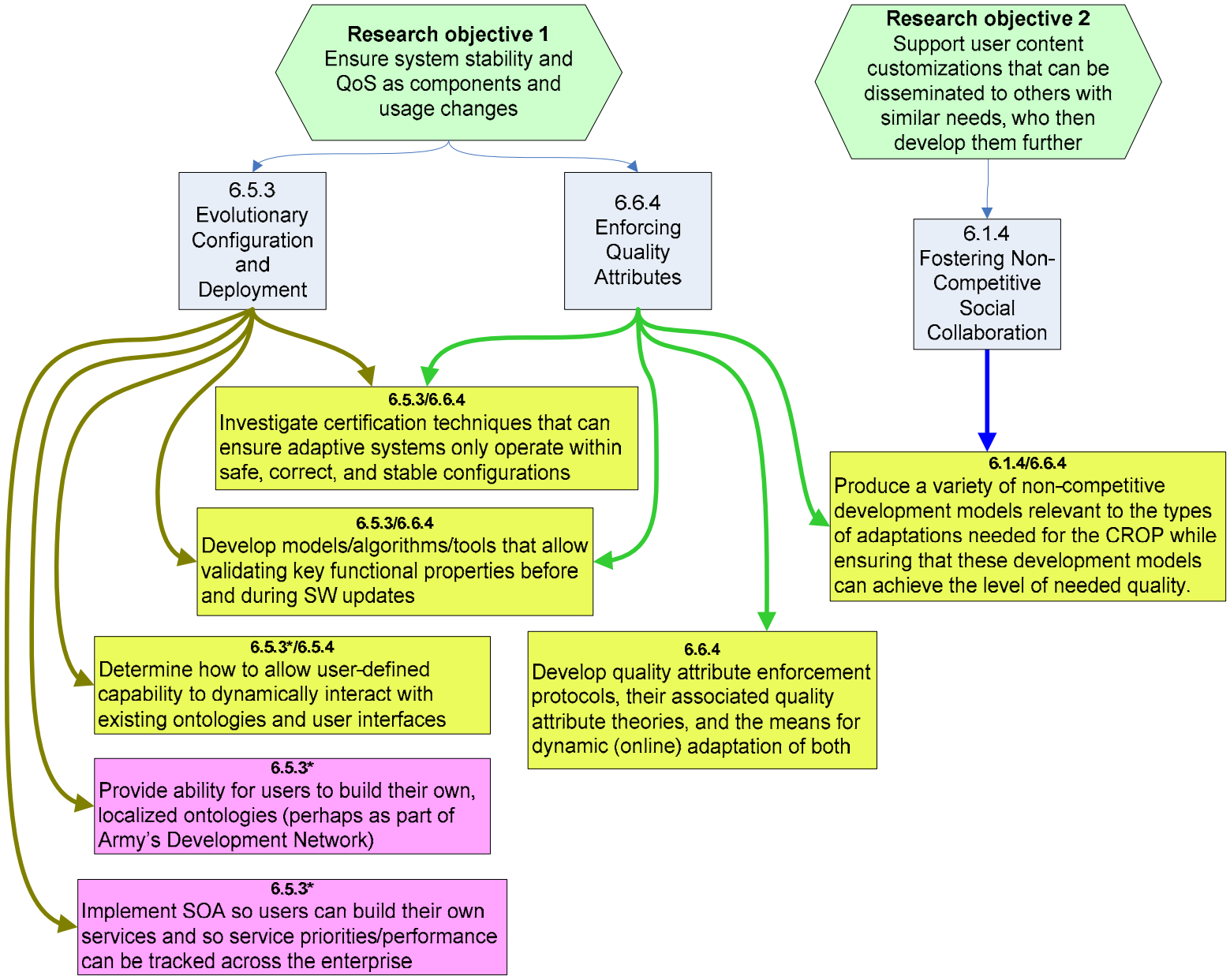


6.2/3 Research









Roadmap Structure and Development Process

Start with: a needed ULS system **capability**

Make: **Observations** about this capability

- Example: user needs change dynamically

Use: ULS systems **perspective** (contrasted with conventional approach)

Identify: **Technical challenge** (related to ULS systems perspective)

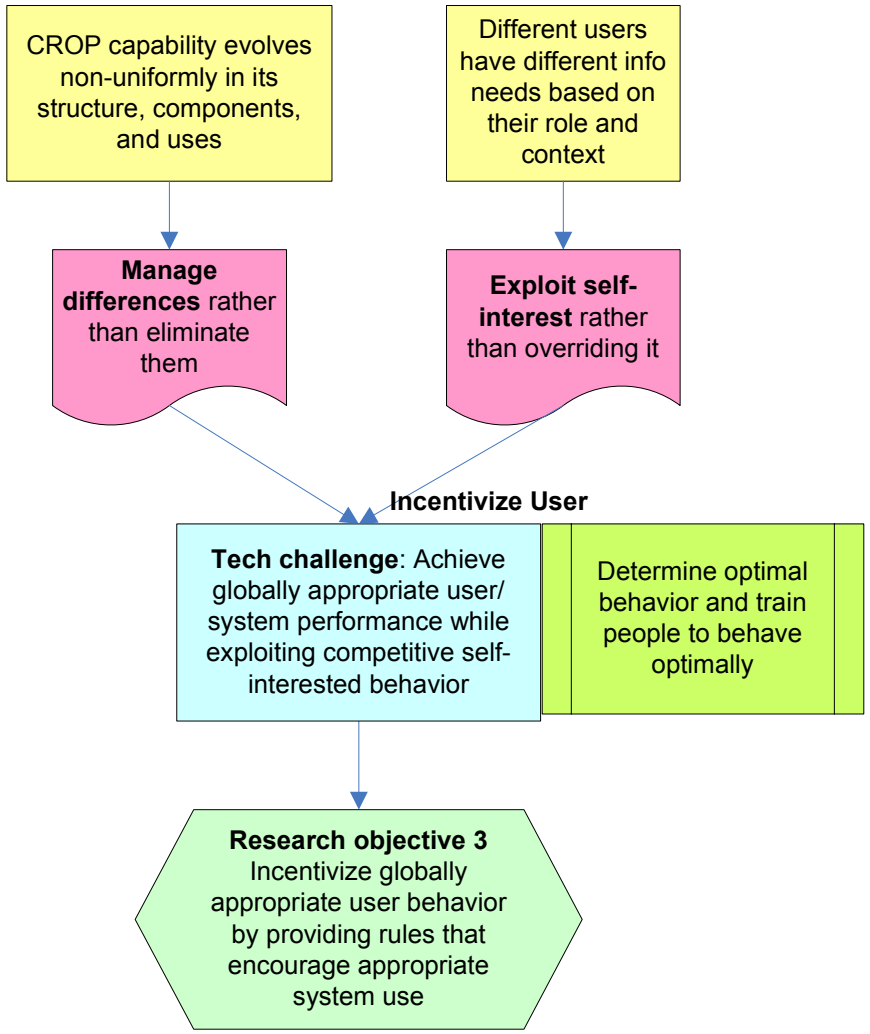
- Contrast with the "usual" technical challenge

Restate challenge as: **Research objective**

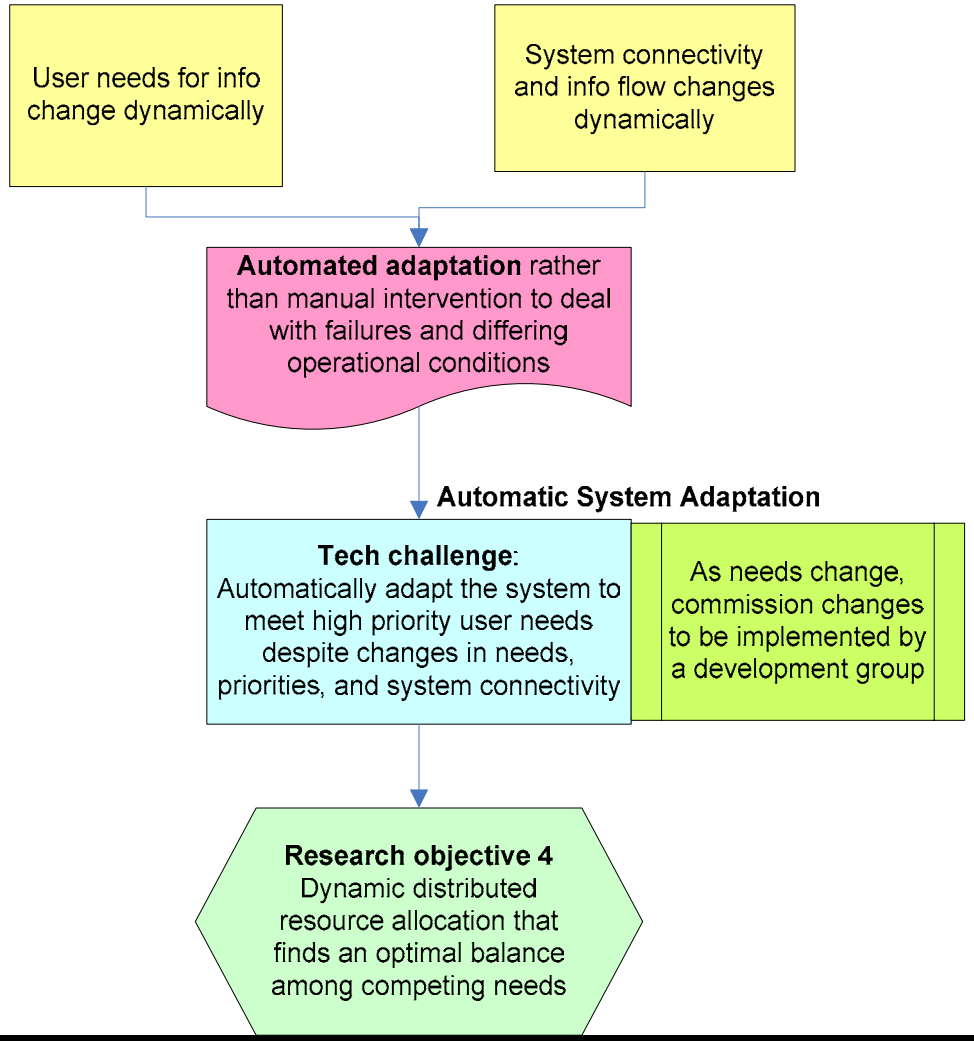
Cite: ULS Systems report **Research Topic**

Define **Research Initiatives**: Several supporting each research objective

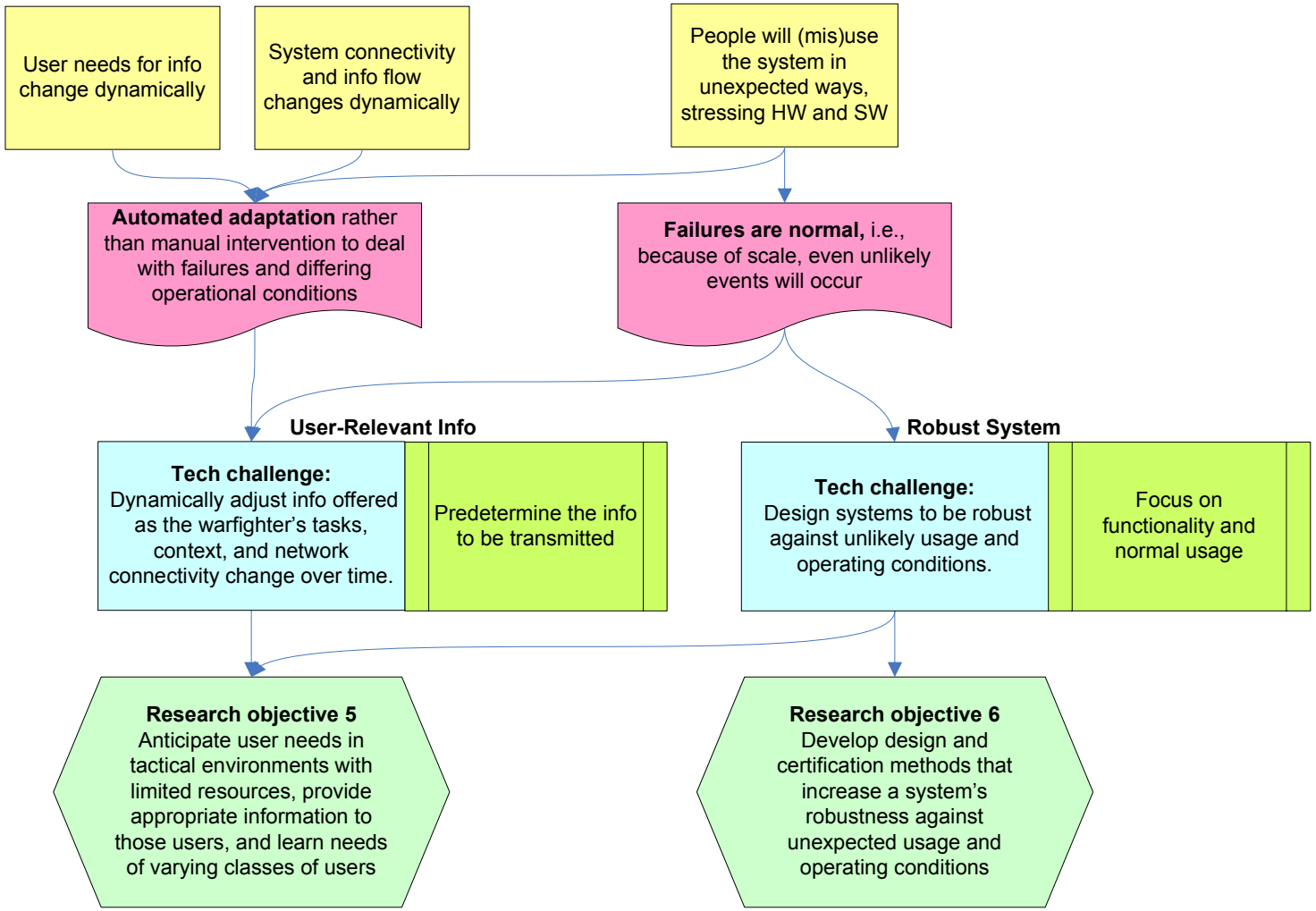
Incentivize User



Automatic System Adaptation



User Relevance and Robustness



ULS Systems Research Topics *In*/Not In Roadmap

6.1.1 Context-Aware Assistive Computing

6.1.2 Understanding Users and Their Contexts

6.1.3 Modeling Users and User Communities

6.1.4 Fostering Non-Competitive Social Collaboration

6.1.5 Longevity

6.2.1 Algorithmic Mechanism Design

6.2.2 Metaheuristics in Software Engineering

6.2.3 Digital Evolution

6.3.1 Design of All Levels

6.3.2 Design Spaces and Design Rules

6.3.3 Harnessing Economics to Promote Good Design

6.3.4 Design Representation/Analysis

6.3.5 Assimilation

6.3.6 Determining and Managing Requirements

6.4.1 Expressive Representation Languages

6.4.2 Scaled-Up Specification, Verification, and Certification

6.4.3 Computational Engineering for Analysis and Design

6.5.1 Decentralized Production Management

6.5.2 View-Based Evolution

6.5.3 Evolutionary Configuration and Deployment

6.5.4 In Situ Control and Adaptation

6.6.1 Robustness, Adaptation, and Quality Attributes

6.6.2 Scale and Composition of Quality Attributes

6.6.3 Understanding People-Centric Qual. Attr.

6.6.4 Enforcing Quality Requirements

6.6.5 Security, Trust, and Resiliency

6.6.6 Engineering Management at Ultra-Large Scales

6.7.1 Policy Definition for ULS Systems

6.7.2 Fast Acquisition for ULS Systems

6.7.3 Management of ULS Systems

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