FAA Requirements Engineering Management Handbook

7. Identify the System Modes

Kansas State University

Steps in the REMH

1. Develop the System Overview
2. Identify the System Boundary
3. Develop the Operational Concepts
4. Identify the Environmental Assumptions
5. Develop the Functional Architecture
6. Revise the Architecture to Meet Implementation Constraints
7. **Identify System Modes**
8. Develop the Detailed Behavior and Performance Requirements
9. Define the Software Requirements
10. Allocate System Requirements to Subsystems
11. Provide Rationale

Architecture Revision: Goals

What are we trying to achieve with this step in the requirements engineering process?

- Identify modes – "macro states" in which system will respond differently to stimuli, i.e., there are discontinuities in externally visible system behavior
- Avoid mode confusion and associated errors
- Simplify writing of detailed requirements

Architecture Revision: Artifacts

What artifacts should we produce as a result of this step?

- List of system modes
- Mode transition system describing when system will transition between modes based on internal events or external stimuli

6 Revise the Architecture to Meet Implementation Constraints

7 Identify the System Modes: Modes define disjointed behaviors of the system that are visible to its operators or to other systems. The detailed behavioral and performance system requirements are frequently different for the various system modes. Identification of the system modes is a useful step that simplifies detailed behavioral and performance requirements specification.

7.1 Identify the major system modes before defining the detailed system requirements.

7.2 Define how the system is allowed to transition between modes.

7.3 Introduce modes only to identify the externally visible discontinuities in system behavior. Do not define modes that cannot be inferred from the externally visible behavior of the system.

7.1 Identify Major System Modes

- A mode is by definition visible to a user
  - Same input causes different response
  - Defined by Leveson as "distinct behaviors of the system"
- Example: system in which we press a button…behaves
  - one way during system power-up,
  - another way during a self-test,
  - and yet another way during normal operation.
- A system mode may or may not be explicitly displayed to a system user, but is, by definition, visible, since the system will respond differently to stimuli while in different modes
- Simplifies system requirements writing
  - E.g., allows the relationship between the monitored and controlled variables to be broken down into smaller pieces for each system mode.

7.2 Define How the System Transitions Between Modes

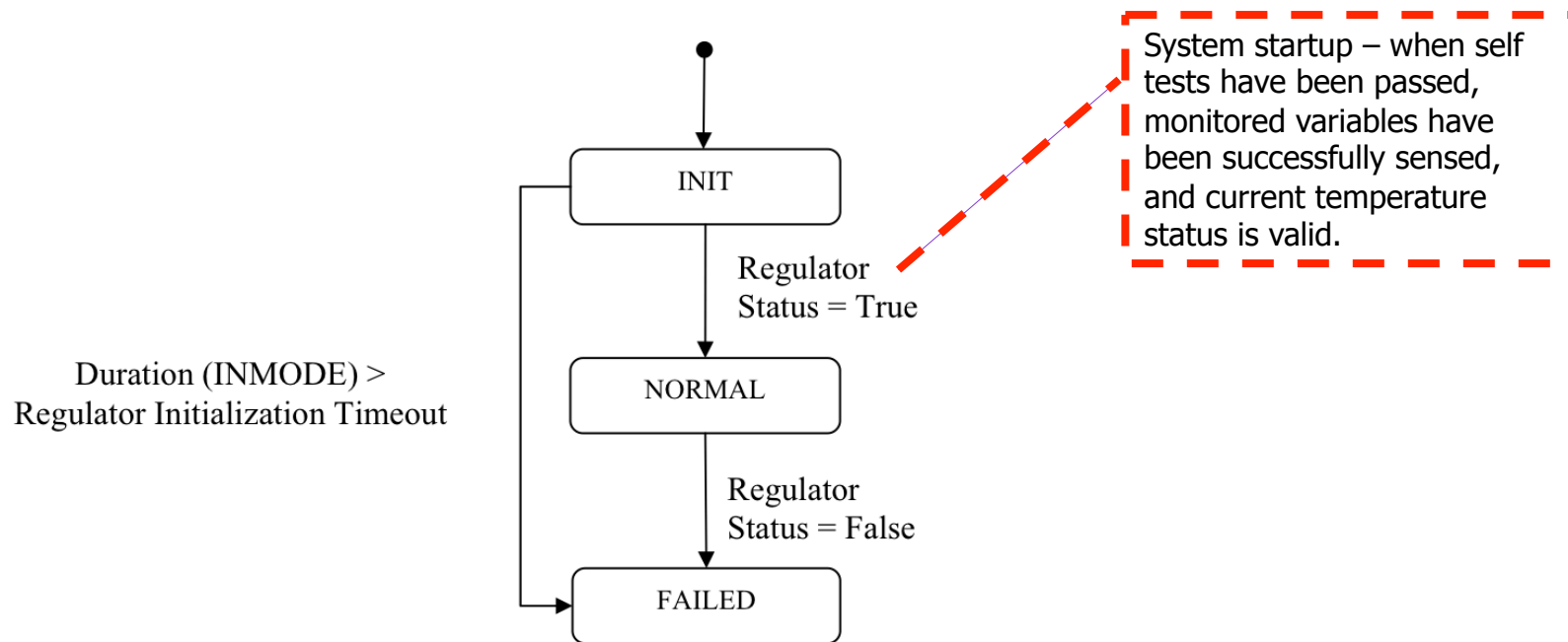Transition between modes can be specified using a state transition diagram

System startup – when self tests have been passed, monitored variables have been successfully sensed, and current temperature status is valid.

Figure 10. Regulate Temperature Function Modes

Name	Type	Definition
Regulator Status	Boolean	NOT (Regulator Interface Failure OR Regulator Internal Failure) AND Current Temperature status = Valid

7.3 Introduce Modes for Externally Visible Discontinuities

- Modes should only be defined if they cause externally visible discontinuities
  - Overly complex transition diagrams can be an indication of too many modes
  - Do not define modes that cannot be inferred from the externally visible behavior of the system
  - Don't include design decisions in mode descriptions

7.3 Introduce Modes for Externally Visible Discontinuities

Once modes are identified, we can reference them in detailed requirements – describing how the system should behave in each mode

- Examples
  - "If the system is in the initialization mode, the controlled variable shall be set to …"
  - "If the system is in failed mode, the controlled variable shall be set to …"

Summary

Modes – "macro states" in which system will respond differently to stimuli, i.e., there are discontinuities in externally visible system behavior

- Identifying modes aids in writing requirements
- Significant failures have resulted from failing to correctly identify system modes

For You To Do

Acknowledgements

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  - *FAA* DOT/FAA/AR-08/32, *Requirements Engineering Management Handbook.* David L. Lempia & Steven P. Miller.