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IETF 119
DTN Management Architecture

Overview

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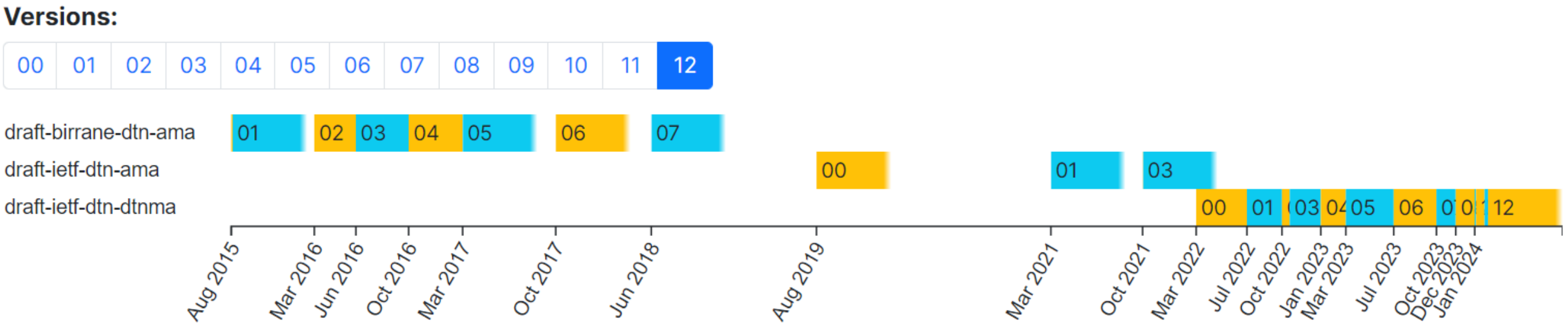
Overview

https://datatracker.ietf.org/doc/draft-ietf-dtn-dtnma/



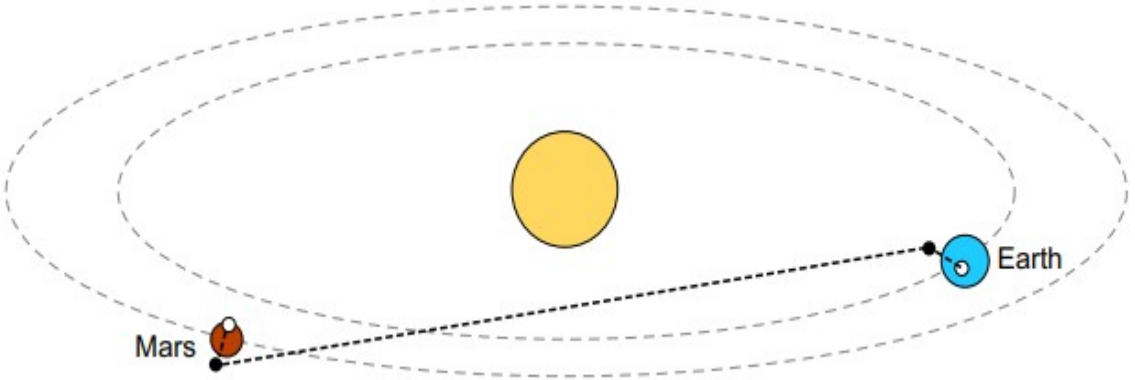
This document describes a DTN management architecture (DTNMA) suitable for managing devices in any challenged environment but, in particular, those communicating using the DTN Bundle Protocol (BP).

Challenged Networks

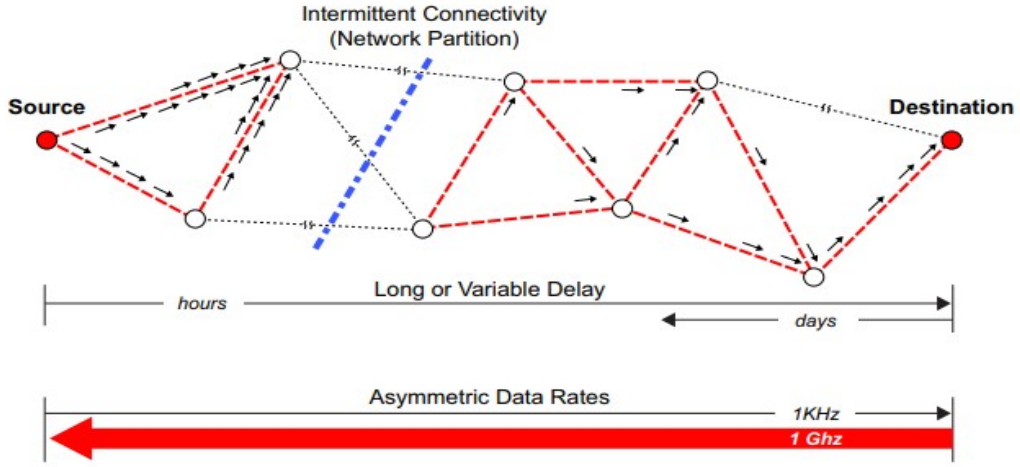
Driving Concerns

Figures taken from: https://www.nasa.gov/wp-content/uploads/2023/09/dtn-tutorial-v3.2-0.pdf?521L75

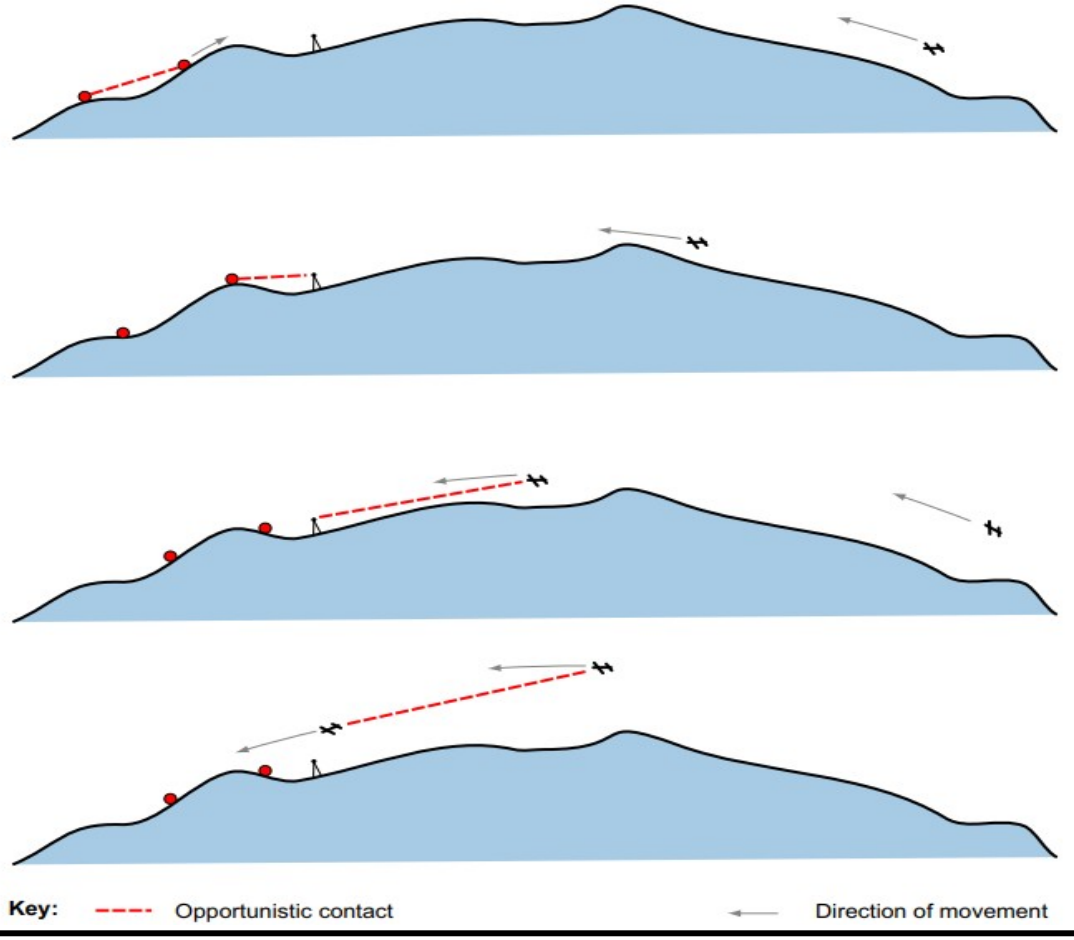
Latencies of seconds/hours/days



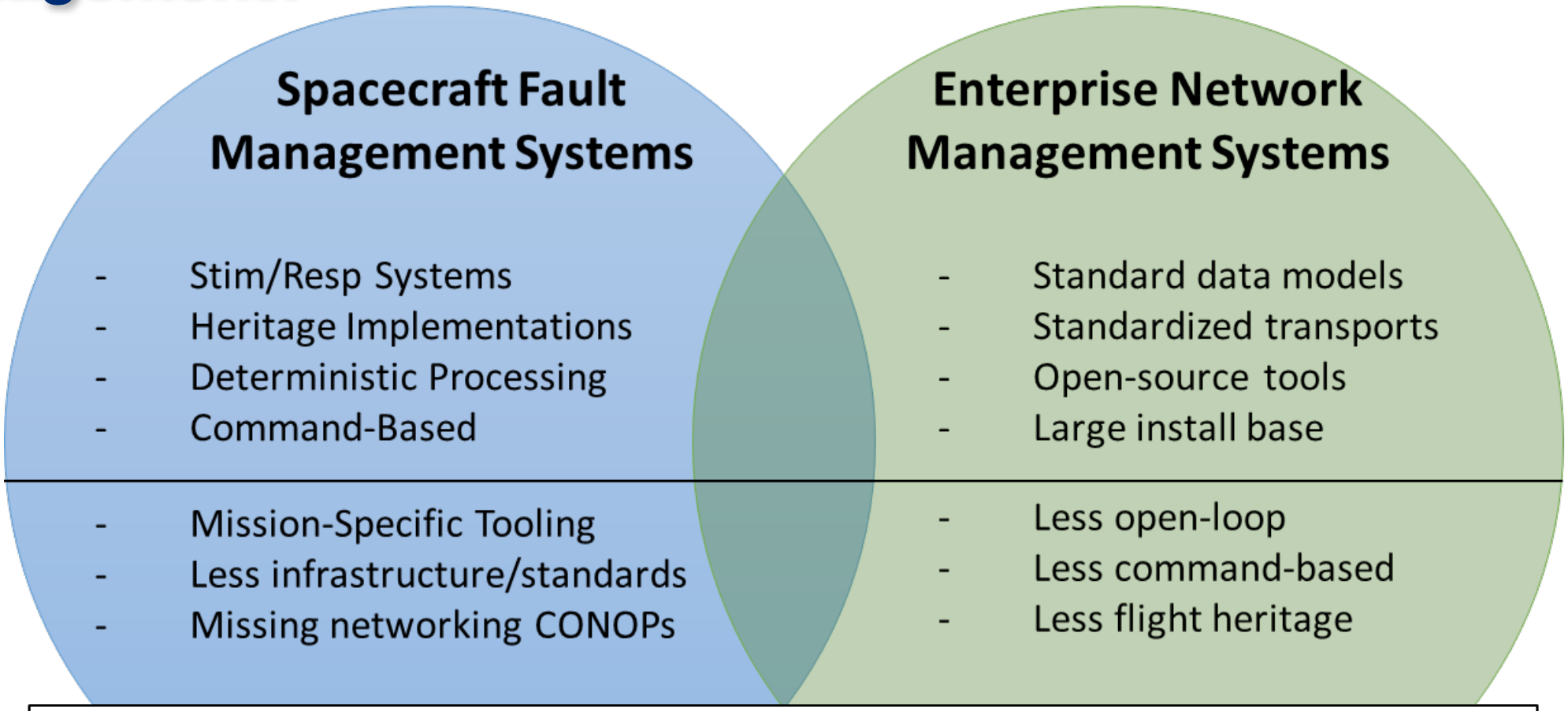
Asymmetric (up to uni-directional) links



No timely end-to-end exchange
Do not rely on timely infrastructure (DNS/Cas)



Can fault autonomy be extended for network management?



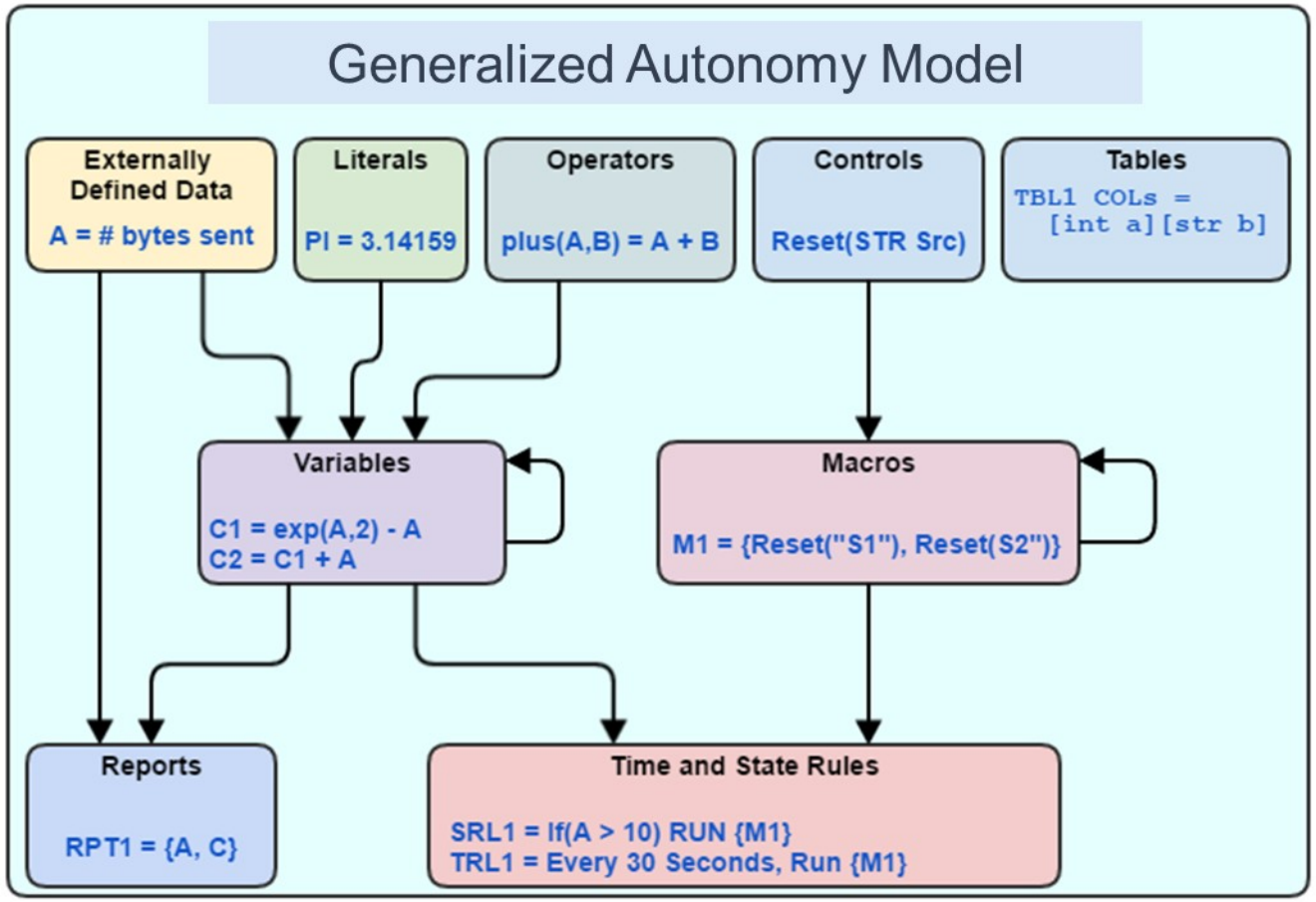
What does a healthy intersection of these worlds look like?

- Express flight autonomy models using network management standards.
- Find ways to capture “domain-specific” languages where they exist.

Common command-based autonomy

A generalized autonomy model fits most fault autonomy systems

- Rule-based Systems
  - Time and State
    - Time special case of state
  - Special considerations
    - N of M evaluations
    - Maximum evaluations
    - Maximum fire counts
- Reason about instances not structures
  - “If value of **X** at time **T…**”
  - “Run a macro parameterized with a run-time variable”
- Cascading Rulesets
  - If <bad condition> for 30 sec try thing 1.
  - If <bad condition> for 60 sec try thing 2.

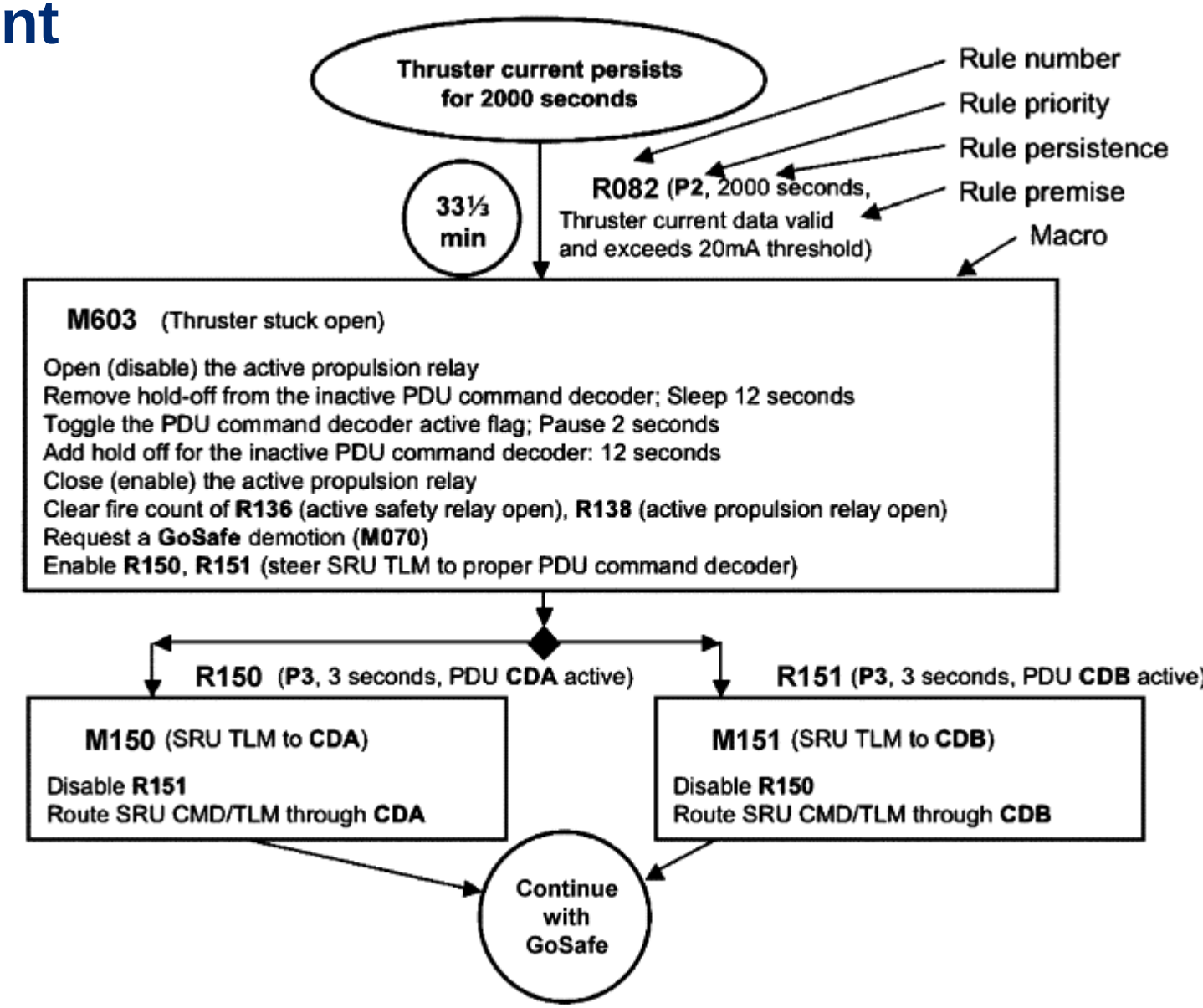


Command-Based Management

Rule-Based Stimulus-Response System

- Inspired by fault-protection systems
  - These systems/engines are already going to be on operational systems
  - Fault protection can be extended to include “network fault” protection

- Extreme example: New Horizons
  - 12 Mhz Mongoose Processor
  - 126 “rules”
  - Access to 8000 data elements
  - 768KB memory for responses

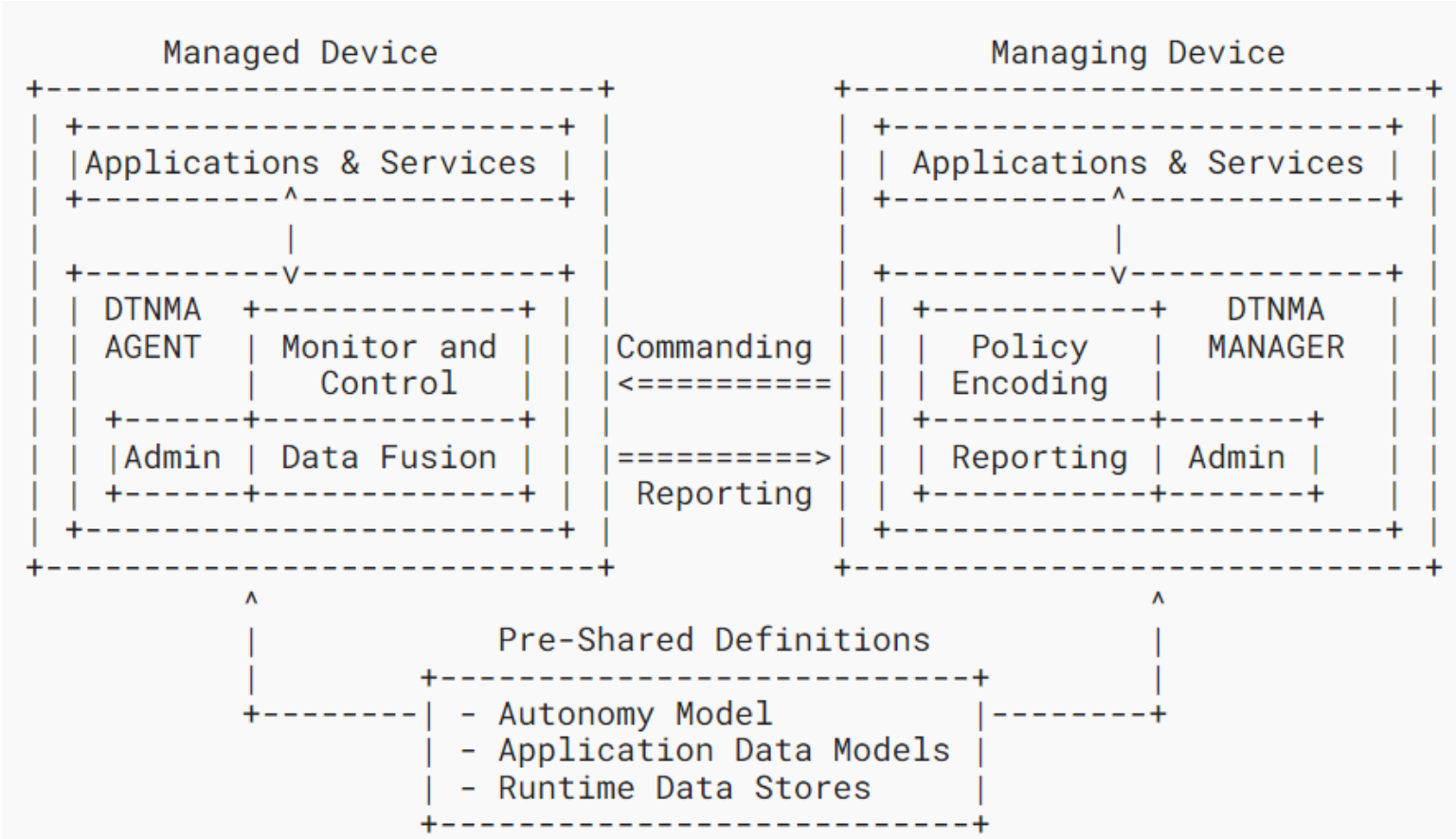


https://www.sciencedirect.com/science/article/pii/S0094576507000604

Modeling Features

Blend network management and fault autonomy

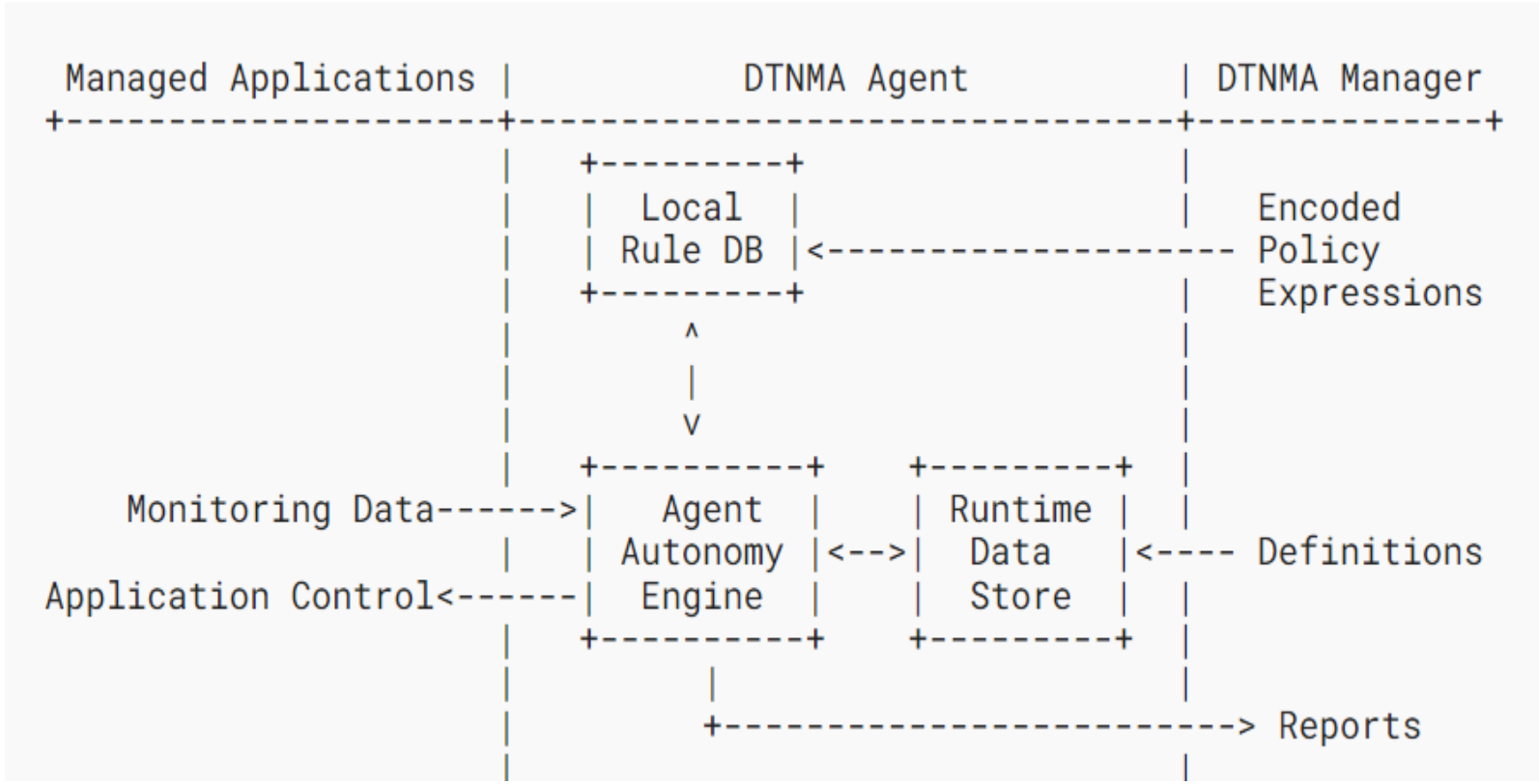
- **Open-Loop Control**
  - Manager pre-configures agents
- **Standardized Autonomy Model**
  - Autonomy “objects”
  - Focus on restrictions (e.g. not “union of everything”)
- **Compressible Model Structure**
  - Common subtrees in model hierarchy
  - Fast filtering / glob’ing / masking



DTNMA Reference Model

Configuring the DTNMA Agent Application

- DTNMA Agent (DA)
  - Application on a managed device
  - Maintains a rules database
  - Implements an autonomy engine
  - Issues commands to co-resident managed applications.
- DTNMA Manager (DM)
  - Manages the DA by configuring it
  - Receives information from Das
- Modeling questions
  - How do we represent the DA autonomy model?
  - How to best transport configuration from a DM to a DA?



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Predicate Autonomy Rules

A known approach to fault management

- Common for disconnected systems
  - ON <event> IF <condition> THEN <action>
  - Common or shared events/conditions
- Stimulus (Event/Condition)
  - Based on local state of device (incl. time)
  - May calculate local variables
  - May have restrictions
    - N of M thresholds
    - Maximum fire counts
- Responses
  - Usually macros (series of commands)
  - Responses may set flags/state to trigger other rule evaluations

IF <condition 1> THEN <response 1>

Single Predicate Expression

IF <common condition> THEN

IF <specific condition 1> THEN <response 1>

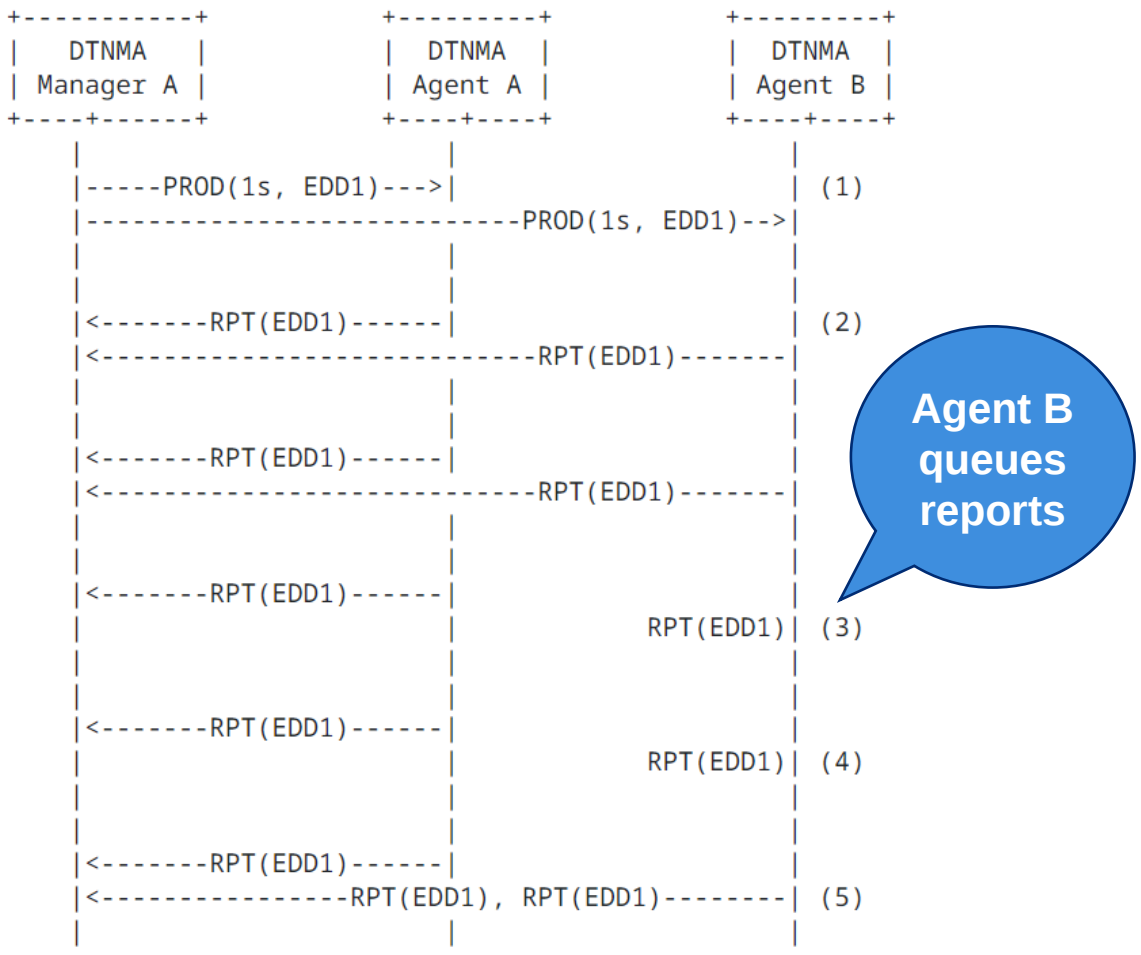
IF <specific condition 2> THEN <response 2>

IF <specific condition 3> THEN <response 3>

Shared Condition for Bulk Evaluation

Some Use Cases

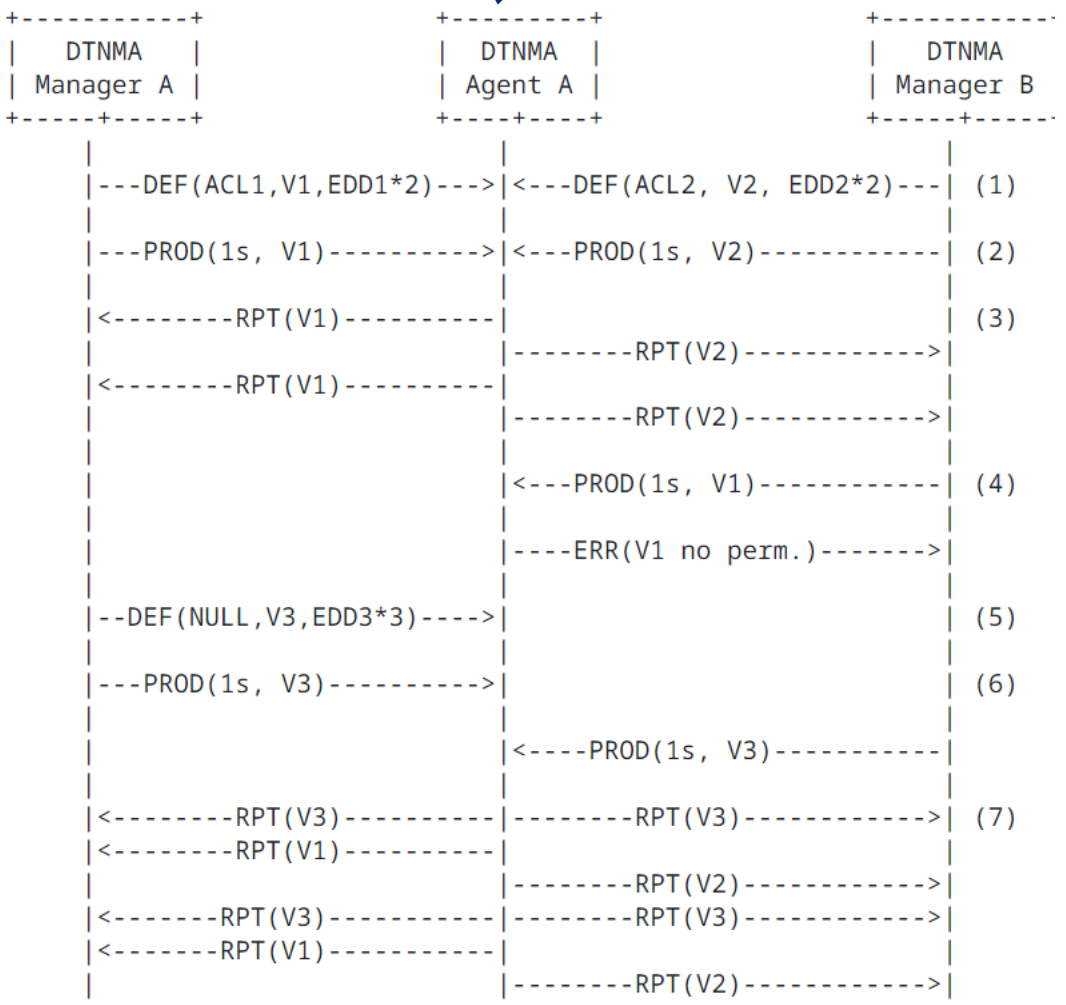
Document defines 6 use cases



Agent B queues reports

Intermittent Connectivity

Permissions-Based Access



Multiplexed Management