# Asynchronous Mgmt Architecture (AMA)

From draft-birrane-dtn-ama-05

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# AMA: Updates

From -04 to -05

- Minor Terminology and Definitions Updates
  - Mostly wordsmithing based on feedback.

- No significant issues or limitations with the architecture.
  - No “structural” changes to the architecture.

# AMA: Introduction & Motivation

- Document purpose
  - Motivation, Service Definitions, Desirable Properties, Roles/Responsibilities, System Model, Logical Data Model
  - Not a prescriptive standard, informative guidance.
- Scope
  - Challenged networks where asynchronous operation is required.
  - Assumes naming, addressing, integrity, confidentiality, authentication, fragmentation, security, etc… already provided.
  - Does not address interface with synchronous network management.
- Motivation
  - Asynchronous management requires:
    - *Autonomy model, less reliance on sessions and per-operation state sync.*
  - SNMP/NETCONF don’t provide these capabilities.
    - *Work in RESTCONF might*
  - Provide a standard model to converge efforts in this area.

# AMA: Service Definitions

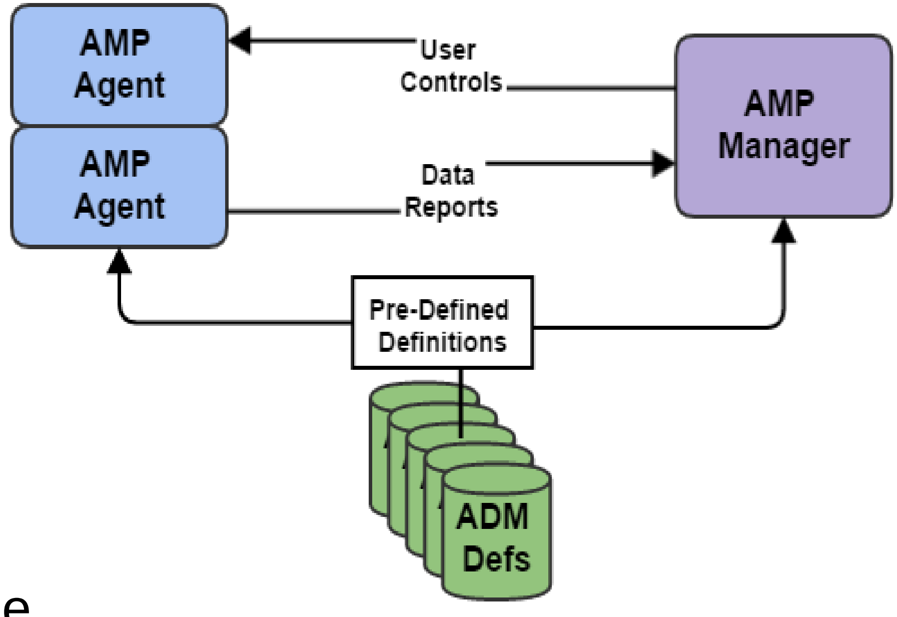
- Configuration
  - Create new datum as function of other data (C = A + B)
  - Ex: Create new reports (RPT = {A, B, C})
  - Ex: Store pre-defined actions (IF (X > 3) THEN Cmd(Params)
- Reporting
  - Push data, don’t pull.
  - Ex: Push as a function of time (Generate report every hour)
  - Ex: Push as function of state (Generate report if (X > 3))
- Autonomous Parameterized Procedure Calls
  - Manage” agent asynchronously by coding response options.
  - Allow for behavior to be customized through parameterization.
  - Ex: Update local route info based on local link analysis
  - Ex: Manage storage to enforce quotas
  - Ex: Apply or modify local security policy
- Administration
  - Finer grained access control for operations.

# AMA: Desirable Properties

- Intelligent Push
  - Asynchronous operation doesn’t support round-trip pull requests.
- Absolute Data Identification
  - Data must be atomically identifiable
    - *Should not need multiple rounds of synchronization to figure out where data lives in an array, for example.*
    - *E.g., support associative looks-ups*
- Custom Data Definition
  - Define new data (variables) local to an agent.
- Autonomous Operation
  - Automation of pre-defined tasks, Autonomy to self-configure same.
  - Distributed operation allows for decentralized control/execution.
  - Deterministic Behavior – Ability to forensically reconstruct events.
  - Engine-Based Behavior – Ability to avoid mobile code where needed.

# AMA: System Model

- Agents
  - Run on Managed Devices
  - Configure/Report on devices
  - Heavy autonomy and parameterized control
- Manager(s)
  - Collect/Fuse data from Agents
  - Configure Agent behavior
  - Open-loop control
- ADMs
  - Well-named Data and Controls
  - Superset of MIB
  - Move to describe them in YANG
  - Preconfiguration reduces msg size



# AMA: Roles/Responsibilities

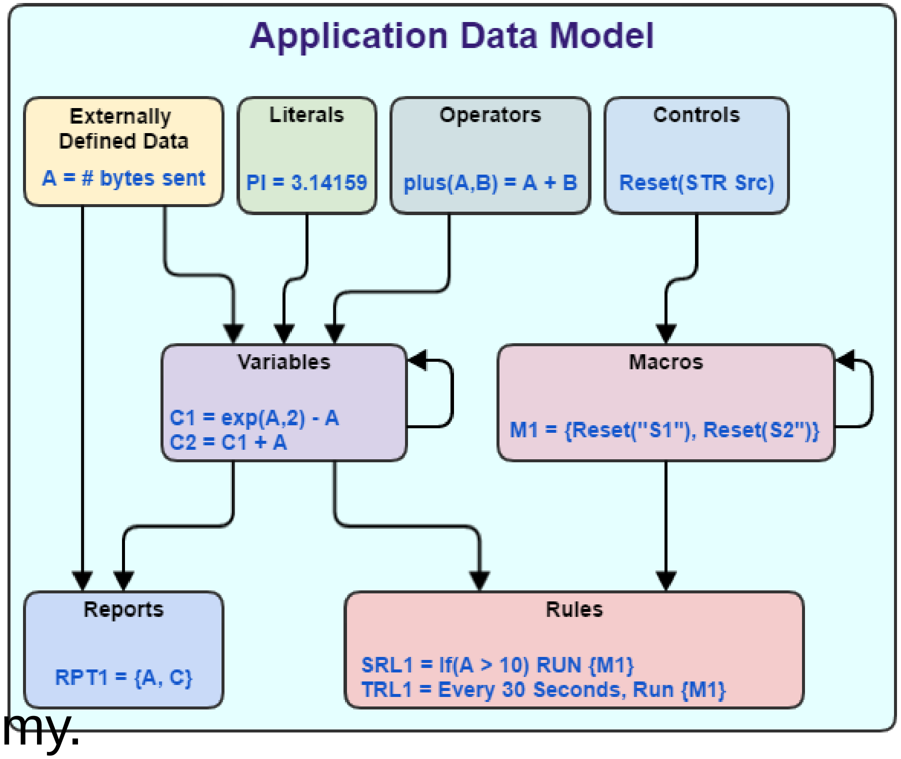
- Agent Responsibilities
  - **Application Support** – Manage local applications/protocols.
  - **Local Data Collection** – Collect and/or calculate new values.
  - **Autonomy Control** – Apply time/state based response options.
  - **User Data Definition** – Store/remember user-defined data variables.
  - **Autonomous Reporting** – Push reports based on time/state.
  - **Consolidate Messages** – Where possible, reduce overhead.
  - **Regional Proxy** – Collect from other nodes in a region.

- Manager Responsibilities
  - **Agent Capabilities Mapping** – Common picture of agent abilities.
  - **Data Collection** – Receive data from multiple agents.
  - **Custom Definitions** – Send user-defined data to agents.
  - **Data Translation** – Interface with other network management systems.
  - **Data Fusion** – Generate new data from received data.

# AMA: Logical Data Model (ADM)

- “Atomic” Elements
  - Solely defined by their ADM.
  - **EDDs**: collected by agents.
  - **Literals:** useful constants.
  - **Ops:** opcodes for math functions.
  - **Ctrls:** opcodes for agent behavior.
- “Variable” Elements
  - Defined by ADM or by User
  - ADM definitions are immutable.
  - **Vars**: strong-typed variables, including a type for “expression”.
  - **Macro**: Ordered set of Ctrls.
  - **Rpts**: Ordered sets of data
  - **Rules:** Time or State based autonomy.

**An ADM defines 8 types of data for each application/protocol managed in the AMA.**



Application Data Model

Externally Defined Data

A = # bytes sent

Literals

PI = 3.14159

Operators

plus(A,B) = A + B

Controls

Reset(STR Src)

Variables

C1 = exp(A,2) - A

C2 = C1 + A

Macros

M1 = {Reset("S1"), Reset(S2")}

Reports

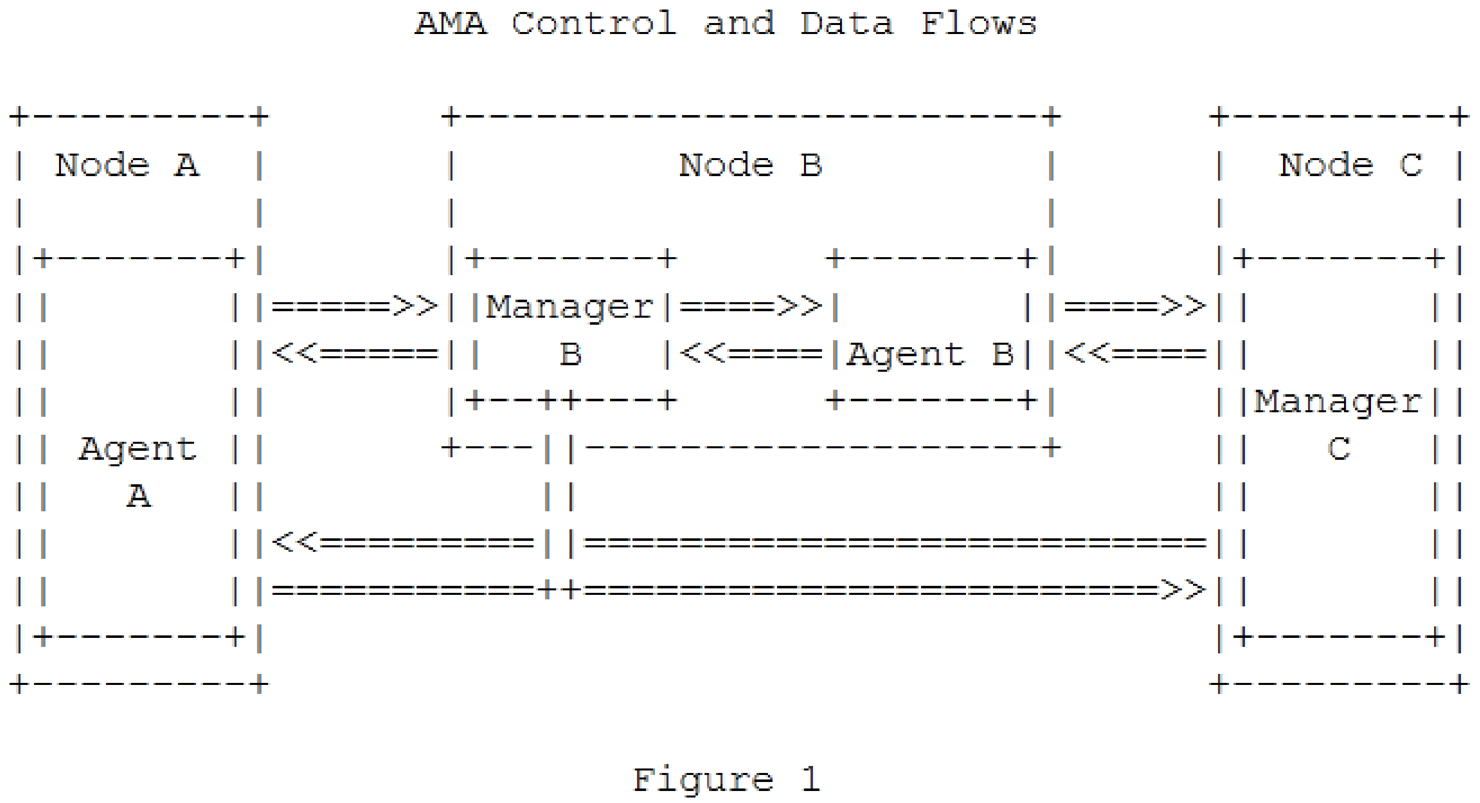
RPT1 = {A, C}

Rules

SRL1 = If(A > 10) RUN {M1}

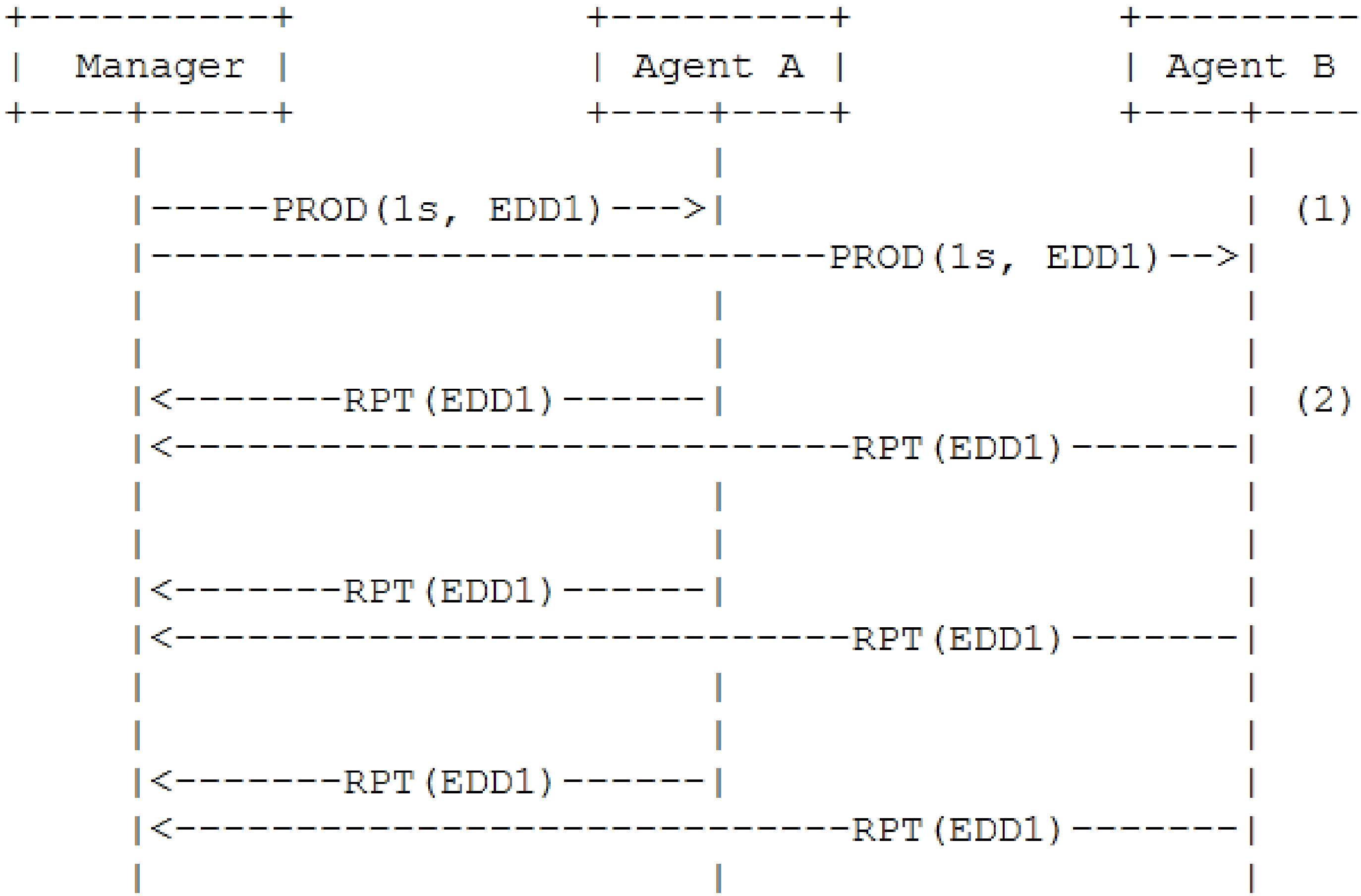
TRL1 = Every 30 Seconds, Run {M1}

# AMA Control and Data Flows



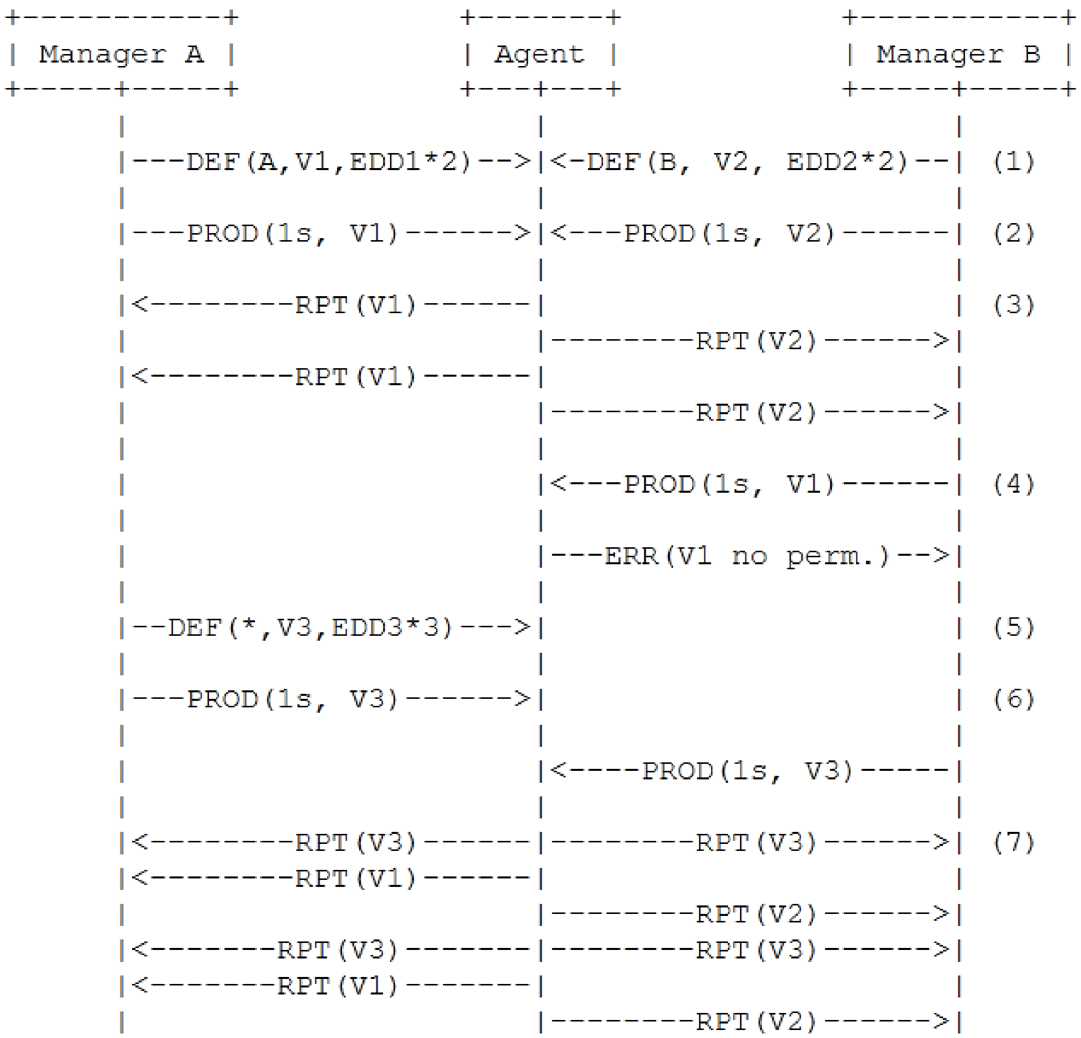
```
                     AMA Control and Data Flows

+----------+       +--------------------------+       +----------+
| Node A   |       |          Node B          |       |  Node C  |
|          |       |                          |       |          |
|+--------+|       |+--------+      +--------+|       |+--------+|
||        ||=====>>||Manager |====>>|        ||====>>||        ||
||        ||<<=====||   B    |<<====|Agent B ||<<====||        ||
||        ||       |+--++----+      +--------+|       ||Manager ||
|| Agent  ||       +---||---------------------+       ||   C    ||
||   A    ||           ||                             ||        ||
||        ||<<=========||=============================||        ||
||        ||===========++===========================>>||        ||
|+--------+|                                          |+--------+|
+----------+                                          +----------+

                               Figure 1
```

# AMA Serialized Management Control Flow



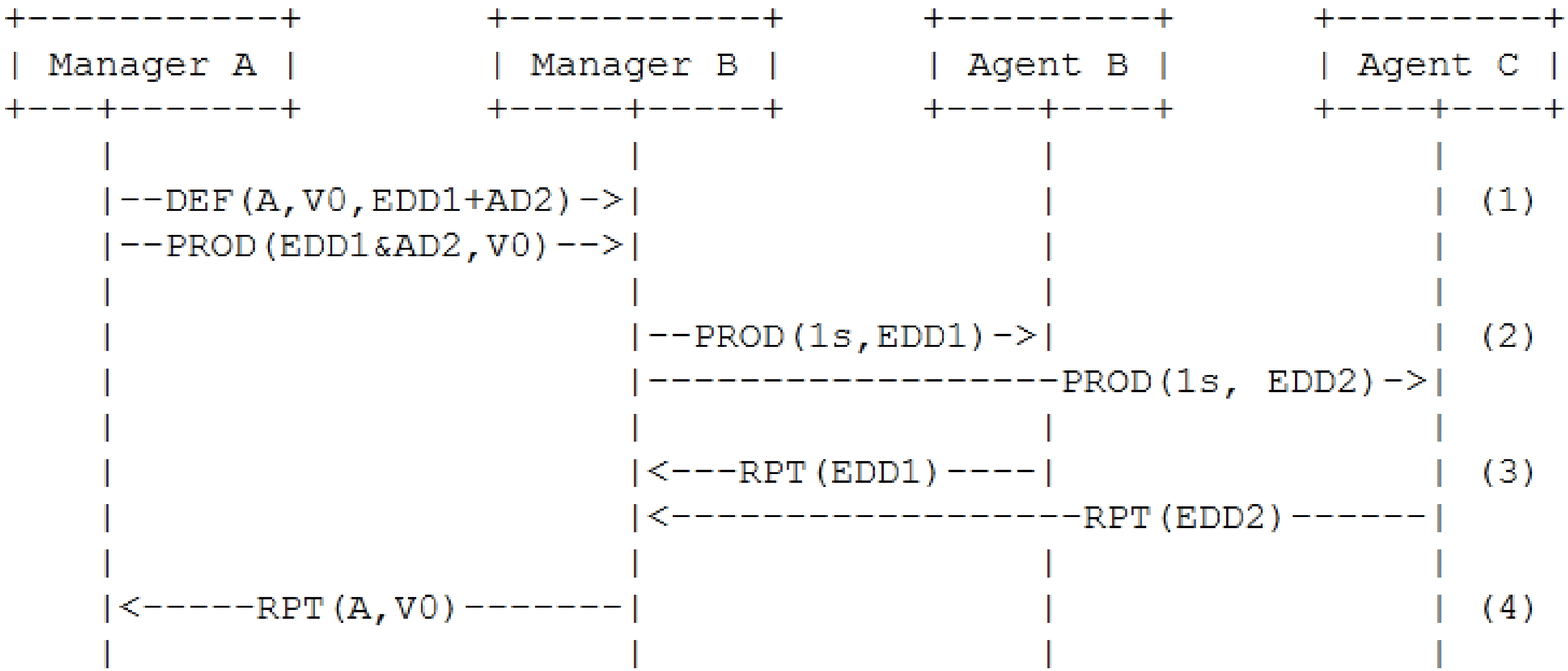
```
+----------+            +---------+           +---------+
|  Manager |            | Agent A |           | Agent B |
+----+-----+            +----+----+           +----+----+
     |                       |                     |
     |-----PROD(1s, EDD1)--->|                     | (1)
     |----------------------------PROD(1s, EDD1)-->|
     |                       |                     |
     |                       |                     |
     |<-------RPT(EDD1)------|                     | (2)
     |<----------------------------RPT(EDD1)-------|
     |                       |                     |
     |                       |                     |
     |<-------RPT(EDD1)------|                     |
     |<----------------------------RPT(EDD1)-------|
     |                       |                     |
     |                       |                     |
     |<-------RPT(EDD1)------|                     |
     |<----------------------------RPT(EDD1)-------|
     |                       |                     |
```

# Multiplexed Management Control Flow



```
+-----------+            +-------+            +-----------+
| Manager A |            | Agent |            | Manager B |
+-----+-----+            +---+---+            +-----+-----+
      |                      |                      |
      |---DEF(A,V1,EDD1*2)-->|<-DEF(B, V2, EDD2*2)--| (1)
      |                      |                      |
      |---PROD(1s, V1)------>|<---PROD(1s, V2)------| (2)
      |                      |                      |
      |<--------RPT(V1)------|                      | (3)
      |                      |--------RPT(V2)------>|
      |<--------RPT(V1)------|                      |
      |                      |--------RPT(V2)------>|
      |                      |                      |
      |                      |<---PROD(1s, V1)------| (4)
      |                      |                      |
      |                      |---ERR(V1 no perm.)-->|
      |                      |                      |
      |--DEF(*,V3,EDD3*3)--->|                      | (5)
      |                      |                      |
      |---PROD(1s, V3)------>|                      | (6)
      |                      |                      |
      |                      |<----PROD(1s, V3)-----|
      |                      |                      |
      |<--------RPT(V3)------|--------RPT(V3)------>| (7)
      |<--------RPT(V1)------|                      |
      |                      |--------RPT(V2)------>|
      |<-------RPT(V3)-------|--------RPT(V3)------>|
      |<-------RPT(V1)-------|                      |
      |                      |--------RPT(V2)------>|
```

# Data Fusion Control Flow



```
+-----------+        +-----------+      +---------+      +---------+
| Manager A |        | Manager B |      | Agent B |      | Agent C |
+---+-------+        +-----+-----+      +----+----+      +----+----+
    |                      |                 |                |
    |--DEF(A,V0,EDD1+AD2)->|                 |                |  (1)
    |--PROD(EDD1&AD2,V0)-->|                 |                |
    |                      |                 |                |
    |                      |--PROD(1s,EDD1)->|                |  (2)
    |                      |------------------PROD(1s, EDD2)->|
    |                      |                 |                |
    |                      |<---RPT(EDD1)----|                |  (3)
    |                      |<------------------RPT(EDD2)------|
    |                      |                 |                |
    |<-----RPT(A,V0)-------|                 |                |  (4)
    |                      |                 |                |
```

# Thank you!

Questions?