Asynchronous Management Architecture (AMA)
What makes it unique, Next steps to standardization

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Challenged Network

- A network that has serious trouble maintaining what an application would today expect of the end-to-end IP model, e.g., by:

    - not being able to offer end-to-end IP connectivity at all,

    - exhibiting serious interruptions in end-to-end IP connectivity, or

    - exhibiting delay well beyond the Maximum Segment Lifetime (MSL) defined by TCP

from RFC 7228

Delay/Disruption-Tolerant Networking (DTN)

Unique use cases have led to development of new protocols for transport, security, reliability, and routing

- BPv7:   https://datatracker.ietf.org/doc/draft-ietf-dtn-bpbis/

- BPSec: https://datatracker.ietf.org/doc/draft-ietf-dtn-bpsec/

- BIBE: https://datatracker.ietf.org/doc/draft-ietf-dtn-bibect/

- TCP CLA: https://datatracker.ietf.org/doc/draft-ietf-dtn-tcpclv4/

- SABR/CGR: https://public.ccsds.org/Pubs/734x3b1.pdf

What about Challenged Network Management?

Services Needed

- Configuration

- Reporting

- Autonomous parameterized procedure calls

- Administration

Desirable Properties

- Intelligent push of information

- Minimized message size

- Hierarchical absolute data identification

- Custom data definition

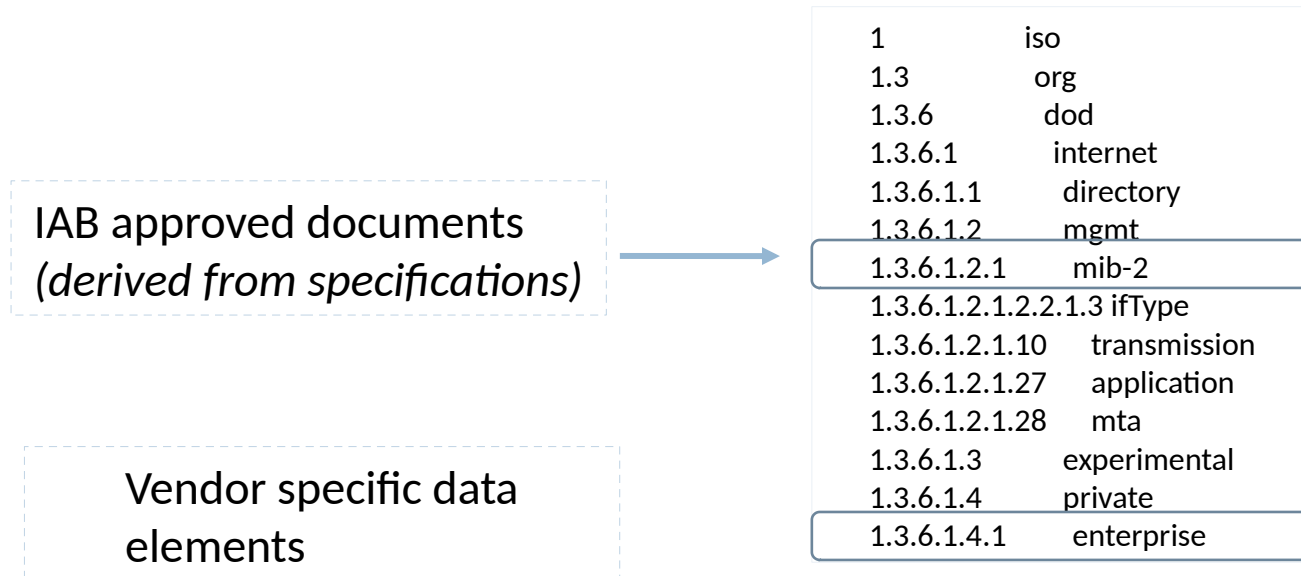- Autonomous operation, rule-based execution of events

Existing Network Management Protocols

- SNMP/MIBs

- YANG/Netconf/Restconf

- CoAP/Coreconf/YANG SIDs

- Autonomic Networking/Intent-based Networking

Note: These are each great protocols, but possibly not a good fit for challenged network management

SNMP/MIBs

- RFC 2578 – Structure of Management Information Version 2 (SMIv2)

- IANA Registry: https://www.iana.org/assignments/smi-numbers/smi-numbers.xhtml

IAB approved documents
(derived from specifications)

Vendor specific data elements

```
1              iso
1.3            org
1.3.6          dod
1.3.6.1        internet
1.3.6.1.1      directory
1.3.6.1.2      mgmt
1.3.6.1.2.1    mib-2
1.3.6.1.2.1.2.2.1.3 ifType
1.3.6.1.2.1.10   transmission
1.3.6.1.2.1.27   application
1.3.6.1.2.1.28   mta
1.3.6.1.3      experimental
1.3.6.1.4      private
1.3.6.1.4.1    enterprise
```

- Organizational hierarchy is much needed in AMA

- SNMP Poll / SNMP Trap are each single data-element transmissions

YANG/Netconf/Restconf

- Yang Data Model: describes how data is represented and accessed

- Accessed using Netconf or Restconf protocols
  - Netconf requires synchronous sessions
  - Restconf requires HTTP and TLS

```
module: ietf-ip
  augment /if:interfaces/if:interface:
    +--rw ipv4!
    |  +--rw enabled?         boolean
    |  +--rw forwarding?      boolean
    |  +--rw mtu?             uint16
    |  +--rw address* [ip]
    |  |  +--rw ip                    inet:ipv4-address-no-zone
    |  |  +--rw (subnet)
    |  |  |  +--:(prefix-length)
    |  |  |  |  +--rw prefix-length?    uint8
    |  |  |  +--:(netmask)
    |  |  |     +--rw netmask?          yang:dotted-quad
    |  |  |             {ipv4-non-contiguous-netmasks}?
    |  |  +--ro origin?            ip-address-origin
    |  +--rw neighbor* [ip]
    |     +--rw ip                    inet:ipv4-address-no-zone
    |     +--rw link-layer-address    yang:phys-address
    |     +--ro origin?               neighbor-origin
```

```
                                                     +------------------------+
                                                     |Server (device)         |
                                                     | +--------------------+ |
                                                     | |      configuration | |
                                             .+      | | m d  state data    | |
                                           |YANG|+   | | e a  ------------   | |
                                           |mods||+  | | t t  notifications | |
                                           +----+||  -----> | a a  ------------   | |
                                            +----+|  | |      operations    | |
                                             +----+  | +--------------------+ |
                                                     |           ^            |
                                                     |           |            |
                                                     |           v            |
+---------+-------------------------------------+    +------+ | ------------- | |
| RESTCONF | NETCONF                           |    |Client| <rpc>  |   | NETCONF   | |
+---------+-------------------------------------+   | (app)|        |   | engine    | |
| OPTIONS | none                               |    |      | <------------  |   |           | |
|         |                                    |    +------+ <rpc-reply>    +-------------+ |
| HEAD    | <get-config>, <get>                |    |                        |       |         / |  \
|         |                                    |    |                    /   |  \
| GET     | <get-config>, <get>                |    |                 /      |     \
|         |                                    |    | +--------+    +---------+ |
| POST    | <edit-config> (nc:operation="create") |  | config |    |system  |+
|         |                                    |    | data-  |    |software ||+
| POST    | invoke an RPC operation            |    | base   |    |component|||
|         |                                    |    +--------+    +---------+|||
| PUT     | <copy-config> (PUT on datastore)   |                   +---------+||
|         |                                    |                    +--------+|
| PUT     | <edit-config> (nc:operation="create/replace") |                   +--------+
|         |                                    |
| PATCH   | <edit-config> (nc:operation depends on PATCH content) |
|         |                                    |
| DELETE  | <edit-config> (nc:operation="delete") |
+---------+-------------------------------------+
```
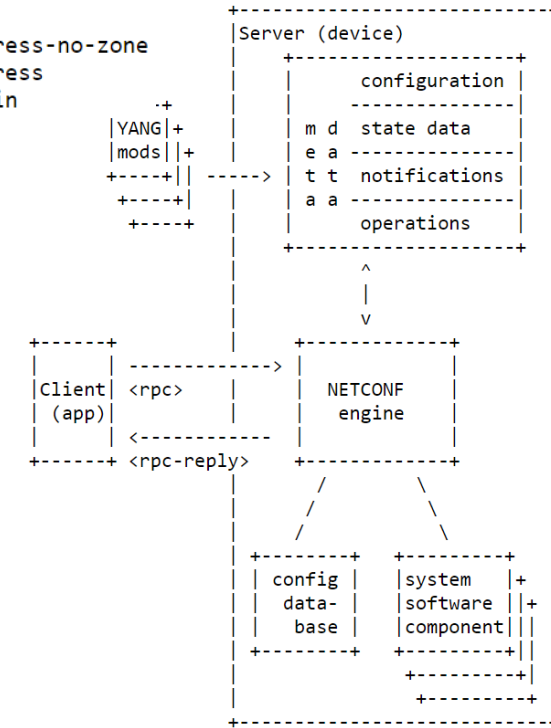
Subscription to YANG Notifications and YANG Push

- Subscription require synchronous streaming of updates to the data model

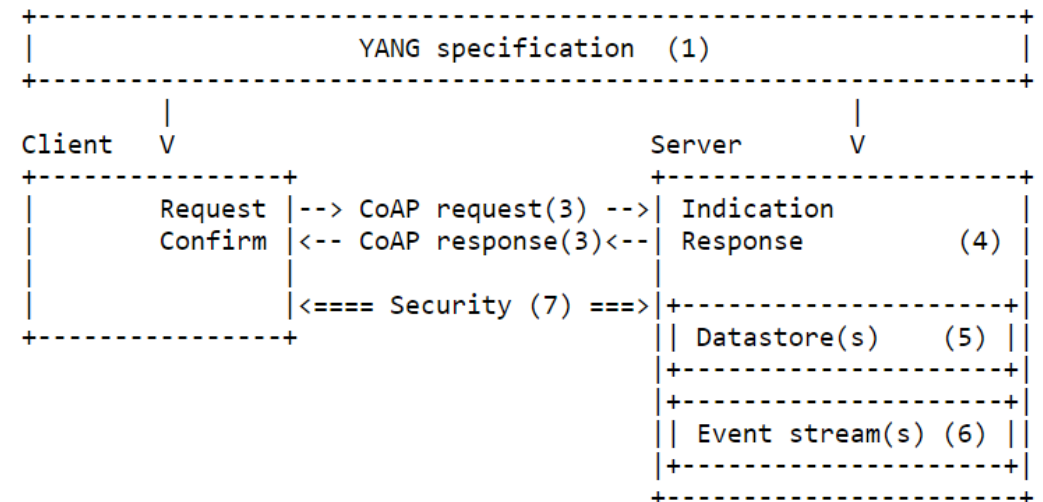- YANG Push allows for asynchronous subscription to updates but with limited features
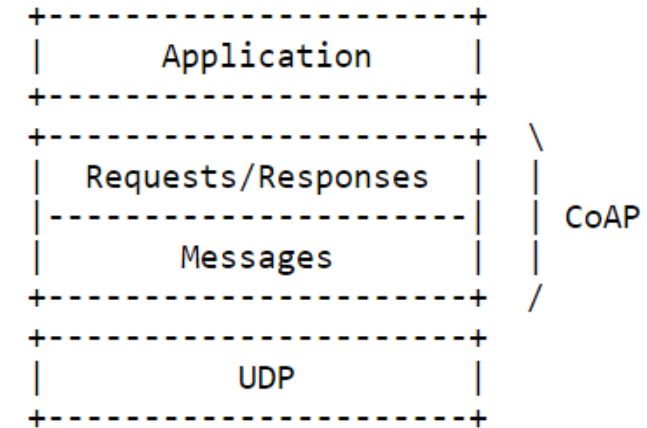 - Periodic push
  - On-change push

```
|   |   +---w (yp:update-trigger)
|   |      +--:(yp:periodic)
|   |      |  +---w yp:periodic!
|   |      |     +---w yp:period         centiseconds
|   |      |     +---w yp:anchor-time?    yang:date-and-time
|   |      +--:(yp:on-change) {on-change}?
|   |         +---w yp:on-change!
|   |            +---w yp:dampening-period?   centiseconds
|   |            +---w yp:sync-on-start?      boolean
|   |            +---w yp:excluded-change*    change-type
```

CoAP/Coreconf/YANG SIDs

- Constrained Application protocol (CoAP): REST messaging protocol for constrained nodes and networks

- Coreconf: Network management protocol for constrained nodes and networks, using constrained YANG data models, CBOR encoding, and YANG Schema Item iDentifiers (SIDs)
  - Dependent on UDP/Secure transport
  - Bound to YANG functionality

```
+-----------------------+
|      Application       |
+-----------------------+
+-----------------------+  \
|   Requests/Responses   |  |
|-----------------------|  |  CoAP
|       Messages        |  |
+-----------------------+  /
+-----------------------+
|          UDP          |
+-----------------------+
```

```
+------------------------------------------------------+
|              YANG specification  (1)                 |
+------------------------------------------------------+
         |                                    |
Client   V                    Server          V
+----------------+           +------------------------+
|        Request |--> CoAP request(3) -->| Indication   |
|        Confirm |<-- CoAP response(3)<--| Response  (4)|
|                |          |            |              |
|                |<==== Security (7) ===>|+------------------+|
+----------------+           || Datastore(s)   (5) ||
                             |+------------------+|
                             |+------------------+|
                             || Event stream(s) (6) ||
                             |+------------------+|
                             +------------------------+
```

Autonomic Networking/Intent-based Networking

- Autonomic Networking: self-managing, decentralized, coexistence with traditional management but not dependent on solutions

  - Autonomic Control Plane (ACP): a virtual out-of-band channel for operations, administration, and management

  - GeneRic Autonomic Signaling Protocol (GRASP): enables autonomic nodes and service agents to dynamically discovery peers, synchronize state, and negotiate parameter settings

- Intent-based Networking: description of operational goals and objectives without prescriptive commands

Highly autonomous approaches, depends heavily on synchronous architecture, orchestration, and node complexity

Do we agree, that AMA is different and challenged network management needs its own approach?

- Updated AMA spec (Work in progress)
  - Increased scope of "data model" to include custom data definition, custom reporting
  - Emphasis and rule-based autonomy
  - Clarify need for hierarchal and moderated absolute data definition
  - Independent of underlying transport, network layer, and security protocols (to take advantage of new DTN protocols)
  - Contrast with existing protocols

Next Steps

- Continue to assess overlap, and work with other IETF WGs
  - Netmod, Netconf
  - CORE
  - Anima
  - Nmrg

- Updates to Application Data Models (ADMs) and Asynchronous Management Models (AMMs)

- New draft for AMM Resource Identifiers and approach to moderation

- Updates to Asynchronous Management Protocol (AMP)

Thank you