Data Model for Computing-Aware Traffic Steering (CATS)

draft-ietf-cats-data-model-00

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Why CATS need a data model?

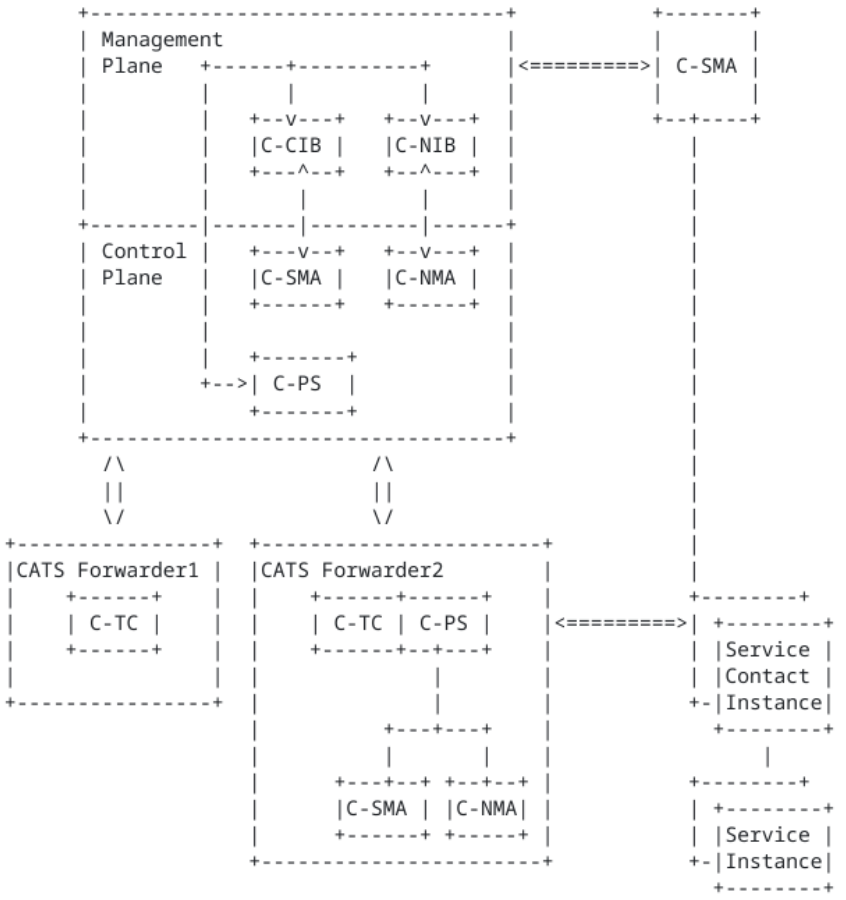
- As per RFC10053, the CATS management plane is responsible for monitoring, configuring, and maintaining CATS systems. The CATS data is required to be maintained in the management plane and configured to the control plane, data plane and C-SMA.
- A YANG data model is required to structure, validate, and automate this data across CATS components.
- As described in [I-D.yxl-cats-protocols-applicability], the CATS data model requires functionalities such as configuration management, traffic steering policy configuration, service metric management, and event reporting, as follows:

  - ✓ provide interfaces for the functionality of the C-PS component, used for communication between the Control Plane and the C-SMA, as well as between the Control Plane and the CATS Forwarder.
  - ✓ provide interfaces for the functionality of the C-TC component, used for communication between the Control Plane and the CATS Forwarder.
  - ✓ provide interfaces for the C-SMA component, used for communication between the Control Plane and the CATS Forwarder and for transmitting service metric information from the C-SMA to the Control Plane; also used for distributing service metric information from the Control Plane to the CATS Forwarder.
  - ✓ enable the CATS Forwarder to report events to the Control Plane via YANG notifications.

How the data model will be used?

- The data model can be used for CATS information maintaining and communication interfaces among the Management Plane, Control Plane, C-SMA, C-NMA and CATS Forwarders.

- ✓ **C-CIB:** CATS Computing Information Base; maintains CATS network computing information and provides basic data for the C-SMA.
- ✓ **C-NIB:** CATS Network Information Base; maintains CATS network information and provides basic data for the C-NMA.
- ✓ **Scope:** the data model is applicable to the CATS system architecture in this Figure and covers the base, traffic-classifier and service-metric objects plus the YANG notifications.
- ✓ **Interfaces:** the model is used between the Control Plane and the C-SMA / CATS Forwarder.



Updates from Last Version

- Presented at IETF#123/124/125/126; comments at the meetings and on the mailing list are appreciated from:
  - Adrian Farrel, Peng Liu, Bin Zhang, Yimi Zhang, Yidan Zhu, Allan Michael, Xiaolong Hu, David Wright
  - Also thanks to Joe Clarke for the YANGDOCTORS early review.

- **Key Updates in draft-ietf-cats-data-model-00 (since IETF 126)**
  - ✓ Adopted as a CATS WG draft: draft-yl-cats-data-model → draft-ietf-cats-data-model.
  - ✓ Data Model Modification and Refinement
    - New 'notify-interval' (default 10 s) to prevent notification flooding caused by flapping.
    - source-type and metric-type changed from enumeration to identityref for extensibility.
    - Single 'notify' replaced by four notifications: metric/flow-limit-exceeded and -recovered, each with timestamp and message.
  - ✓ Added Operational Considerations section.

Update 1: Data Model Modification and Refinement

- **In CATS base tree, added new 'notify-interval' (default 10 s) to prevent notification flooding caused by flapping.**

CATS Base Tree:

- Can be used for communication between the Control Plane and the C-SMA
- Can be used for the interface between the Control Plane and the CATS Forwarder.

```
+--rw base
 |  +--rw enable?                boolean
 |  +--rw update-interval?       uint32
 |  +--rw metric-limits?         uint32
 |  +--rw flow-limits?           uint32
 |  +--rw flow-timeout?          uint32
 |  +--rw notify-interval?       uint32
 |  +--rw service-policy* [cs-id]
 |     +--rw cs-id                cs-id
 |     +--rw policy-type?         enumeration
```

Update 2: Data Model Modification and Refinement

- **In CATS service-metric tree, 'source-type' and 'metric-type' changed from enumeration to identityref for extensibility.**

CATS Service-metric Tree:

- Be used for interfaces between the Control Plane and the CATS Forwarder, as well as for transmitting service metrics information from the C-SMA to the Control Plane.
- Be used for forwarding service metric information from the Control Plane to the CATS Forwarder.

```
+--rw service-metrics
 |  +--rw service-metric* [cs-id csci-id source-type]
 |     +--rw cs-id                cs-id
 |     +--rw csci-id              csci-id
 |     +--rw source-type          identityref
 |     +--rw priority?            uint8
 |     +--rw affinity?            uint8
 |     +--rw location?            inet:ip-address
 |     +--rw metrics
 |      |  +--rw metric* [metric-type]
 |      |     +--rw metric-type       identityref
 |      |     +--rw metric-value?     uint32
 |     +--ro forwarded-packets?   yang:zero-based-counter64
 |     +--ro forwarded-bytes?     yang:zero-based-counter64
```

Update 3: Data Model Modification and Refinement

- **Replace the single 'notify' notification with four notifications: 'metric-limit-exceeded', 'metric-limit-recovered', 'flow-limit-exceeded' and 'flow-limit-recovered'.**
- **Each notification carries a 'timestamp' and a human-readable 'message' (including the configured maximum limit).**

CATS Notify Tree:

- Be utilized for the CATS Forwarder to report events to the Control Plane.
- Separate notifications per event type allow operators to better parse and route specific events.

- metric-limit-exceeded: sent when the number of metric entries exceeds the configured maximum.
- metric-limit-recovered: sent when the number of metric entries returns to or falls below the maximum.
- flow-limit-exceeded: sent when the number of flow entries exceeds the configured maximum.
- flow-limit-recovered: sent when the number of flow entries returns to or falls below the maximum.

```
+---n notify
   +--ro metric-limit-reached?  boolean
   +--ro flow-limit-reached?    boolean
```



```
+---n metric-limit-exceeded
 |    +--ro timestamp   yang:date-and-time
 |    +--ro message     string
+---n metric-limit-recovered
 |    +--ro timestamp   yang:date-and-time
 |    +--ro message     string
+---n flow-limit-exceeded
 |    +--ro timestamp   yang:date-and-time
 |    +--ro message     string
+---n flow-limit-recovered
     +--ro timestamp    yang:date-and-time
     +--ro message      string
```

Update 4: Added Operational Considerations

- **Installation and Configuration**
  - ✓ **Set 'update-interval' to balance responsiveness against control plane load.**
  - ✓ **Size 'metric-limits' and 'flow-limits' according to expected service scale and available device resources.**
- **Monitoring**
  - ✓ **Read-only state notification nodes: 'matched-packets'/'matched-bytes' (traffic classification statistics) and 'forwarded-packets'/'forwarded-bytes' (service forwarding statistics).**
  - ✓ **'notify-interval' helps prevent notification flooding under unstable conditions.**
- **Migration Considerations**
  - ✓ **CATS can be incrementally deployed alongside traditional forwarding.**
  - ✓ **The model augments 'ietf-routing' YANG model without replacing it, allowing gradual migration.**

Next Steps

- **Comments raised during the adoption call will be addressed in the next revision.**
- **Further feedback on the mailing list is welcome.**

Thanks!