



Creating Infinite  
Possibilities.

# The Power of YANG Configuration Templates

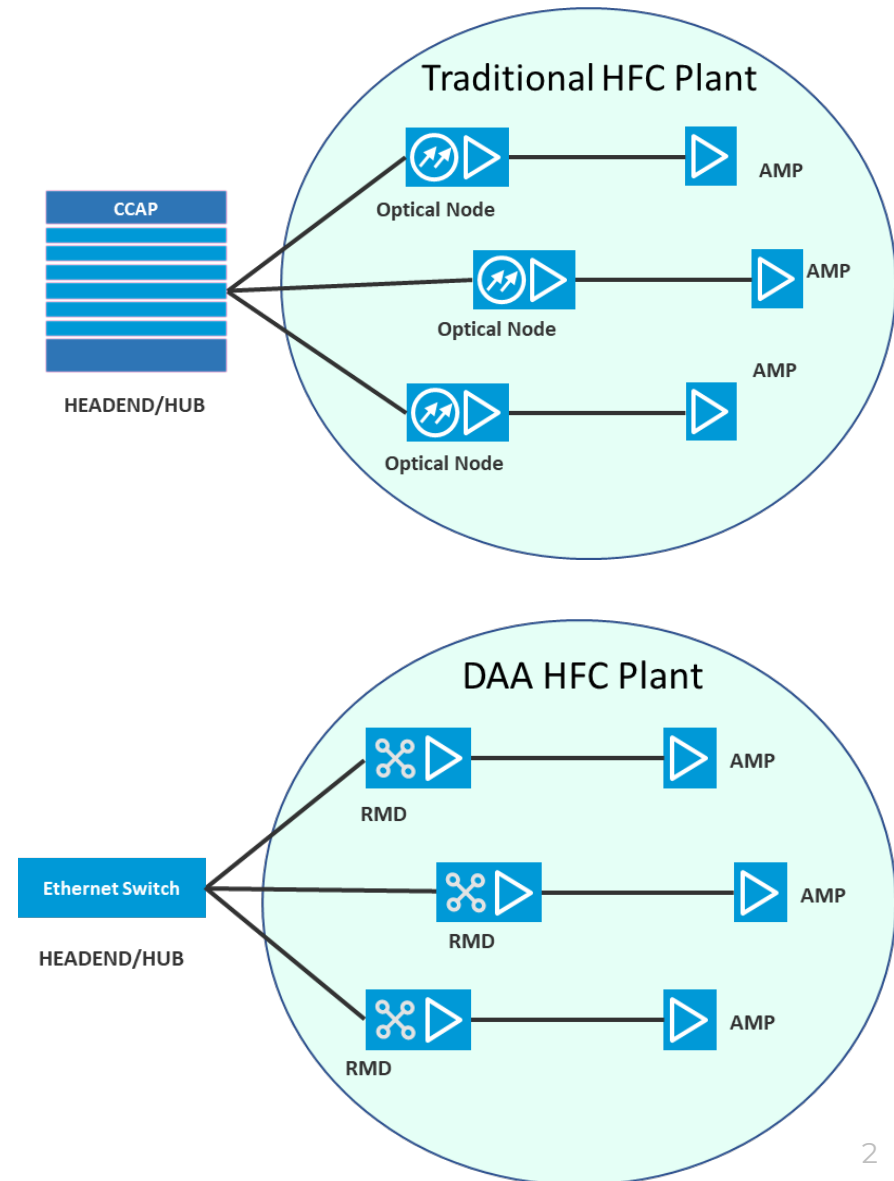
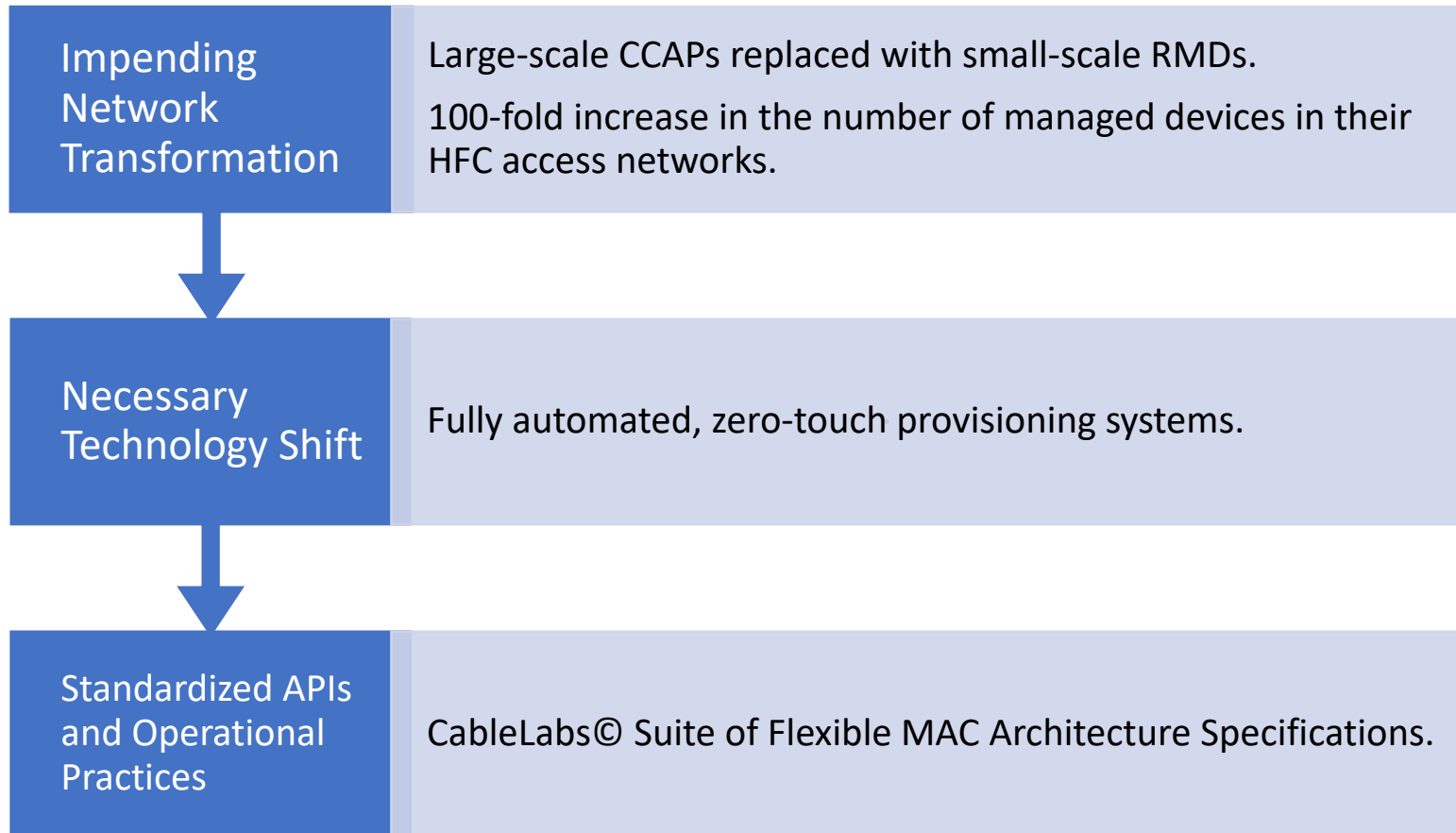
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## Distributed Access Architecture Transition



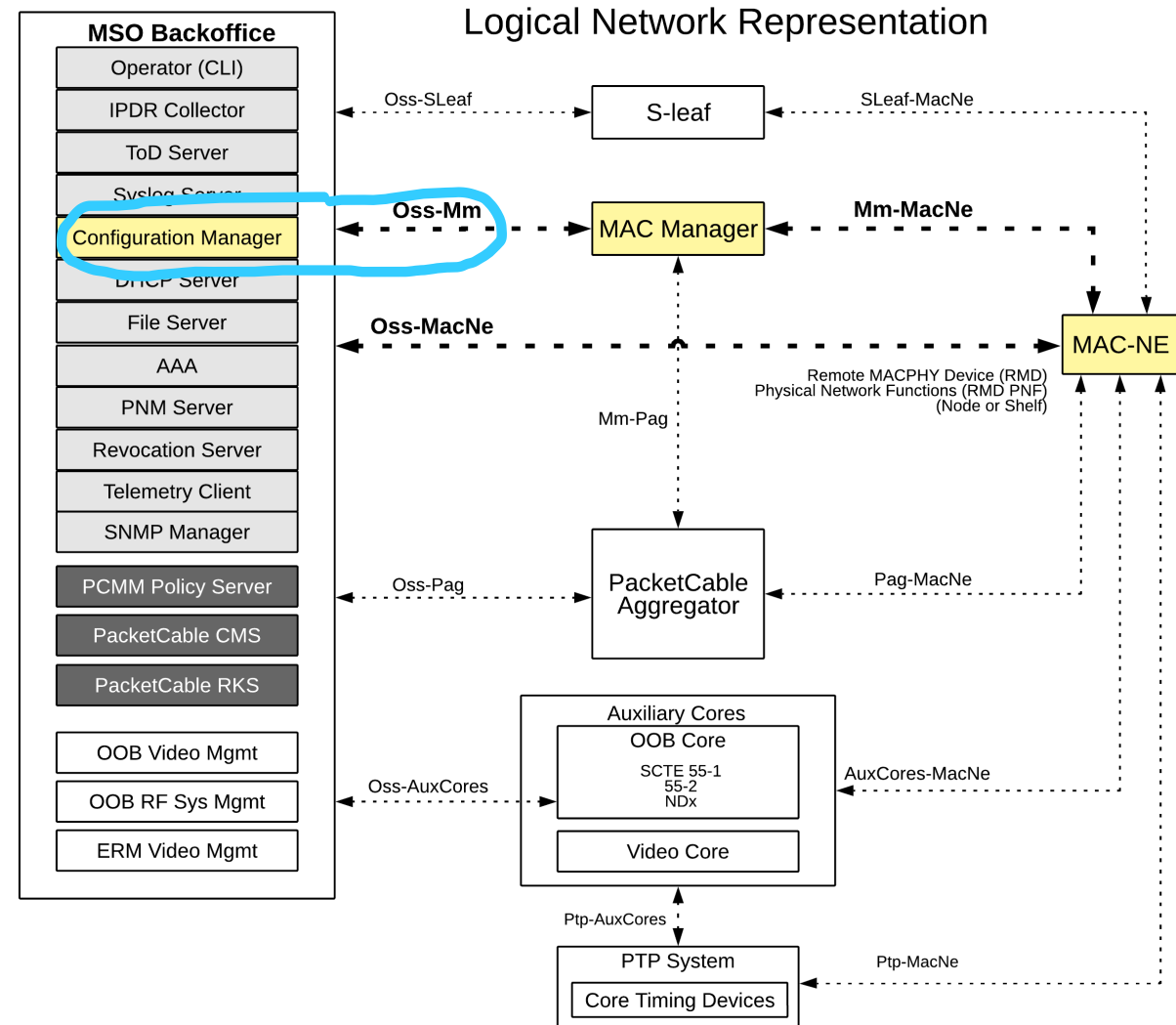
## FMA Reference Architecture

CableLabs® suite of Flexible MAC Architecture specifications to address the challenges of the DAA transition.

The interface “Mn-MacNe” realized with RESTCONF and MAC-NE YANG Models.

Unicast transfer of config specific to a particular MAC-NE results in linear scaling of the total footprint of configuration data.

**Example:** HFC plant node count 100,000.  
**Average config size:** 10 000 discrete attributes,  
 or 500 KB config data per MAC-NE.  
**Total Config Data Footprint:** 1 B discrete attributes,  
 or 50 GB config data per system.



## Solution Approach

### Observations

- Highly repeatable patterns in the target environment.
- Modular, cookie-cutter-like, HFC access network design.
- The standardization of device configuration management interfaces using YANG data models.

### Methodology

- Modularization: division of complete device data sets into reusable, more manageable segments.
- Data abstraction: Identification of common patterns.
  - Extraction of individual data and creation of templates containing common data.

Key enabler: YANG, as a powerful, modular and versatile data modelling language.

## What are YANG-based Configuration Templates?

**A template: a predefined prototype for instantiated configuration data** that can be further customized and applied to multiple systems in various scenarios.

```
“security”: {  
  “sav”: {  
    “sav-control”: {  
      “cm-auth-enable”: true  
    }  
  },  
  “tftp-security-config”: {  
    “config-file-learning-enabled”: true  
  },  
  “cmts-encrypt”: {  
    “encrypt-alg-priority”: “AES128_CBC_MODE DES56_CBC_MODE DES40_CBC_MODE”  
  },  
  “certificates”: {  
    “cert-revocation-method”: “NONE”,  
    “online-cert-status-protocol”: {  
      “signature-bypass”: false  
    }  
  }  
}
```



A **YANG-based Configuration Template** contains instantiated configuration data compliant to a particular YANG model.



There is no established standardized or informal definition of YCT.



A complete or a partial data set of a branch of YANG schema tree.



Data encoding follows rules from IETF standards.



The instantiated data can be programmatically validated against the corresponding YANG model.



## Template Data Payload

Instantiated config dataset of a branch of the YANG schema.

- May include variables and expressions.

**Variable:** A data node value replaced by a symbolic name.

- Values for variables are kept in the Target Database.
- Variable values are replaced during the rendering of a template.

**Expression:** An algorithmic formula to compute a value of a data node.

- An expression can include operations on constants, template variables and values of other data nodes contained within the template, including the key attributes of YANG lists.

```
“rdti-cfg”: {  
  “core-ptp-clk-cfg”: {  
    “ptp-clk-profile-id”: “00:19:a7:02:01:00”,  
    “ptp-master-addr”: “$ptp-master-ip-address”,  
    “ptp-master-priority”: 0,  
    “ptp-clk-priority1”: 128,  
    “ptp-clk-priority2”: 255,  
    “ptp-clk-domain”: 24  
  }  
}
```

```
$channel-frequency = $start-frequency + channel-index* 6,000,000.
```

## Template Metadata

```
“template-metadata”: {  
  “template-name”: “ptp-config-101”,  
  “template-schema-root-point”: “/mac-ne/networking/”,  
  “template-description”: “This template defines configuration for MAC-NE PTP  
operation for G.8275.2 PTP profile”,  
  “template-notes”: “This template is incomplete. It is missing a number of  
mandatory configuration attributes”,  
  “template-revision-history”: [  
    {  
      “revision”: “2022-01-01”,  
      “description”: “Added ptp-clk-domain attribute.”,  
      “Author”: “George D.”  
    },  
    {  
      “revision”: “2021-10-01”,  
      “description”: “Initial revision”,  
      “Author”: “Bob D.”  
    }  
  ]  
}
```

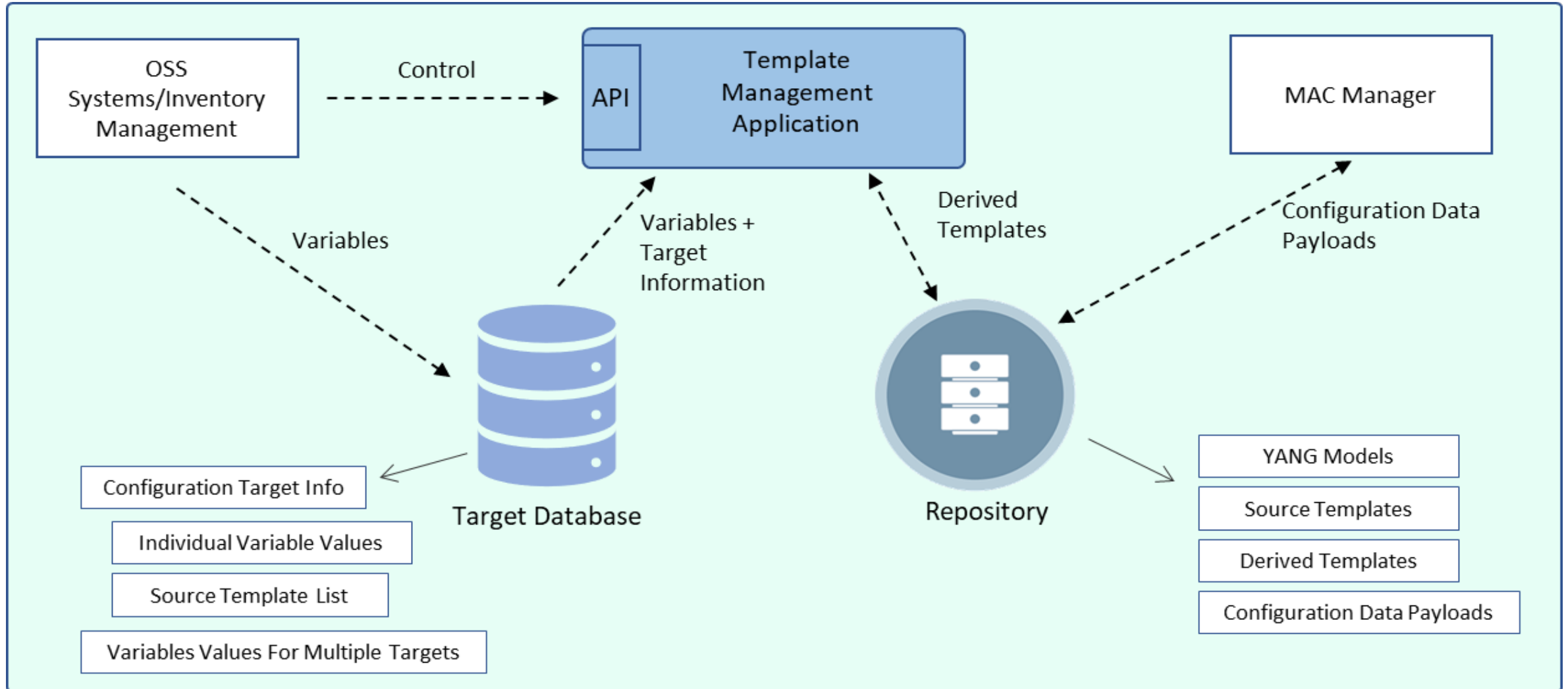
**Metadata:** a set of attributes that hold miscellaneous properties of a template outside of the configuration data payload.

- The most important metadata attributes are the **template-name** and the **template-schema-root**.

The template name serves as the primary identifier of the template within the system.

The template schema root defines the parent node of the template’s YANG data schema tree.

## Template-Oriented Configuration Management System





## Template Rendering

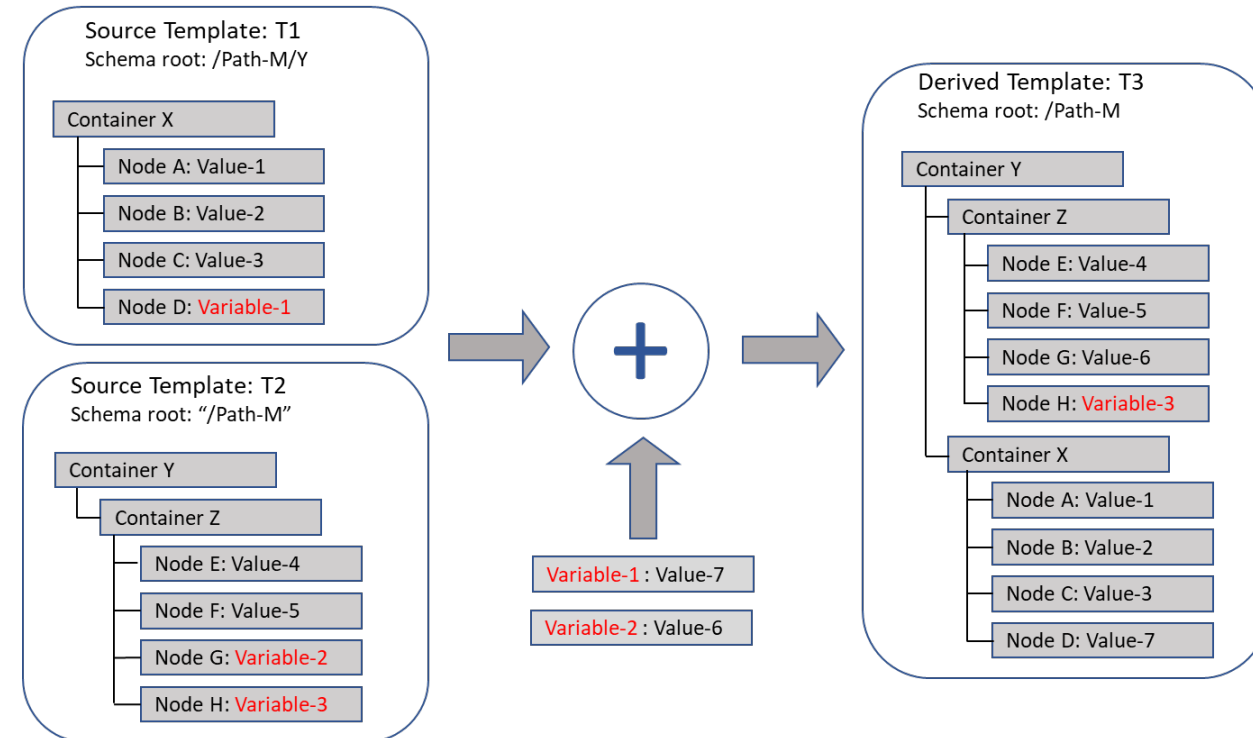
**Rendering:** A predictable and repeatable process of data payload assembly. Source data is transformed into the target. Process driven by the associated YANG model.

**Rendering Example:** Two source templates T1 and T2 are rendered into a derived template T3.

The data from Container X is inserted into data tree within Container Y. Assembly driven by schema roots of all source templates.

Variable-1 and Variable-2 are replaced with individualized values from target database.

Template T3 inherits variable-3 from template T2.



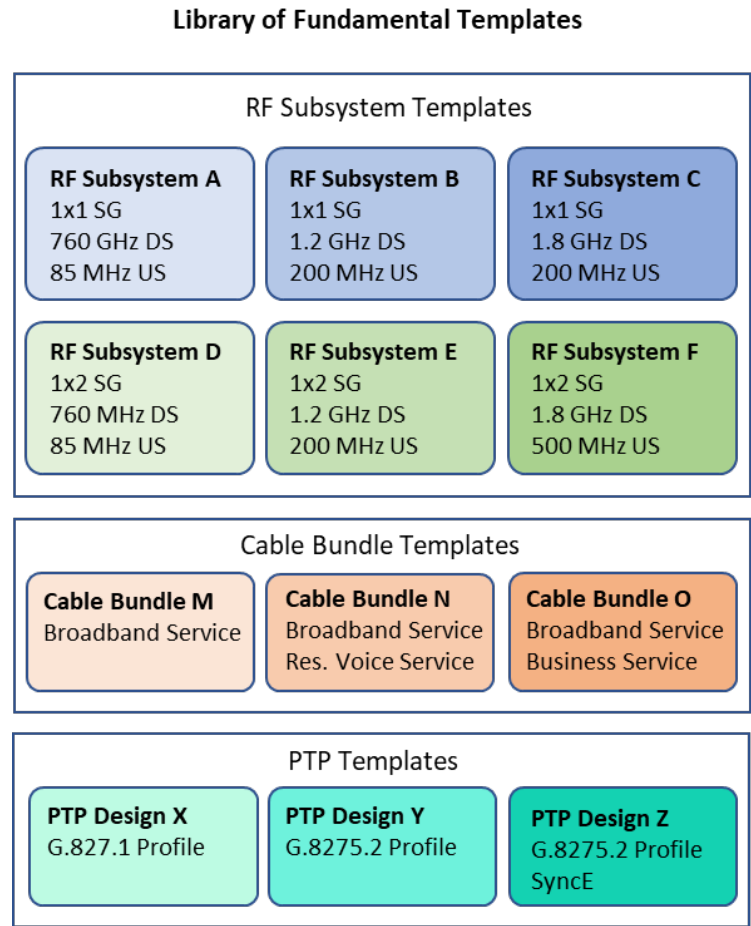
# The Power of YANG Configuration Templates

## The Modular Data Design

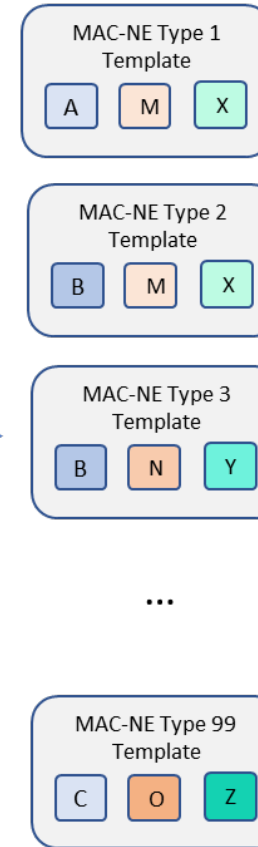
Dozens of fundamental templates.

100s of MAC-NE configuration templates.

Inventory of fully instantiated, device-specific configuration payloads.



**Library of MAC-NE Type Templates**



**Target DB**

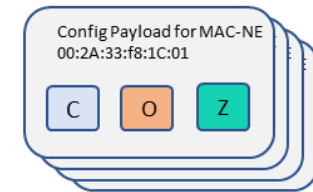


Individual Data

**Repository**



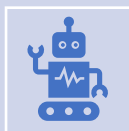
Device-specific Configuration Payloads



## Conclusion



The paper outlines YANG-based configuration template framework exemplified with Flexible MAC Architecture. The presented methodology has equal applicability in other, similar architectures.



Cable Operators can effectively leverage YANG-based Configuration Management methodology to scale, simplify and automate system configuration tasks within their back-office systems.



The business outcomes are in the form of modular, automated, and streamlined provisioning systems and processes with increased agility and reduced OPEX.



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Thank You!

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