TVR (Time-Variant Routing) Applicability

draft-wqb-control-schedule-framework-00

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Applicability of TVR to real networks

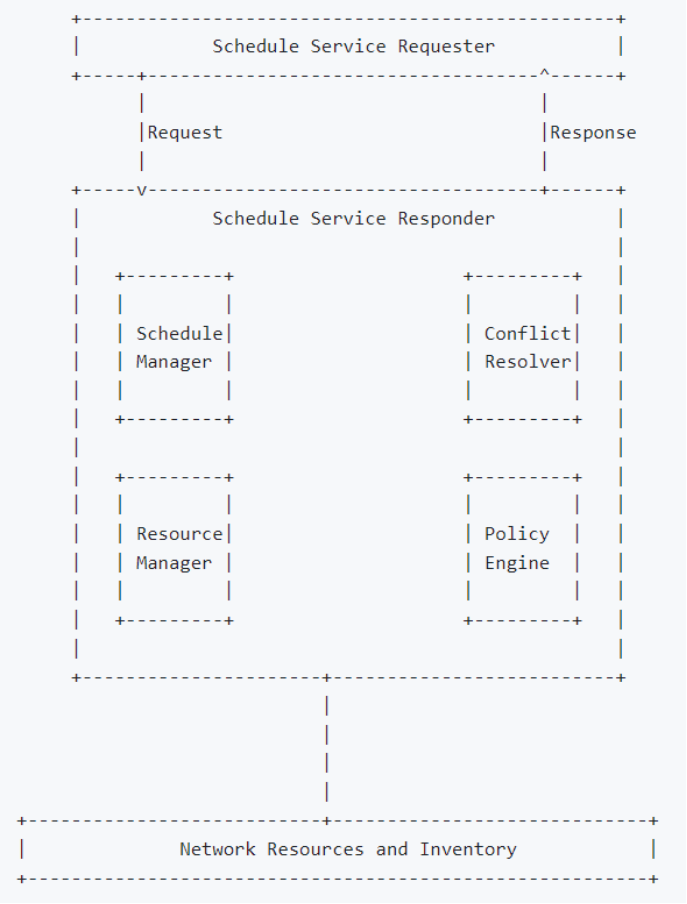
- The TVR Charter includes the following milestone:
- Applicability Statement
  - *“This document should provide an applicability statement on how the information and data models may be used”*
    - https://datatracker.ietf.org/wg/tvr/about/
- Depending on the use case to apply TVR YANG, additional IETF YANG models are also required.
  - Which functional components will configure TVR entities and how they interact needs consideration.
  - Several additional process and messaging mechanism also need to be decided.

A Framework for the Control Scheduling of Network Resources

- The authors created a new I-D:
  - “A Framework for the Control Scheduling of Network Resources”
  - draft-wqb-control-schedule-framework
- This document provides functional components to service a time variant scenario
  - It will describe the entities involved in requesting scheduled changes of network resources
  - It discusses the additional challenges such as conflict resolution, priority handling, and synchronization of scheduled tasks.
- This I-D is intended to provide an applicability statement on how TVR YANG and ancillary YANG models may be used.

Components for Network Schedules

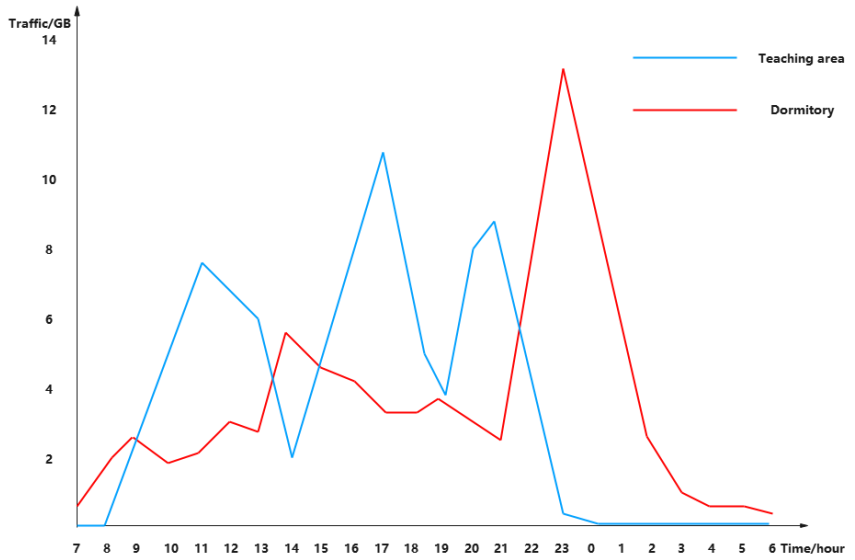
- What basic functional components are required for the control and scheduling of network resources?
  - Scheduled Service Requester: The entity making the scheduling requests of network events, policies, services and resources.
  - Schedule Service Responder: The entity accepting and reacting the scheduling Requests from Schedule Service Request.
    - Resource Manager: Manages the network resources that are subject to scheduling.
    - Schedule Manager: Handles creation, modification, deletion, and querying of schedules.
    - Conflict Resolver: Detects and resolves scheduling conflicts based on predefined policies and priorities.
    - Policy Engine: Enforces scheduling policies and rules, ensuring compliance with organizational requirements.



Basic components of scheduled network

TVR Tidal Traffic Use Case (1/2)

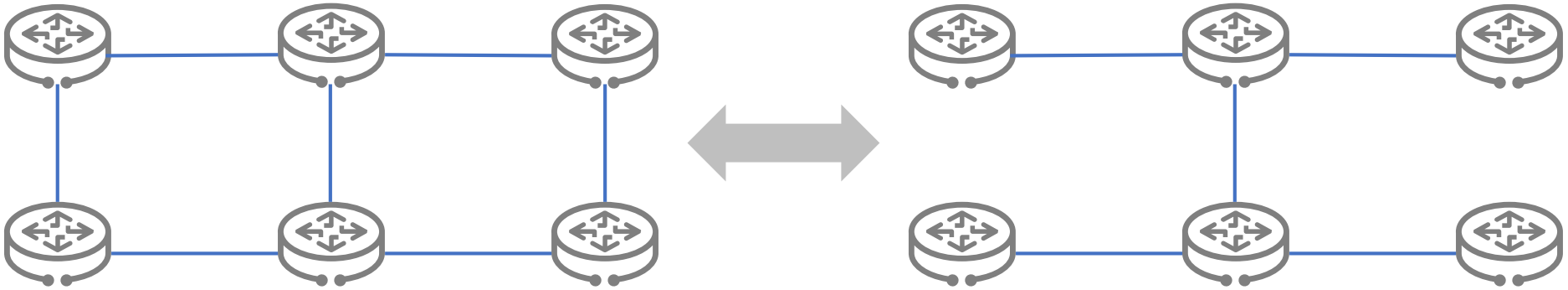
- Tidal Network Example
  - Traffic on the network has an obvious tidal period, including heavy-traffic periods and light-traffic periods
    - Network topology change caused by specific traffic pattern.
  - The time duration of heavy traffic and light traffic are clearly identifiable
    - Students or employees work specific hours
    - Network change will occur twice per day
  - The switching time between the heavy-traffic period and the light-traffic period is well established
    - Working time and day of week are predictable



Tidal effect of traffic in campus network

TVR Tidal Traffic Use Case (2/2)

- Benefits of time variant approach for Tidal Network
  - The low tide topology requires less bandwidth to support fewer users
  - Devices and port can be shut down or put to sleep to save energy



Topology at heavy-traffic period

Topology at light-traffic period

- 14 ports up
- 0 port down/sleep

- 10 ports up
- **4 port down/sleep**

28% Port Power Consumption is saved

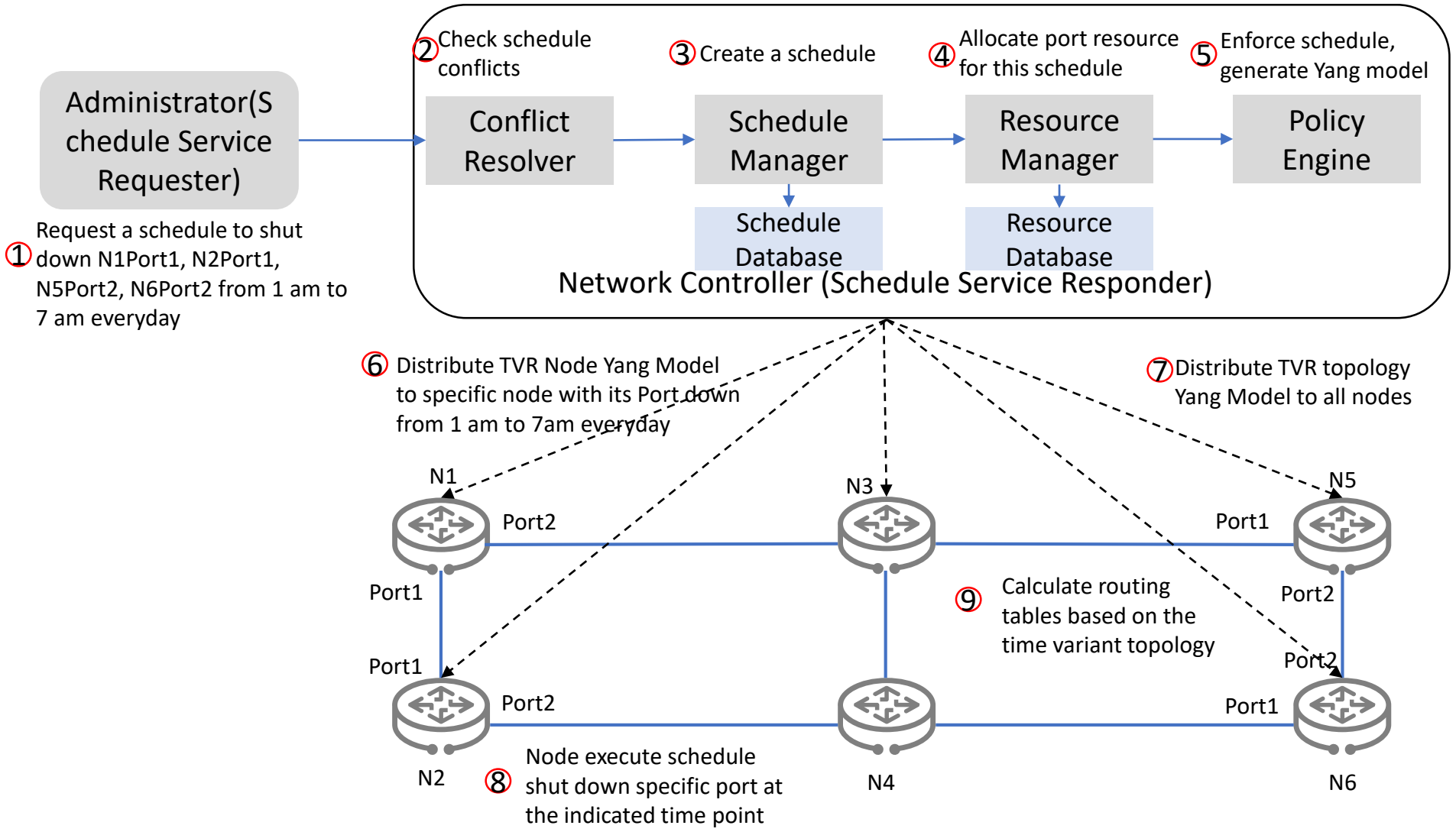
What Process Would Be Required?

- Monitoring of interfaces to build a traffic profile
  - Establishing clear tidal points for lower and upper network traffic
- Running simple algorithm to establish minimum and peak topology to service expected demand
  - Generate low and peak topologies
- Creating network schedule to reflect minimum and peak traffic demands
  - Defining schedules
- Use a mechanism to distribute schedules
  - To be decided and agreed (will be decided for planned Hackathon)
- Executing schedules
  - To be decided and agreed (will be decided for planned Hackathon)

What Entity and Network Data is Required?

- The following IETF YANG models are identified for the Tidal Use Case
  - ietf-interfaces
  - schedule-yang
  - tvr-schedule-yang
    - ietf-tvr-node.yang
    - ietf-tvr-topology.yang
- We will need to Anything else?
  - This may depend on IETF Hackathon (see later slide).

Example Process for Tidal Use Case



YANG Code Examples

- Example for Tidal…
  - Node power up from 1th Dec 2025 to 1th Dec 2026;
  - Default state of interface1: unavailable;
  - Default bandwidth of interface1: 1Gbps;
  - Interface1 power up at 7 o’clock every day, and it will last for 18 hours.
  - This schedule for interface 1 will last from 1th Dec 2025 to 1th Dec 2026.

```
{
    "ietf-tvr-node:node-schedule": [
        {
            "node-id": 12345678,
            "node-power-schedule": {
              "power-default": false
              "schedules": [
                {
                  "schedule-id": 111111,
                  "period-start": "2025-12-01T00:00:00Z",
                  "period-end": "2026-12-01T00:00:00Z",
                  "attr-value": {
                    "power-state":true
                  }
                }
              ]
            }
            "interface-schedule": [
              {
                "name": "interace1",
                "default-available": false,
                "default-bandwidth": 1000000000,
                "attribute-schedule": {
                  "schedules":[
                    {
                      "schedule-id": 222222,
                      "recurrence-first": {
                        "utc-start-time": "2025-12-01T07:00:00Z",
                        "duration": 64800 //60*60*18
                      },
                      "utc-until": "2026-12-01T00:00:00Z",
                      "frequency": "ietf-schedule:daily",
                      "interval": 1,
                      "attr-value": {
                        "available":true,
                      }
                    }
                  ]
                }
              }
            ]
        }
    ]
}
```

IETF TVR Hackathon

- Based on Tidal Use Cases
  - Show the proposed framework can be used for scheduling scenarios
  - Implementation of the applicable IETF YANG
  - Highlight the YANG code required to service the tidal example
  - Generate JSON examples to show how the YANG is used and encoded
- Next steps
  - Agree scope of hackathon, do we have a good use case?
    - Planning on IETF 121 (Dublin, November 2024)
  - Plan for early implementations of required YANG modules
  - YANG and JSON examples to be generated between hackathon partners and presented to TVR working group
    - Maybe included in Appendix in this document

Next Steps

- Would this be a useful document for TVR?
- Are we missing function or models for the use case?
- Are there willing partners for the TVR hackathon?
- Any other questions or suggestions?