A Yang Data Model for Optical Impairment-aware Topology

draft-ietf-ccamp-optical-impairment-topology-yang-05

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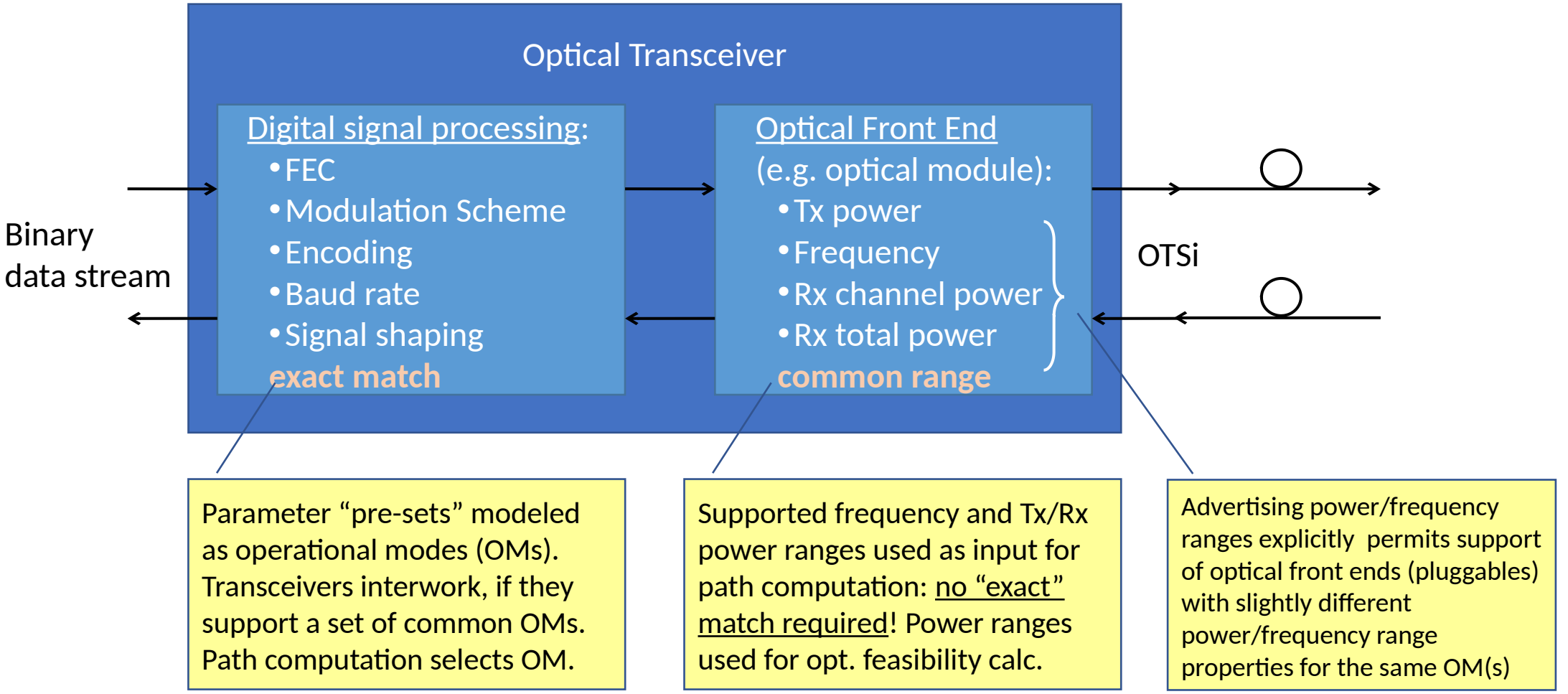
Major Activities since September Interim Meeting

- Weekly CCAMP WebEx meetings (Thu, 4-5pm CEST)
- Topics addressed: TRANSPONDER model
  - We finalize with the version 05 of the draft, the introduction of Transponder model with YANG modification and new text introduced in section 2.5
    - Reconcile the different transponder models (WSON, flexgrid, optical impairments) present in CCAMP using new layer0-types-ext module containing common YANG structures and definitions (typedefs, identities, groupings)
    - Reconcile the transponder model with complementary interface model contained in draft-ietf-ccamp-dwdm-if-param-yang

Optical transponder properties capabilities model: 3 different “modes”

- 3 different approaches (“modes”) to express the transceiver capabilities of a transponder needed to determine optical signal compatibility:
- ITU-T G.698.2 application codes: Guarantees interoperability since encompass also optical path constraints parameters for a single fiber type but have strong limitations and do not exist for the state of the art transceivers (> 100G)
- Organizational mode
  - is identified by organization-identifier and an operational-mode subsuming a set of transceiver properties (e.g. FEC type,Modulation scheme, baud rate, carrier BW etc).
  - Optical power and carrier frequency are modeled separately , not in pre-setting.
  - Two transceivers are inter-operable, if they have at least one (organization-identifier, operational-mode) pair in common AND if the supported carrier frequency and power attributes have a matching range
- Explicit mode, with an explicit list of parameters to consistently configure the mode of operation for the transceivers. No optical path parameters: it does not guarantee interoperability. Useful in case no ITU-T AC or OM exist or the optical constraints of AC or OM cannot be met by the line system

Transceiver Modeling
Typical Organizational Mode Use Case



Application code, organizational mode and explicit mode

- Application code and organizational mode working in a similar way:
  - need to find in the source and destination transceiver a common set of supported AC/OM and then path computation should compute a path meeting the requirement of one of this common AC/OM
- But AC does not support advanced transceiver capabilities e.g. bit rate over 100 G no ITU-T standard application code available in this case
- Organizational mode is needed to overcome this AC limitation, providing a mechanism to allow determining transceiver interoperability.
- Explicit modes are needed in case no common AC or OM exist or the optical constraints of common AC or OM cannot be met by the line system.
  - Moreover gives an alignment with device/interface model

Optical transceiver capabilities

- The transceiver capabilities are described by the set of modes the transceiver is supporting and each mode must follow only one of the 3 modes defined.
- YANG model is flexible , permitting to describe transceiver capabilities by mixing different modes i.e. a transceiver may support AC 1, OM 2, OM 3 and EM 4,5
- The set of parameter values defined for an explicit mode can be comply to a 0..n OM and 0..n AC
  - supported-modes container may provide 2 different list with pointers to related AC and OM
- Moreover a transceiver description comprises a set of properties that can be explicit or implicit depending of the modes, see next slide.

Transceiver properties description in the model

	Transceiver attributes range	**Other Transceiver attributes (optical impairments limit etc.)**
MODE	Min/max Nominal Carrier Frequency Transmitter power range Receive channel power range Receive Total power	FEC type Modulation scheme Encoding Baud rate Carrier Bandwidth Min OSNR, max PDL, CD ……..
ITU-T Application code	IMPLICIT	IMPLICIT
Organizational mode	EXPLICIT	IMPLICIT
Explicit mode	EXPLICIT	EXPLICIT

Optical transceiver setting

- It describes the properties of the OTSi transmitted or received by the transceiver attached to a specific transponder port.
- Each OTSi has 3 pointers:
  - 1 pointer to transponder instance containing the transceiver terminating the OTSi
  - 1 pointer to transceiver instance terminating the OTSi
  - 1 pointer to the currently configured transceiver mode
- Additionally OTSi is described by
  - current carrier-frequency
  - currently transmitted channel power
  - currently received channel power
  - currently received total power

Reference YANG with common grouping from ietf-layer0-types-ext

```
augment /nw:networks/nw:network/nw:node/tet:te
        /tet:tunnel-termination-point:
  +--ro otsi-group* [otsi-group-id]

  |  +--ro otsi-group-id    int16
  |  +--ro otsi* [otsi-carrier-id]
  |     +--ro otsi-carrier-id          int16
  |     +--ro transponder-ref?         leafref
  |     +--ro transceiver-ref?         leafref
  |     +--ro configured-mode?         leafref
  |<grouping common-transceiver-configured-param> // current power and frequency values
  +--ro transponder* [transponder-id]
    +--ro transponder-id    uint32
    +--ro transceiver* [transceiver-id]
      +--ro transceiver-id     uint32
      +--ro supported-modes
        +--ro supported-mode* [mode-id]
          +--ro mode-id                  string
          +--ro (mode)
            +--:(G.698.2)
             |  +--ro standard-mode?        standard-mode
            +--:(organizational-mode)
             |  +--ro organizational-mode
             |     +--ro operational-mode?
             |     |       operational-mode
             |     +--ro organization-identifier?
             |     |       organization-identifier
             |<grouping common-organizational-explicit-mode> // common power and frequency ranges attributes
            +--:(explicit-mode)
              +--ro explicit-mode
                +--ro supported-modes
                 |  +--ro supported-application-codes*
                 |  |       -> ../../mode-id
                 |  +--ro supported-organizational-modes*
                 |          -> ../../mode-id
                 |<grouping common-explicit-mode> // full list of tranceiver attributes for explicit mode
                 |<grouping common-organizational-explicit-mode> // common power and frequency ranges attributes
```

```
common-transceiver-configured-param
      +--ro OTSi-carrier-frequency?   frequency-thz
      +--ro tx-channel-power?         dbm-t
      +--ro rx-channel-power?         dbm-t
      +--ro rx-total-power?           dbm-t
```

```
common-explicit-mode
  +--ro line-coding-bitrate?                        identityref
  +--ro max-polarization-mode-dispersion?           decimal64
  +--ro max-chromatic-dispersion?                   decimal64
  +--ro chromatic-and-polarization-dispersion-penalty* []
  |  +--ro chromatic-dispersion
  |     |       decimal64
  |  +--ro polarization-mode-dispersion
  |     |  |       decimal64
  |  +--ro penalty
  |     |         decimal64
  +--ro max-diff-group-delay?                       int32
  +--ro max-polarization-dependent-loss?            decimal64
  +--ro available-modulation-type?                  identityref
  +--ro OTSi-carrier-bandwidth?                     frequency-ghz
  +--ro min-OSNR?                                   snr
  +--ro min-Q-factor                                int32
  +--ro available-baud-rate?                        uint32
  +--ro available-FEC-type?                         identityref
  +--ro FEC-code-rate?                              decimal64
  +--ro FEC-threshold?                              decimal64
```

```
common-organizational-explicit-mode
+--ro min-central-frequency?       frequency-thz
 +--ro max-central-frequency?      frequency-thz
 +--ro minimum-channel-spacing? frequency-ghz
 +--ro tx-channel-power-min?       dbm-t
 +--ro tx-channel-power-max?       dbm-t
 +--ro rx-channel-power-min?       dbm-t
 +--ro rx-channel-power-max?       dbm-t
 +--ro rx-total-power-max?         dbm-t
```

Issue raised during weekly call discussion

- The model is full supported by ALL the weekly attendees but 1.

Issue: Organizational mode does not provide only a pre-setting subsumed parameters but also explicit power and frequency range

How to deal with possible overlapping between implicit set of parameters and the explicit ones ?

Example: Server reports a transceiver being capable to support an organizational-mode X with Fmin = 10, but the organizational-mode X “implicitly” defines Fmin = 50. Which values the client has to consider for path computation ?

Possible solution rule: “if the OM optical specification defines an implicit parameter, the YANG model should not report the same parameter explicitly” (for further discussion)

As reported in the minute of related meeting (see github https://github.com/ietf-ccamp-wg/draft-ietf-ccamp-optical-impairment-topology-yang/blob/master/minutes/minutes-2020-11-05.md
) “ attendees agree on the need to add some text in the future version to clarify "precedence/priority" in the modes “

Open Issues

https://github.com/ietf-ccamp-wg/draft-ietf-ccamp-optical-impairment-topology-yang/issues

- 16 issues still open
- Issues #41 and 42 are related to transponder model and require just a better definition of some parameters
- Alignment with ITU-T terminology and definitions for the data plane
  - Sub-sections in section 2.3 will have to be updated
  - Open issue on GitHub: #25
- Need to address issue #23 on 3R Regenerator as planned after completion of Transponder model
- Open issues #5 and #12 have been closed since related to transponder model so closed with the actual update of the YANG model.
- Other issues: see GitHub link above
- Repositories : https://github.com/ietf-ccamp-wg

Next Steps

- Modeling of 3R regenerators based on optical transponder model
- Address the other open issues on GitHub
- In parallel upload layer0-types-ext draft
- Keep draft-ietf-ccamp-dwdm-if-param-yang aligned to draft-ietf-ccamp-optical-impairment-topology-yang


Thank You!

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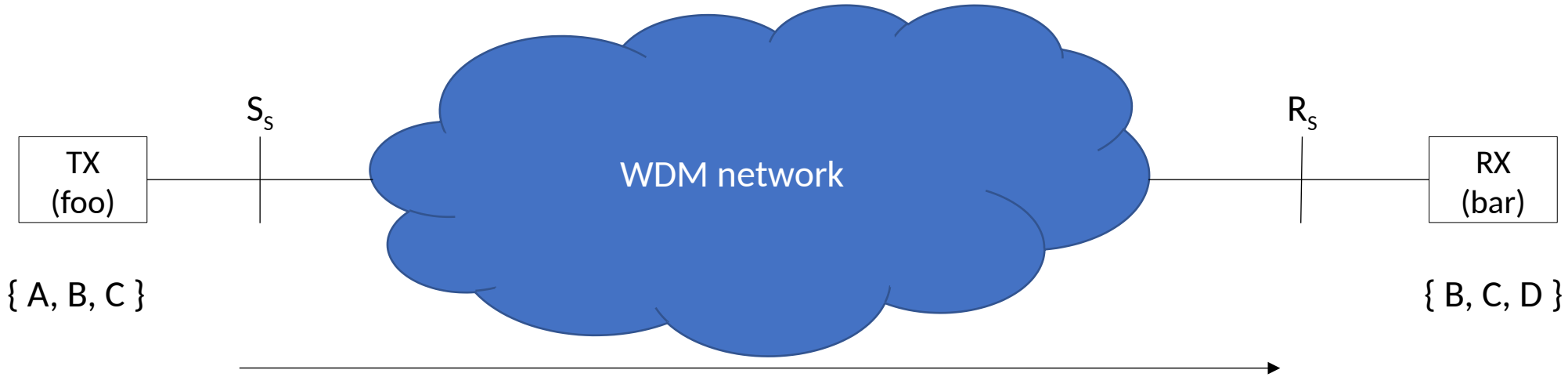
Application code/organizational mode case



1. If A,B, C are ITU-T AC, we need to find in the source and destination transceiver a common set of Supported AC, e.g B,C in this example.
2. Path computation should compute a path matching optical requirements of B or C
3. If the optimal path is compliant with optical requirements in B,
   - the domain controller setup the path and configures TX and RX device controllers with application code B