Sonet/SDH Virtual Concatenation for RPR

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Introduction

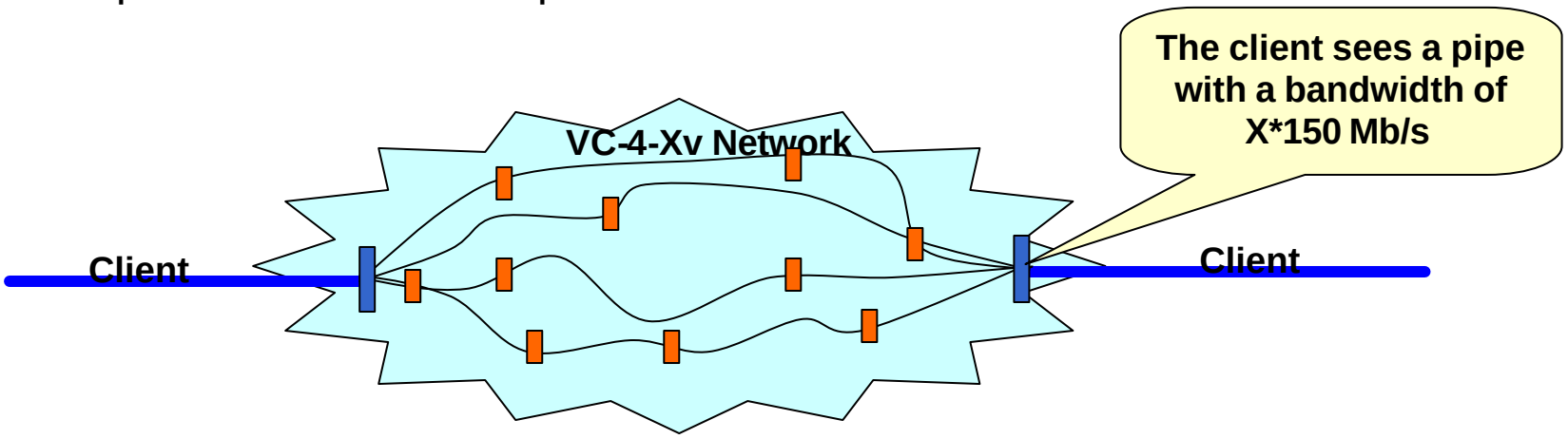
Scope of the Presentation

- Summarize the Sonet/SDH virtual concatenation feature
  - It is a new feature introduced by the latest G.707/2000
  - It allows for granular increment of Sonet/SDH path bandwidth
- Analyze which impacts has its support on RPR MAC
  - Supporting more granular ring upgrades
  - Supporting multiple physical links between nodes
  - Transparency of 802.17 RPR MAC operations

Summary of Virtual Concatenation

Main concepts

- Virtual concatenation of Sonet/SDH Paths (VC-4 or STS-3c-SPE) is currently being defined in ITU-T G.707/2000
- Virtual concatenation is not restricted to the situation in which all the individual VCs are contained within a single Multiplex Section
  - The real potential flexibility of virtual concatenation occurs when each individual VC, forming the virtually concatenated VC, is routed over a number of different and impendent Sonet/SDH paths



Main features

- A VC4-Xv (or STS-3c-Xv-SPE) provides a contiguous payload area of X VC-4 with a payload capacity (bandwidth seen by the upper layer) of X*150 Mb/s
  - Where the VC4-Xv signal is generated, its payload is then separated into X different VC4s
  - Where the VC4-Xv signal is terminated, the X different VC4s are combined together
- To perform the realignment of the individual VC-4 that belong to a virtually concatenated group it is necessary to
  - Compensate for the differential delay experienced by the individual VC-4s
  - Know the individual sequence number of each VC-4
- A specific byte in each VC-4 payload is used to signal the sequence number and for multi-frame indication
- The maximum differential delay that can be compensated is 256 ms
  - Implementations can compensate a smaller differential delay

Impacts of Virtual Concatenation on RPR

Contiguous Concatenation for RPR

- **Without** virtual concatenation
  - RPR frames are encapsulated into GFP frames
  - GFP frames are then mapped into Sonet/SDH paths, the VC4 (STS-3c-SPE), or continuous concatenated paths, the VC4-Xc (STS-3Xc-SPE)
    - Possible values of X limited to 4, 16, 64, 192, … (4x increments)

- The Sonet/SDH paths used by RPR may or may not be multiplexed, in the Sonet/SDH layer, together with other VC4s into an STM-N or STS-3N physical interface
  - This multiplexing is completely transparent to the RPR MAC layer
- The RPR MAC always sees a PHY with a bandwidth equal to X times 140 Mb/s

Virtual Concatenation for RPR

- **With** virtual concatenation
  - RPR frames are encapsulated into GFP frames
  - GFP frames are then mapped into Sonet/SDH virtual concatenated paths, the VC4-Xv (STS-3c-Xv-SPE)
    - All integer numbers for X are admitted
- All the Sonet/SDH VC4 (STS-3c-SPE) may or may not be multiplexed together, and optionally with other VC4s, into one or more STM-N or STS-3N physical interfaces
  - This multiplexing is completely transparent to the RPR MAC layer
- The RPR MAC always sees a PHY with a bandwidth equal to X times 140 Mb/s

Virtual Concatenation Issues

- No difference at the RPR MAC layer between contiguous and virtual concatenation
  - All the complexity is managed by the PHY layer
- Sonet/SDH virtual concatenation allows for a more granular ring speed upgrades
  - Instead of 4x upgrades, all the speeds multiple of 140 Mb/s can be supported
- Sonet/SDH virtual concatenation allows for multiple physical rings between adjacent nodes
  - No multi-ring support is required at MAC layer – RPR MAC still works with a dual counter rotating ring topology
- Sonet/SDH virtual concatenation is already defined and supported by Sonet/SDH vendors

Conclusions

Conclusion

- RPR solutions based on Sonet/SDH technology can benefit of the virtual concatenation feature in order to support
  - More granular ring speed upgrades
  - Multiple physical links between adjacent nodes
- Virtual concatenation and its benefits can be easily supported without impacting the RPR MAC layer
  - The RPR topology remains a dual counter rotating ring with link bandwidth of X times 140 Mb/s
- All the complexity is left out of the MAC in the PHY layer
  - The functionality is already defined and supported by Sonet/SDH vendors

Requirements

- The IEEE 802.17 MAC Standard shall not avoid supporting any virtual concatenated Sonet/SDH path layer as possible a Sonet/SDH PHY
  - It impacts only the Sonet/SDH PHY specification
  - It does not forbid supporting also link aggregation above the MAC