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 standard feature introduced by the latest G.707/2000
  - It allows for granular increment of Sonet/SDH path bandwidth

- Analyze the use of virtual concatenation in an RPR system based on Sonet/SDH PHY
  - Fully transparent to 802.17 RPR MAC operations
  - Supporting more granular ring upgrades
  - Supporting multiple physical links between adjacent nodes
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 independent Sonet/SDH paths

**The client sees a pipe with a bandwidth of X*150 Mb/s**

Client VC-4-Xv Network Client
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

- The Sonet/SDH layer is responsible to perform the realignment of the individual VC-4s that belong to a virtually concatenated group
  - Compensate for the differential delay experienced by the individual VC-4s
  - Know the individual sequence number of each VC-4
Virtual Concatenation in RPR
Contiguous Concatenation in 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 VC4 or VC4-Xc 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 150 Mb/s
Virtual Concatenation in 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 150 Mb/s
Virtual Concatenation in RPR Systems

- 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 150 Mb/s can be supported
- Sonet/SDH virtual concatenation allows for multiple physical links between adjacent nodes
  - RPR MAC is unaware of this
  - It can continue working 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 supported without impacting the RPR MAC layer
  - The RPR topology remains a dual counter rotating ring with link bandwidth of X times 150 Mb/s
  - The functionality is already defined and supported by Sonet/SDH vendors

- The functionality is out of the MAC – it belong to the PHY layer
  - The functionality is already defined and supported by Sonet/SDH vendors
The IEEE 802.17 MAC Standard should also support any virtual concatenated Sonet/SDH path layer as a possible RPR PHY

- It impacts only the Sonet/SDH PHY specification

Virtual concatenation support is only a system vendor option