Trend in the standardization of FCoPW and FC over MPLS implementation

October 2006
Outline

- FCoPW Overview
- Standardization Status
- Encapsulation
- Congestion Control
- Summary
FC PW Overview

- FC PW allows the transport of point-to-point Fibre Channel to support SAN extension and disaster recovery
- A new service for the Multi-Service transport network
- Key attributes
  - Transparency for separation of carrier and enterprise domains
  - Large distances
  - Reliable transport
  - Efficient transport by PSN statistical multiplexing
Motivation

**KEY**
- **TDM encapsulation**
- **Fibre Channel PW encapsulation**
- **Ethernet PW encapsulation**
- **PPP/MLPPP – Ethernet Interworking - Ethernet PW encapsulation**
- **GFP/X.86 Termination – Ethernet PW encapsulation**

**Diagram Elements**
- **MPLS Network**
- **TDM PW**
- **Ethernet PW**
- **FC PW**
- **PE**
- **Fibre Channel**
- **PPP/MLPPP**
- **Ethernet**
- **Ethernet over TDM**
- **TDM**
FC Transport Methods

- FC over WDM
  - Limited distance
  - Not BW efficient
- FC over SONET/GFPT
  - Based on SONET/SDH transport network
  - No statistical multiplexing
- FC over IP
  - SAN-centric model
  - Necessitates TCP/IP network layers
FC over PW Reference Model

Attachment circuit (AC)
Native Fibre channel Port

Provider Edge

Native Service Processing
PW Termination
PSN Tunnel

MPLS
PSN
Standardization Status

- IETF PWE3 WG – PW termination
  - draft-ietf-pwe3-fc-encap-01.txt (June 2006)
  - Encapsulation methods
  - FC PW signaling
  - Congestion control
  - draft-ietf-pwe3-fc-encap-02.txt – in work to include mainly congestion control details
Standardization Status

- T11 FC-BB WG – NSP functionality
  - FC-BB_PW is a work item in FC-BB-4
  - Credit management
  - Link Initialization
  - Login monitoring
  - Primitive Signals handling
  - Adaptation of FC information for PW transport
Encapsulation

- FC port traffic is carried transparently over a **single PW**
- FC information encapsulation
  - FC **data frame** is carried in one PW PDU
  - FC-BB_PW generated **control frame** (WAN flow control, Ping) is carried in one PW PDU
  - FC **Primitive Sequences** are terminated at the local FC-BB_PW and sent as single control frame
  - FC **Primitive Signals** (Idle, R_RDY) are terminated and handled at the local FC-BB_PW

<table>
<thead>
<tr>
<th>PSN.Header</th>
<th>PW.Label</th>
<th>Control.Word</th>
<th>SR.Header</th>
<th>SOF</th>
<th>Frame.Header</th>
<th>Payload</th>
<th>CRC</th>
<th>EOF</th>
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<tr>
<td>4Byte</td>
<td>4Byte</td>
<td>4Byte</td>
<td>4Byte</td>
<td>24Byte</td>
<td>0-2112Byte</td>
<td>4Byte</td>
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<tr>
<td>PSN Header</td>
<td>PW Label</td>
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<td>Payload</td>
<td>CRC</td>
<td>EOF</td>
</tr>
<tr>
<td></td>
<td>PWE3 fields</td>
<td>Encapsulated FC frame</td>
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Congestion Control

- Avoid frame loss as experienced by the CE
- Enable statistical multiplexing
Congestion Control

- Adaptive Rate Control
  - Guarantee minimum bandwidth (CIR)
  - Reduce loss probability by limiting bursts
  - Enhance efficiency by adapting to network conditions
  - Provide fairness between flows (TCP-friendly based on RFC3448)

- Selective Retransmission of lost frames
  - Enable in-order, no-loss transport
  - Allow efficient retransmission of lost frames
  - Provide congestion indications to the rate control mechanism
  - Standardized for FC transport in T11 FC-BB WG
Congestion Control

- Ingress queue management
  - Avoid received frame loss due to buffer overflow
  - Control credit management
- Credit management
  - Buffer-to-buffer credit handling with the CE
  - Performed as part of the NSP as standardized in T11 FC-FS WG
Implementation Example

- FC PW over Resilient Packet Ring
- Protected service over the ring
- Service is not degraded upon protection events
- Statistical multiplexing with Ethernet services
Summary

- FC PW benefits for a carrier:
  - Separation of SAN and Transport network domains
  - Very large distance (~1000 Km) to support disaster recovery
  - Reliable transport by packet retransmission
  - Efficient BW utilization by statistical multiplexing and repetitive signal suppression
  - Low latency by MPLS-TE