SRP and DPT Frequently Asked Questions

Contents

Introduction

This document answers frequently asked questions in regards to Spatial Reuse Protocol (SRP) and Dynamic Packet Transport (DPT) Cisco hardware and software equipment.

Q. Where can I find the DPT feature guide?

A. Refer to the Spatial Reuse Protocol Feature Guide in order to find the DPT feature guide.

Q. Can DPT carry 802.1q frames?

A. With the Cisco 10720 router, with Universal Transport Interface (UTI) support, and the tunnel server card on the Gigabit Switch Router (GSR), you are able to take Ethernet frames, and encapsulate the frames to the UTI. You can then carry the encapsulated frames over the DPT ring, and to the GSR tunnel server card in order to process.

Q. How do I measure a new DPT ring segment for quality and stability?

A. These Cisco IOS® Software **debug** commands can be used in order to check Layer 2 (L2)

protocols, once a ring is brought up:

- **debug srp topology**—Must send every five seconds and receive every five seconds from each node in the ring.
- **debug srp ips**—Must send every second and receive every second from each neighbor.

Send four types of traffic and issue the **show interface srp** and **show srp counters** commands in order to check these counters:

- Unicast low-priority traffic (default Type of Service (ToS) 0 to 5)
- Unicast high-priority traffic (default ToS 6 to 7). Be careful of the default 20mB rate limiter.
- Multicast low-priority traffic (default ToS 0 to 5)
- Multicast high-priority traffic (default ToS 6 to 7)

With regard to the Bit Error Rate (BER), this information applies:

- You can read the BER for B1, B2, and B3 from the output of the **show controller** command.
- You can change the thresholds for B1, B2, and B3 the same way you can for a normal Packet over SONET (PoS) link.
- You cannot see any BER counts in the ring unless there is an extremely long haul, for example 70 to 80 km or more.
- The range for the BER threshold is -3 to -9, though you cannot see any B1, B2, or B3 errors in a well-built ring.

For specific SRP and DPT equipment, refer to Spirent (Adtech) and Ixia , who offer SRP and DPT test equipment. You can tell if the line card is operational, whether messages are exchanged, with these products. The Spirent (Adtech) system can create messages in order to simulate an operational ring (Intelligent Protection Switching (IPS), keep alives, and topology). Both of these products are software extensions to their OC-48 PoS testers.

Q. What is the overhead created by DPT to an IP packet?

A. SRP overhead is 21 bytes above the base IP packet, which is 16 bytes OH, 4 bytes Frame Check Sequence (FCS) and 1 byte delimiter. The data usage is minimal for control packets. There are packets for IPS, topology, node name, and usage, which depends on the configuration. This totals approximately 2000 packets per second, which is mostly usage. All of these are small packet sizes (40 to 128 bytes), which amount to about 0.05 percent of the traffic.

Q. How do you configure SRP MAC accounting?

A. Issue these commands in order to configure SRP MAC accounting:

- **interface SRP0/0**
- **srp count xxxx.xxxx.xxxx**

Issue the **show srp source-counters** command as shown in this example in order to view the results:

```
srp-router#show srp source-counters
```

Source address information for interface SRP0/0 is shown in this format:

- **xxxx.xxxx.xxxx, index 1, pkt. count 10**

Q. What is the benefit to run DPT over SONET with a protected or unprotected ring?

Benefits of DPT over SONET

A. The main benefit of running DPT over SONET is the fact that you use a technology that is optimized to carry IP or data traffic while you maintain the existing Time-Division Multiplexing (TDM) services. This way you introduce statistical multiplexing onto a TDM infrastructure. All of this is over a single-fiber pair.

DPT over SONET with a Bidirectional Line Switched Ring (BLSR) or a Unidirectional Path Switched Ring (UPSR)

If you run DPT over unidirectional path switched ring (UPSR), the only practical way is to run this over an unprotected UPSR. A device such as the Cisco ONS 15454 offers this capability, but not all Add Drop Multiplexers (ADMs) do. In this situation, you must rely on the DPT protection in the case of failures. If there is a failure, the DPT protection, Intelligent Protection Switching [IPS], takes affect and you have a wrapped DPT ring.

In the case of DPT over bidirectional line switched ring (BLSR), if there is a failure, the BLSR protection kicks in and you have no wrap in the DPT ring. This means more bandwidth at all times. The only time DPT protection is activated is in the case of a failure between the DPT router and the ADM. You cannot create unprotected SONET circuits over a BLSR ring. BLSR uses shared protection and assumes that every circuit uses this protection.

Q. Does the OC-12 DPT line card (Engine 1) implement high- and low-priority transit and transmit queues for the SRP-FA?

A. The OC-12 DPT line card has only one queue in the transmit path, and two queues in the transit path. However, the rings operate on a single-queue basis due to the single transmit queue.

The SRP-Fairness Algorithm (FA) only works on the low-priority queue (which is implemented) and never operates on the high-priority queue. There is no low- or hi-rate limiting on the OC-12 DPT line card.

In addition, the four-port OC-12c/STM-4c DPT Internet Service Engine (ISE) line card, Cisco 12000 and 12400 series is based on Engine 3. This line card fully supports hi and low SRP queues and full modular Quality of Service (QoS) Command Line Interface (CLI) (MQC). The customer is able to change the priority slicing and assign specific types of packets to a specific queue. The line card also allows any traffic policy to assign any action, such as bandwidth or Type of Service (ToS) changes.

Note: Refer to Cisco IOS Software: Quality Of Service for more information on QoS.

Q. How many nodes can a DPT ring accommodate?

A. For an STM-16 DPT ring, this information applies:

- You are limited to 62 node rings if you use the older Frame Check Sequence (FCS) version of DPT (rev-A). This is also true if you mix rev-A and rev-B versions of the DPT card.
- The new limit is 128 node rings, if all your nodes use the newer version (rev-B).

For an STM-4 DPT ring, this information applies:

- A maximum of 30 nodes
- Refer to Dynamic Packet Transport Technology and Performance for more information on DPT modeling and technology.

Q. Is SRP or DPT the correct term to use?

A. Cisco DPT is the type of network architecture customers can build, based on the Cisco SRP MAC architecture and protocol. In the future customers are able to build Resilient Packet Ring (RPR) network architecture, based on the IEEE 802.17 MAC architecture and protocol. DPT/RPR is the naming the market and customers use.

These are definitions of the terms mentioned:

- RPR—The name of the category of products and technologies that deliver RPR functionality.
- DPT—The product line name for the Cisco family of RPR products, such as the OC-48 DPT line card for the Cisco 12000 series router.
- SRP—The name of the Cisco-developed MAC-layer protocol and the underlying technology used in the Cisco DPT and RPR family of products. SRP is an open, freely available, specification (RFC 2892), and has been submitted to the IEEE for consideration as the basis of the forthcoming 802 standard MAC-layer implementation.
- IEEE 802.17—The name of the forthcoming standard MAC-layer protocol implementation for an RPR.

Q. Can a Gigabit Switch Router (GSR) OC-48 DPT card be downgraded to an OC-12?

A. No, this is not possible. There are two areas that limit this capability. This is the DPT stack:

DPT/SRP RAC ASIC <--> SONET/SDH framer <--> Optics PHY <--> Fiber

- The Resource Availability Confirmation (RAC) Application-Specific Integrated Circuit (ASIC) for OC-12 is a version 1 Spatial Reuse Protocol (SRP) ASIC. The RAC ASIC for OC-48 is a version 2 SRP ASIC. There are a few small differences between version 1 and 2. Both run their own fixed ASIC clock rate.
- Both framers, for OC-12 and OC-48, run their own fixed framer clock rate. A framer supports one interface line rate.

Q. Can you mate a C48/SRP-SR (Short Reach line card) and OC48/SRP-LR (long-reach line card) in a Gigabit Switch Router (GSR)?

A. There are no issues if you mix SR and LR OC-48s with SRP in the same GSR. This has been

extensively tested, and there are no restrictions. The only concern is if an SR or LR is fiber-connected to a line card with a different reach, such as a SR line card connected to a LR line card over fiber. In this case, you must use attenuation in order to bring power levels down in the fiber.

Q. Can you provide information on SRP bandwidth?

A. SONET line rate (for an OC-48) is 2488.32 Mbps. The overhead quick calculation is 1 byte per 27 bytes transmitted. Therefore, the available payload is approximately 26/27 or 2488.32 = 2396.16 Mpbs.

The number that is usually used for general calculations, for rough math, is 2.395 Gbps. This number takes into account Path OverHead (POH)). This is the bandwidth available in order to insert SRP control packets and data packets.

You always have the full 2.395 available to the SRP, and while SRP control packets take up almost no bandwidth (even keep alive at 106us intervals is almost nothing), the size of packets with 16-byte SRP overhead can make a big difference to your IP bandwidth. For example, 40-byte IP packet = 56 byte SRP packet = 40/56 * 2.395 = 1.71 Gbps of IP traffic even though SRP uses all 2.395 G. However, a 1500-byte IP packet = 1516 byte SRP packet = 1500/1516 * 2.395 = 2.369 Gbps of IP traffic even though SRP uses all 2.395 G.

Q. What is Single Ring Recovery (SRR)?

A. SRR deals with multiple fiber failures on a single ring. The SRR protocol allows DPT to run over a single ring when two or more failures are on the same ring. The SSR protocol enables an SRP ring to preserve full-node connectivity in the event of multiple failures on one of its two counter-rotating rings (Inner Ring (IR) or Outer Ring (OR)), while the other ring is failure free. In all other cases, such as dual ring failures, the SRP ring maintains the standard SRP Intelligent Protection Switching (IPS) behavior.

These are the rules:

- If it is a single failure, use IPS.
- If there are multiple failures at the same ring, each node initiates SRR.

SRR is an extension to the SRP. SRR includes these two new SRP control packet types:

- discovery packets
- announce packets

These allow for each router to learn about the failures in the ring. Discovery packets are sent every ten seconds when enabled on all ring nodes. If a ring node detects a local failure, the node launches a discovery packet on both rings. Every ring transit node updates the packet with its own failure information. The originator launches an announce packet that indicates the number of failures on each ring when the topology discovery packet returns.

Note: Topology packets are sent point-to-point to MAC address 0000.0000.0000.

Also, the SRP fairness algorithm does not work when a single ring is used. The bandwidth of each node is hard limited, and the per-node bandwidth limit is 100M with OC-12/STM-4 and 400M with OC-48/STM-16. SRR is a software release implementation and is not enabled by default. The **show srp srr** command reports the status of the SRR feature. Refer to Single Ring Recovery Protocol for more information.

Q. How does the 1310nm laser signal interconnect with a 1550 nm laser signal?

A. A 1550 nm laser signal, at a 1550 nm interface, can be received by or detected by a diode at the 1310 nm interface. A 1310 nm laser signal, at a 1310 nm interface, can be received by or detected by a diode at the 1550 nm interface.

The reason for this is that all the optical router interfaces, DPT and Packet over SONET (PoS), use the receive (Rx) part of the interface (a wideband diode). This means the diode can receive either 1310 nm or 1550 nm laser signals.

In general, you can use the rules in this section as a guideline for a STM-16 long distance dark fiber design. This example is based on the Long Reach 2 (LR2) interface. But, similar rules apply for the Long Reach 1 (LR1) interface. The dispersion is less of an issue with the 40 km fiber. The fiber attenuation at 1310 nm, used with the LR1 interface, is higher.

This is an example with an STM-16 LR2.

There are two parameters that are important in a long distance dark fiber design:

- Optical power
- Dispersion

Fiber media specifications with respect to loss (dB/km at 1550 nm) and dispersion (ps/nm/km) are critical at these distances.

Too many or too few amplification and dispersion limitations generate ring wrap conditions due to a signal degrade condition. This is indicated in the output from the **show controllers srp** command. This is usually due to improper optical power levels or high dispersion levels. These are two critical parameters in such a long network span. Too high or too low power, with edge value conditions, can also cause a lot of bit errors.

G.652 and G.653, or fiber with similar specifications, are two commonly used fiber types. Regular G.652 Single-Mode Fiber (SMF) is optimized for zero dispersion around 1310 nm. This is not optimal for 1550 nm transmission, used with a LR2 interface. Therefore, G.653 DS was developed with zero dispersion at 1550 nm.

Common fiber loss examples are 0.2 to 0.4 dB/km at 1550 nm. About 0.30 dB/km for dark fiber is middle-class quality fiber. This does not include any span or segment interconnect loss.

The LR2 PHY is tested in order to ensure that is is less than the International Telecommunication Union (ITU) mandated optical path penalty. Vendor specification of the LR2 optics is characterized to 1800 ps/nm of the total dispersion. As an example, the maximum span can be 100 km at the limit of dispersion tolerance, in the case of an 18 ps/nm/km fiber.

These are the specifications for the SMF LR2 interface:

- Operating wavelength 1550 nm
- Transmit power 3 dBm (max) -2 dBm (min)
- Receive sensitivity -9 dBm (max) -28 dBm (min)
- Recommended distance 80 km
- Power budget 26 dB

You need to calculate for a worse-case scenario. This can include connector loss, splices, aging of

optics, aging of fiber, and patch cords, which could be 3 to 4 dB in total. Such a cable is usually laid down in segments, and the interconnections also take up some of the budget.

The maximum span is approximately 86 km with a power budget of 26 dB and a fiber attenuation per km of 0,3 dB. For example, in the case of a 23 dB power availability (26 - 3 = 23), the maximum span can be 76 km at the limit of power tolerance.

The maximum span is approximately 104 km with a power budget of 26 dB and a fiber attenuation per km of 0,25 dB. As an example, in the case of a 23 dB power availability (26 - 3 = 23), the maximum span may be 92 km at the limit of power tolerance.

Both of these examples show that there is a certain delta, and the fiber media specifications and additional loss matter. The LR2 80 km recommended distance is just a save value. You never work with these fixed numbers in optical networking, in general. This is because there are too many variable optical parameters involved.

Real loss measurement, or fiber media vendor specifications, is a requirement in order to design dark fiber-based DPT and Resilient Packet Ring (RPR) networks.

In case a span is more than 80 km, the 15104 can be considered as a 3-R regenerator. The 15104 has only LR optics with a 26 dB power budget per link (east or west). If necessary, optical power can be tuned with an optical attenuator. The 15104, with its 3-R function, compensates for any dispersion accumulated in the path. A similar concept applies to the STM-16 LR1 design.

These are the specifications for the SMF LR1 interface:

- Operating wavelength 1310 nm
- Transmit power +2 dBm (max.) -3 dBm (min.)
- Receive power -8 dBm (max.) -28 dBm (min.)
- Recommended distance 40 km
- Power budget 25 dB

Note: All DPT and RPR interfaces use SMF. Multi-Mode Fiber (MMF) is 850 nm and with a core of 50 or 62.5 micron. The SMF is 1310 nm and 1550 nm with a core of 8 micron.

Q. How does DPT protection switching work?

A. The DPT/Resilient Packet Ring (RPR) protection switching uses a concept similar to that of SONET or Synchronous Digital Hierarchy (SDH). The protection switching is in a window of sub-50 msec switching. But, this does not use the SONET or SDH detection parameters.

There are these three steps in case of a failure at a single ring topology:

1. 10 msec detection and sub-50 msec restoration (ring wrap)
2. Intelligent Protection Switching (IPS) topology update and distribution for optimal path
3. Any route table update

The first two steps are very fast and belong to Layer 2 (L2) (SRP , Resource Availability Confirmation (RAC), Application-Specific Integrated Circuit (ASIC), and the framer). The last step is in Layer 3 (L3) and is the least to notice a topology change. Seldom does any single ring topology change, due to a segment failure, trigger a route table update. This is because the Layer 3 action is too slow, and most single rings use a single subnet. There is no routing in such ring.

There is never a race condition between SRP and any Interior Gateway Protocol (IGP) or Exterior Gateway Protocol (EGP).

Multiprotocol Label Switching (MPLS) Fast Reroute (FRR) uses a similar concept to that mentioned in step 1. If it is a very large network, such as a long-haul DPT/RPR with dark fiber and cascaded 3-R regenerators, or as an overlay over Dense Wavelength Division Multiplexing (DWDM), step 2 with the IPS topology update and distribution for optimal path, takes extra time. There is no interaction or any communication between any IGP or EGP, and SRP link failure detection at the interface. The different layers are transparent and such communication is for each particular layer end-to-end at each segment. Typical restoration values are far less than 50 msec and are in the range of 5 to 10 msec in a lab environment (short spans). In the field this could be different, but still less than 50 msec.

If there is transparency between the Layer 1 (L1), Layer 2, and Layer 3 failure detection mechanism, such as in the case of node, segment, or topology failures, higher layers are not always aware. If Layer 1 handles the recovery quickly, an Layer 2 mechanism such as Spanning Tree Protocol (STP), or an Layer 3 mechanism such as IGP or EGP does not do any restoration or reconverge. But, some corner cases exist with DPT and RPR overlay and Packet over SONET (PoS) overlay.

Q. What is DPT pass-through?

A. The interface can go in SRP pass-through under these two conditions:

- If you put the interface in `admin down` state with the **shutdown** command.
- The MAC and Resource Availability Confirmation (RAC) watchdog expires. The interface goes into the `down` state, and the RAC and MAC is put in pass-through.

The **srp shutdown [a|b]** command is equivalent to the **srp ips request forced-switch [a|b]** command, and is not related to SRP pass-through mode.

This is a configuration sample:

```
Router-yb(config-if)#srp shutdown b

router-yb#show run int srp 1/1

interface SRP1/1

no ip address

no ip directed-broadcast

srp ips request forced-switch b

end
```

Q. Is Hot Standby Routing Protocol (HSRP) supported on Dynamic Packet Transport (DPT)?

A. HSRP is not supported on SRP. The command line interface (CLI) command you use in order to configure SRP has been disabled on the C10720, but this does not look as though it was done on the Gigabit Switch Router (GSR). SRP requires each node to have a single MAC address. But,

with HSRP, you can assign multiple MAC addresses to a single node which breaks this assumption. This can work in certain setups, but this is not a stable configuration.

Related Information

- **Optical Technology Support Pages**
- **Technical Support & Documentation - Cisco Systems**