White Paper

Eclipse Resilient Wireless Packet Ring™

Introduction

Harris Stratex Networks has added new software-enabled feature enhancements to support carrier-class Ethernet operation on the Eclipse™ advanced wireless networking system.

These new features extend Eclipse Gigabit Ethernet transport options by the introduction of *Resilient Wireless Packet Ring* (RWPR™) and advanced layer 2 link aggregation, thanks to a patent-pending fast-switching algorithm developed by Harris Stratex Networks.

RWPR delivers enhanced RSTP (Rapid Spanning Tree Protocol), but whereas RSTP re-convergence times can be up to 5 seconds, RWPR re-convergence times are as low as 50 milliseconds.

The same RWPR fast-switch capability is also used to optimize layer 2 link aggregation, when traffic from a failed link is switched to share the bandwidth available on the remaining link or links.

Principal Benefits

Benefits of the new Eclipse RWPR and link aggregation capabilities include:

- Carrier-class network re-convergence times to better support time-sensitive service level agreements.
- Reliable and consistent RSTP and link aggregation operation, even in the presence of link fading.
- Comprehensive support for scalable bandwidth solutions through the aggregation of one or more additional co-path links in one larger virtual link.
- Support for radio and fiber links; both may be included in Eclipse ring and link-aggregated networks.
- Aggregated links may be used within RWPR ring topologies to support 600+ Mbps rings.
- Lower cost network solutions. Edge devices do not need to support RSTP and/or link aggregation on Eclipse connections.

Eclipse High Speed Gigabit Ethernet Transport

Eclipse extends wireless data connectivity to Gigabit speeds, providing carrier class, high-speed data backhaul.

This Gigabit Ethernet capability is enabled by equipping the Eclipse Intelligent Node Unit (INU) with a DAC GE interface card to support:

- 150, 300 and 600 Mbps Ethernet transport options;
- Licensed frequency bands from 5 to 38 GHz;
- Flexible modulation and bandwidth options;
- Hot standby, diversity and ring protection options;
- Optional cross-pole interference cancellation (XPIC);
- Electrical 1000Base-T and optical 1000Base-LX user connections;
- Extremely low latency, less than 360 microseconds for 2000 byte packets;
- Programmable switching fabric transparent mode, VLAN (secure) mode, or mixed mode;

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- Comprehensive QoS policing and prioritization options (802.1p);
- VLAN tagging (VID and priority mapping).
- QinQ (802.3ac);
- RWPR-enhanced RSTP (802.1d);
- Layer 2 link aggregation (802.3ad);
- Flow control through 802.3x pause-frame option;
- Jumbo frames to 9600 bytes;
- Comprehensive RMON and performance indicators;
- User-friendly configuration tool with a rich graphical interface.

Figure 1: Eclipse GE Solution

RWPR Application and Operation

On a ring network, Rapid Spanning Tree Protocol (RSTP) is typically used to create and maintain the ring structure, which supports service restoration or re-convergence times of 2 to 5 seconds in the event of a break in the ring.

With RWPR protection, this time is reduced to milliseconds, typically less than 100 msec for a 10-node Eclipse ring, or 50 msec for 5 nodes.

RSTP Characteristics

Within Ethernet networks where two or more paths are provided between common end-points, RSTP is implemented to provide redundant path protection.

RSTP creates a 'tree' that spans all switches in the network, forcing redundant paths into a standby, or blocked state to prevent the contention that would otherwise occur with the arrival of looped Ethernet frames.

If subsequently one network segment becomes unreachable because of a device or link failure, the RSTP algorithm reconfigures the tree to activate a standby path.

RSTP uses a fast messaging protocol to communicate between switches on the network, to identify the ports involved, and to set ports for a traffic carrying role or a backup (redundant path) role. It is also used to detect link outages among the ports and to reconfigure the network accordingly. This reconfiguration process typically takes up to 5 seconds, meaning traffic is interrupted for this period.

Enhanced RSTP using RWPR

Eclipse RWPR-enhanced RSTP is now integrated within the L2 switch contained in the DAC GE plug-in. External RSTP switches are not required.

Unlike a typical RSTP implementation (which involves a progressive exchange of messages between all nodes, beginning with those immediately adjacent to the failure point), RWPR uses a unique fast-failure detection mechanism to rapidly and reliably detect a failure on a transport channel, and to then communicate immediately with participating RSTP ring nodes when a ring topology change is required.

RWPR failure detection acts independently of any intermediate hops (Eclipse repeaters or external switches) to provide an end-to-end solution.

RWPR operation is proprietary to Harris Stratex Networks, it is not compatible with equipment from other vendors.

Figure 2 illustrates a basic Eclipse 150 Mbps RWPR ring. Each network node comprises a single INU populated with two RAC plug-ins and one DAC GE.

Figure 2: Eclipse 150 Mbps RWPR Network

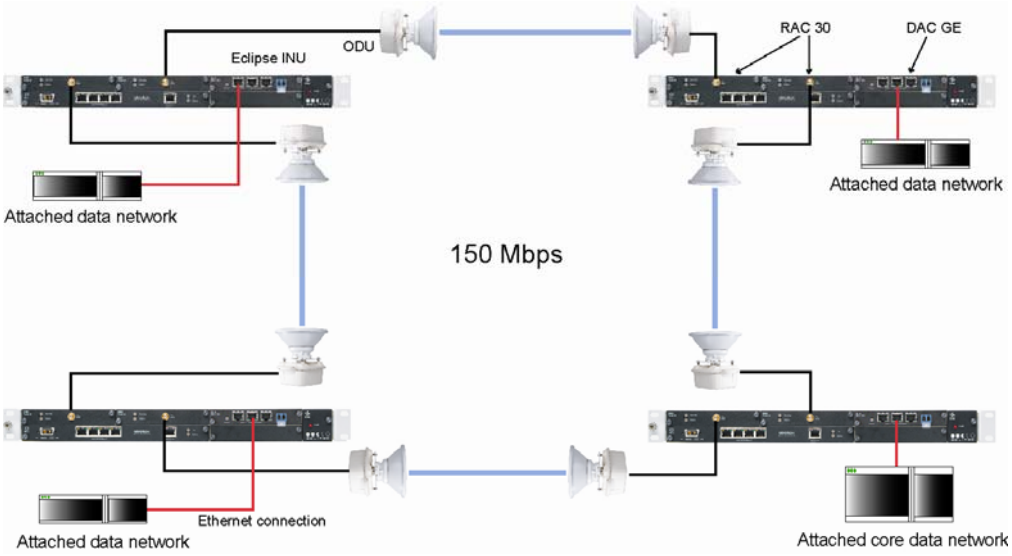
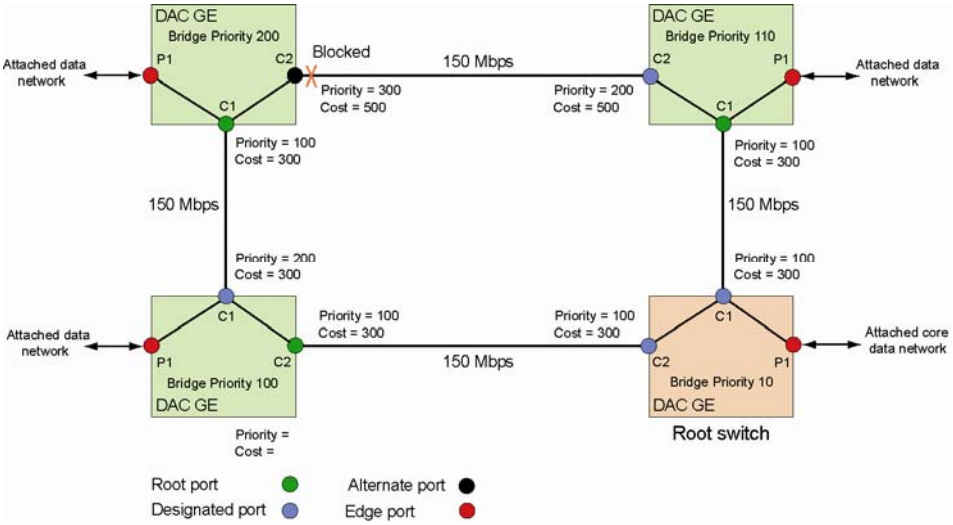


Figure 3 illustrates possible DAC GE RWPR settings at each of the 150 Mbps network nodes shown above. The settings are used to ensure election of the root switch at the network core, and to establish the preferred topology on the remaining switches.

Figure 3: Eclipse RWPR Switch Network



Eclipse Link Aggregation

Introduction

The same fast failure detection capability used for RWPR is also utilized to support fast-switched link aggregation.

- Link aggregation groups two or more radio links to operate as a single virtual link with a traffic capacity that is the sum of the individual link capacities.
- Traffic streams transiting the virtual link are split between the physical links based on their source and destination MAC addresses and the 'aggregation key' allocated to each of the physical links. This splitting prevents the occurrence of an Ethernet loop, even though all traffic is sent and received on a common LAN interface at each end of the virtual link.
- Should one of the links fail, the affected traffic is automatically redirected onto the remaining link, or links.
- In the event the remaining link or links do not have the capacity needed to avoid a traffic bottleneck, appropriate QoS settings are used to prioritize traffic such that all high priority traffic is maintained. The pause-frame option, if enabled, can help prevent traffic congestion.
- When a link within an aggregated group is returned to service the keying process restores equitable load sharing across all links.

Benefits

Capacity Where more capacity is required than can be provided by one link, another parallel link can be added. This is particularly relevant to microwave radio links where available channel capacities typically restrict maximum throughputs to 150 Mbps on the sub 18 GHz bands, or 300 Mbps 18 GHz and higher. An added benefit when implemented in conjunction with the Eclipse co-channel XPIC option is that two aggregated 150 Mbps links (300 Mbps total) can be operated on the *same* channel using both vertical and horizontal polarizations.

Redundancy The load sharing provided by two links with link aggregation means that with appropriate traffic priority settings all high priority data will continue to be sent should one link fail due to a path or equipment failure. To provide a similar level of redundancy without aggregation, hot-standby or diversity protection is required, but with such protection the standby equipment is not used to pass traffic.

Link Aggregation Examples

Figure 4 illustrates basic Eclipse link aggregation using two 150 Mbps links to create a single 300 Mbps data connection. The links may be operated on adjacent channels, or co-channel using the RAC 40 XPIC option.

Figure 4: Eclipse Link Aggregation: 300 Mbps using 2x150 Mbps links

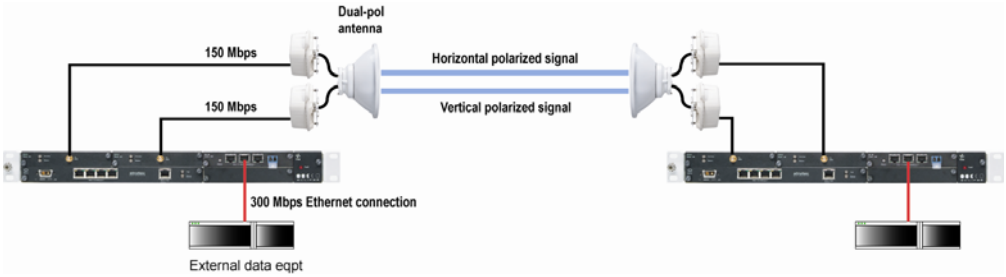
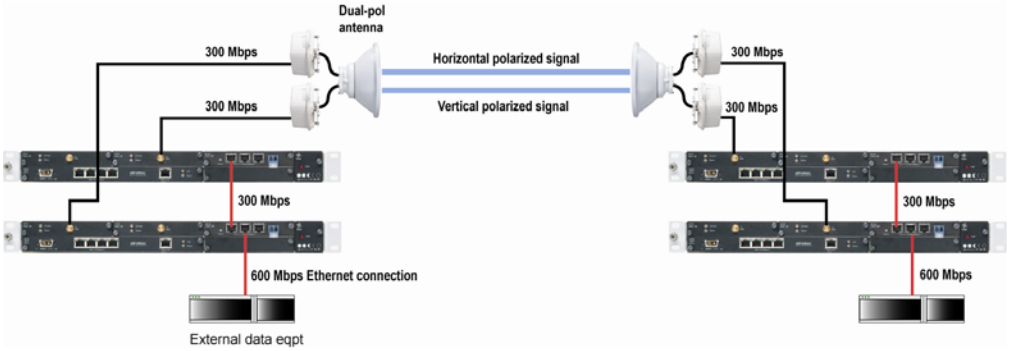


Figure 5 illustrates Eclipse link aggregation using two 300 Mbps links to support a single 600 Mbps customer interface. The links are operated on adjacent channels. Eclipse link aggregation may also be used with other configurations, such as four paralleled 150 Mbps links, or a 300 Mbps link with one or two 150 Mbps links.

Figure 5: Eclipse Link Aggregation: 600 Mbps using 2x300 Mbps links



Link aggregation can also be used in a ring network to support traffic bandwidths to 600 Mbps and higher. Two or more co-path links are first link-aggregated on each hop, and then RWPR ring protected.

Summary

With RWPR™ Harris Stratex Networks delivers carrier-class Ethernet traffic switching on Eclipse networks to aid construction of complex, resilient networks.

- Embedding an enhanced RSTP switching fabric within the radio delivers significantly faster and more consistent convergence times compared to expensive external switching solutions.
- For networking applications which require a highly scalable bandwidth solution, the Eclipse link aggregation groups two or more radio links into one larger virtual link.
- Aggregated links may be configured on RWPR networks to support 600+ Mbps ring applications.
- The fast link detection algorithm used for RWPR and link aggregation ensures optimum network resiliency if one or more links are temporarily lost.
- Direct Eclipse support for RSTP and link aggregation supports lower-cost network solutions.
- Existing users of the DAC GE have full access to the new RWPR and link aggregation capabilities through a software upgrade.