STC 产品介绍

闫铁涛

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议程

- 思博伦仪表介绍
- Spirent TestCenter硬件组成
- Spirent TestCenter软件界面操作介绍
- RFC 2544 介绍
- 接入设备测试方法
- 测试例演示
- Q & A

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思博伦通信主要测试仪表举例

- SmartBits 数据网络测试平台
- Spirent TestCenter 超高端口密度数据测试平台
- Avalanche 网络应用层仿真/性能/网络安全测试仪
- AX4000 宽带网络测试平台
- Abacus 大话务量呼叫测试系统
- DLS 线路仿真器
- ANUE 网络损伤仿真仪
- SR5500 无线通信测试测量仪表
- GSS 卫星定位仿真仪
- LandSlide 3G核心网性能测试仪
- ITest 系列自动化测试工具

思博伦通信在中国

- 中国区总部位于北京。
- 在国内有北京，上海，广州3个代表处
- 在中国有售后支持中心和维修中心
- 售后服务热线：

  800-810-9529/400-810-9529

  010-82330055
- 售后服务邮箱：Support@spirent.com
- 在国内有Global Service 团队，负责专业认证培训（SCPA，SCPT，SCPE），自动化和对外测试服务。有10多位工程师为中国的用户提供专业认证培训和自动化开发服务。

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部分中国客户

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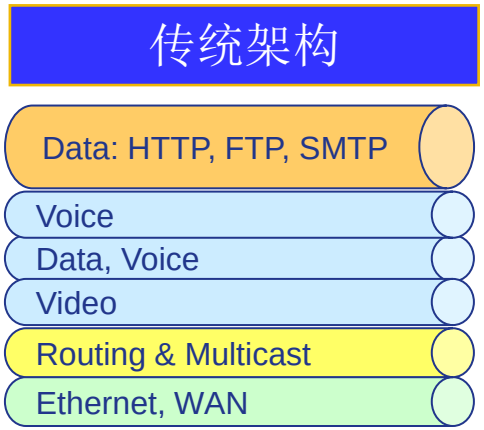
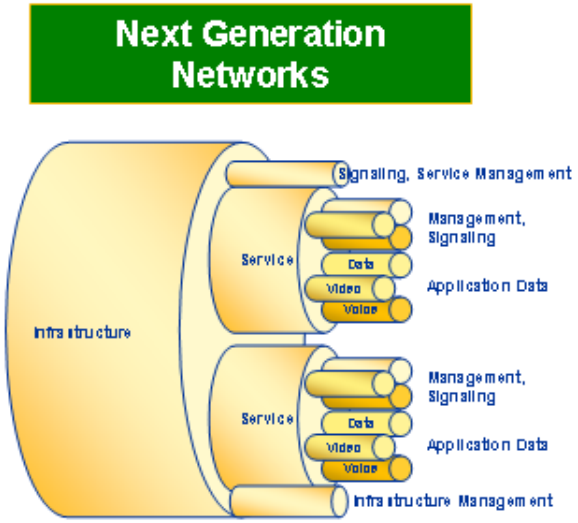
下一代网络的特点和测试面临的挑战

- 下一代网络的特点
  - 融合网络，一个网络上支持多种服务（Triple Play）
  - 端口高密度
  - 设备性能高，交换容量大
  - 高复杂性
- 下一代网络测试面临的挑战
  - 高密度和高扩展性测试
  - 完整的网络测试方案（L2－L7，核心功能，汇聚功能，接入功能）
  - 复杂的测试和高效方便的测试配置
  - 实验室测试环境的真实性
  - 模拟集成的环境(许多故障只有在集成环境下才能出现)
  - 丰富而有效的故障诊断工具
  - 自动化解决方案
  - 多用户测试





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Spirent TestCenter

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Spirent Testcenter 能做什么

- 核心网设备，接入设备，终端设备和网卡的性能和QoS 测试(RFC 2544, RFC 2889,etc)
- 接入测试(PPPoX,DHCP,IGMP/MLD,L2TP and mix of them, for example: IGMP over PPPoE,IGMP over DHCP,IGMP over PPPoEoVlan)
- 交换测试 (STP,RSTP,PVST,RPVST,MSTP)
- 路由测试 (both unicast routing test and multicast routing)
- MPLS 和MPLS VPN VPN(LDP, RSVP-TE, 2547Bis, Martini, Kompella L2,LDP-VLPS, BGP-VPLS)
- 城域以太网测试(城域以太网性能和QoS, SLA, Ethernet OAM, MEF 认证，LACP，PBB/PBT, T-MPLS, PWE3, VPLS)
- IPTV 测试,包括频道切换和视频质量测试
- 一致性测试
- L4-L7 应用层测试(防火墙性能测试，网络攻击测试，真实应用层业务测试，各种应用服务器测试)

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Spirent TestCenter 机箱

SPT-9000

- 144个千兆端口或96个万兆端口在一个标准机箱中
- 主要用于大型工作组或者大规模测试
- 模块热可插拔
- 千兆背板用于控制和结果
- 冗余电源，LCD，模块化设计

40/100GE

SPT-2000 / 2000HS

- 24个千兆端口或16个万兆端口在一个便携机箱
- 模块热可插拔
- 千兆背板用于控制和结果

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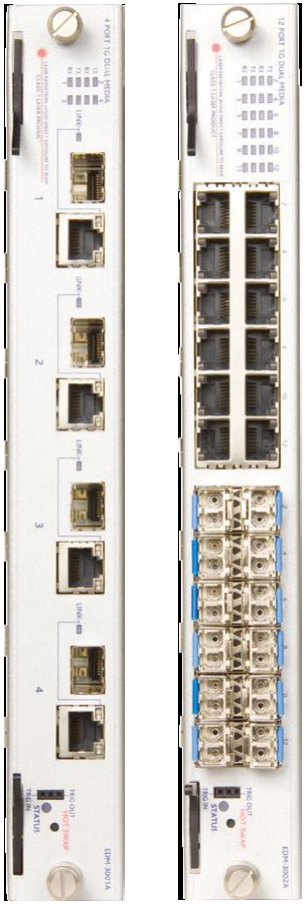
STC 千兆测试模块

EDM-1002B EDM-1003B EDM-2002B EDM-2003B



CM-1G-D4 CM-1G-D12

CPU-5002A

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STC 万兆测试模块

CV-10G-S8

CV-10G-S2

CM-10G-S2

CPU-5003A

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STC 万兆接口测试模块

MX-10G-S2

MX-10G-S4

MX-10G-S8

- DX-10G-S32

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STC 其他接口测试模块

NG-100G-F2

CV-8GFC-S4

UPY-2001A

UPY-2002A

WAN-2002A

WAN-2003A

XFP-4004A

SFP-4001A

SFP-4002A

- XFP-4004A个性化板、OC-192c或STM-64c
- SFP-4001A个性化板、OC-48c/12c/3c或STM-16c/4c/1c
- SFP-4002A　ATM个性化模块、OC-12c/3c或STM-4c/1c

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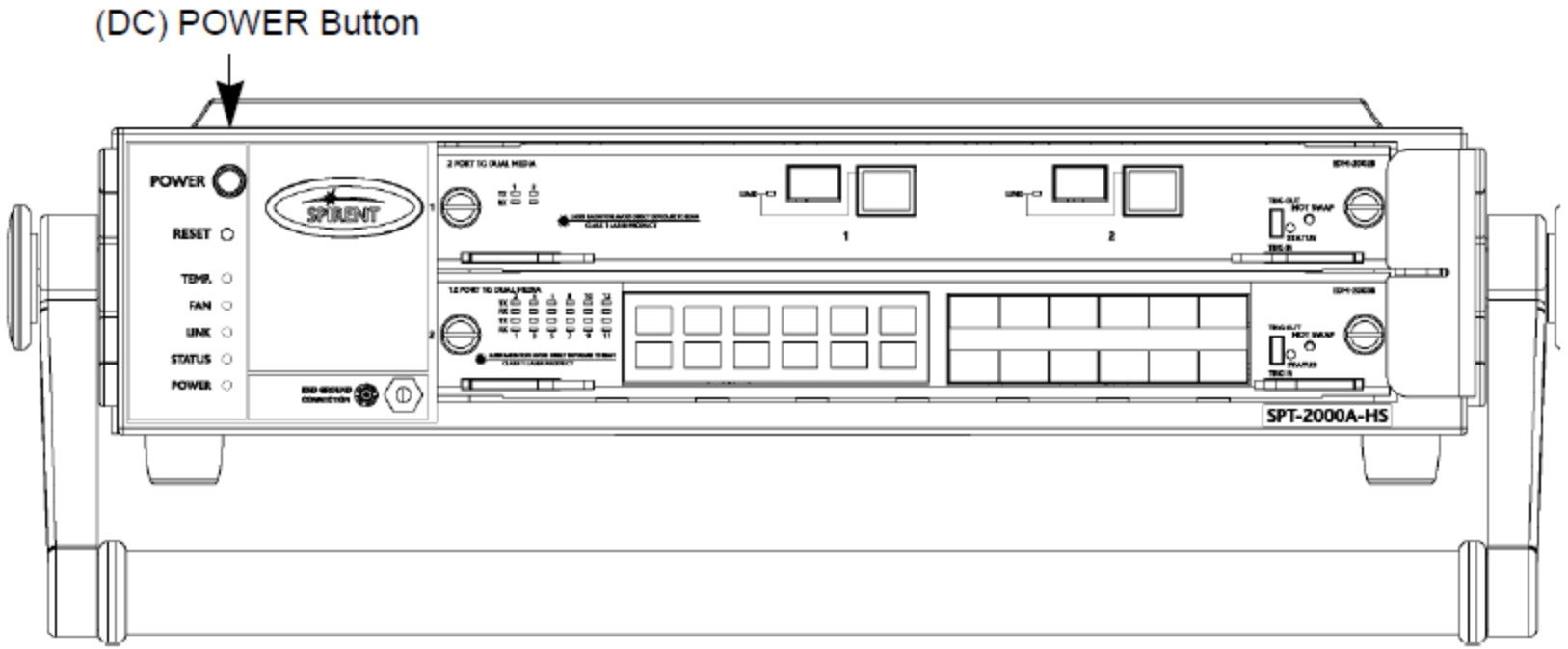
CHS-2000A-HS前面板



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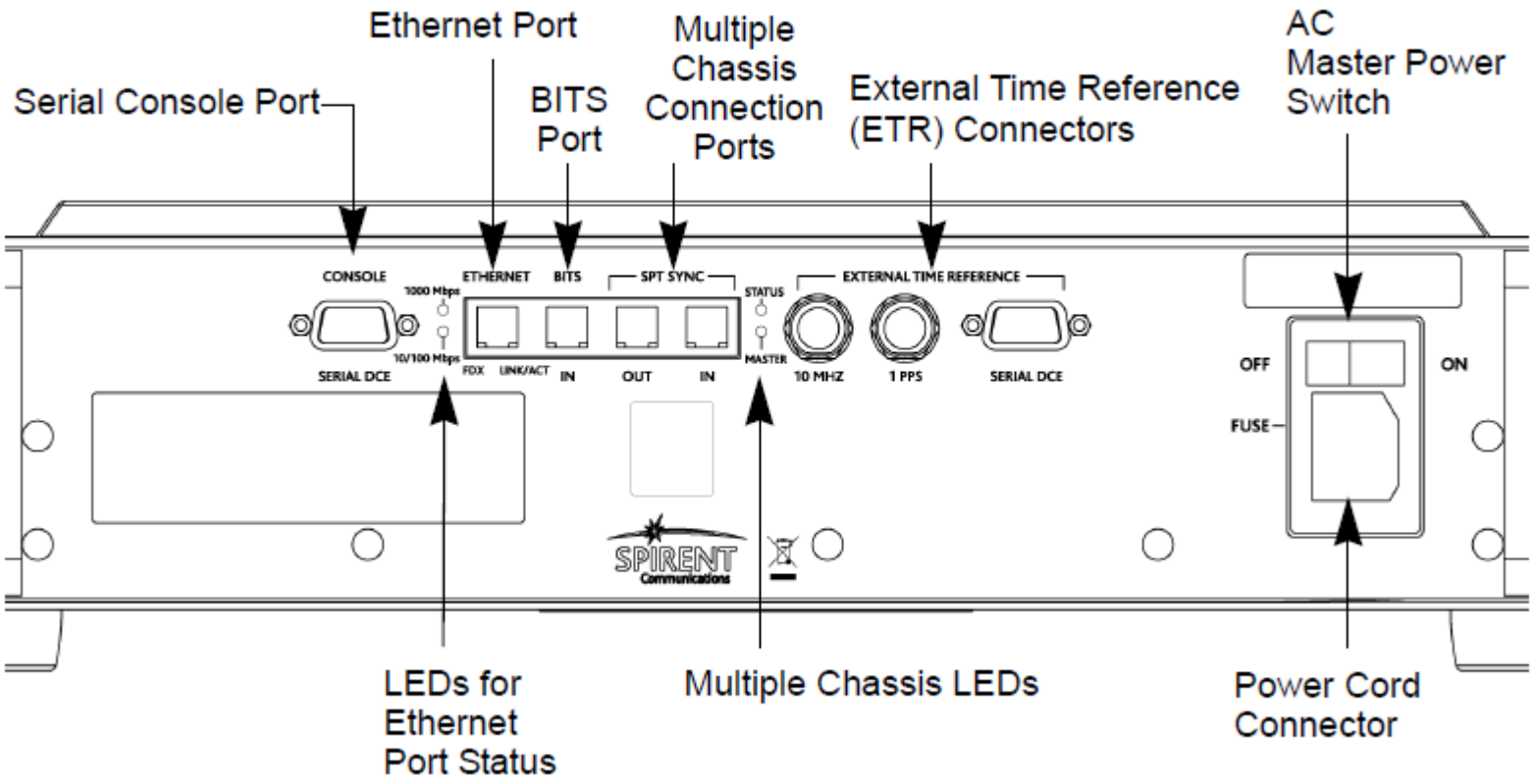
CHS-2001A-HS 机箱连接



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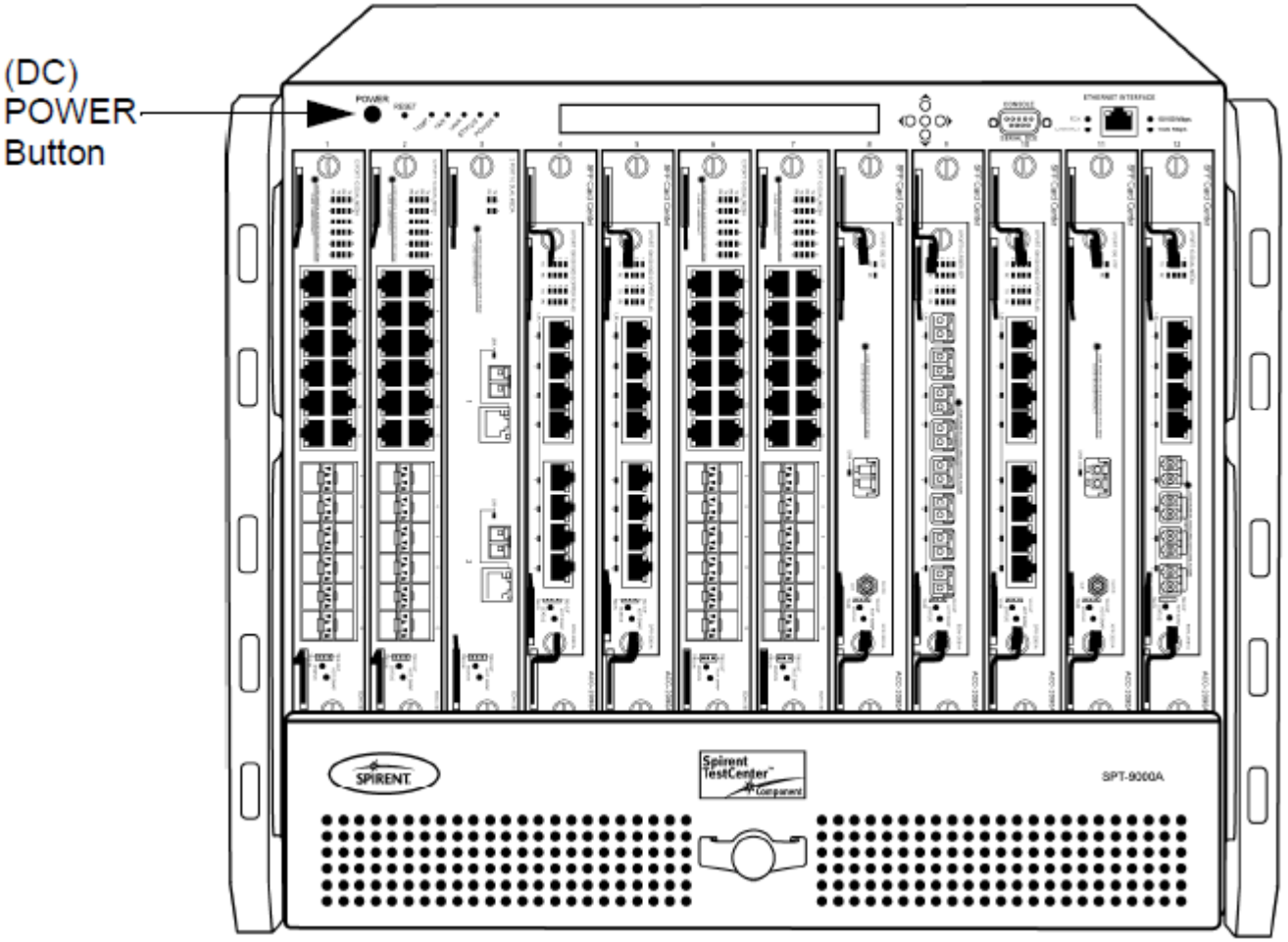
CHS-9000A 前面板



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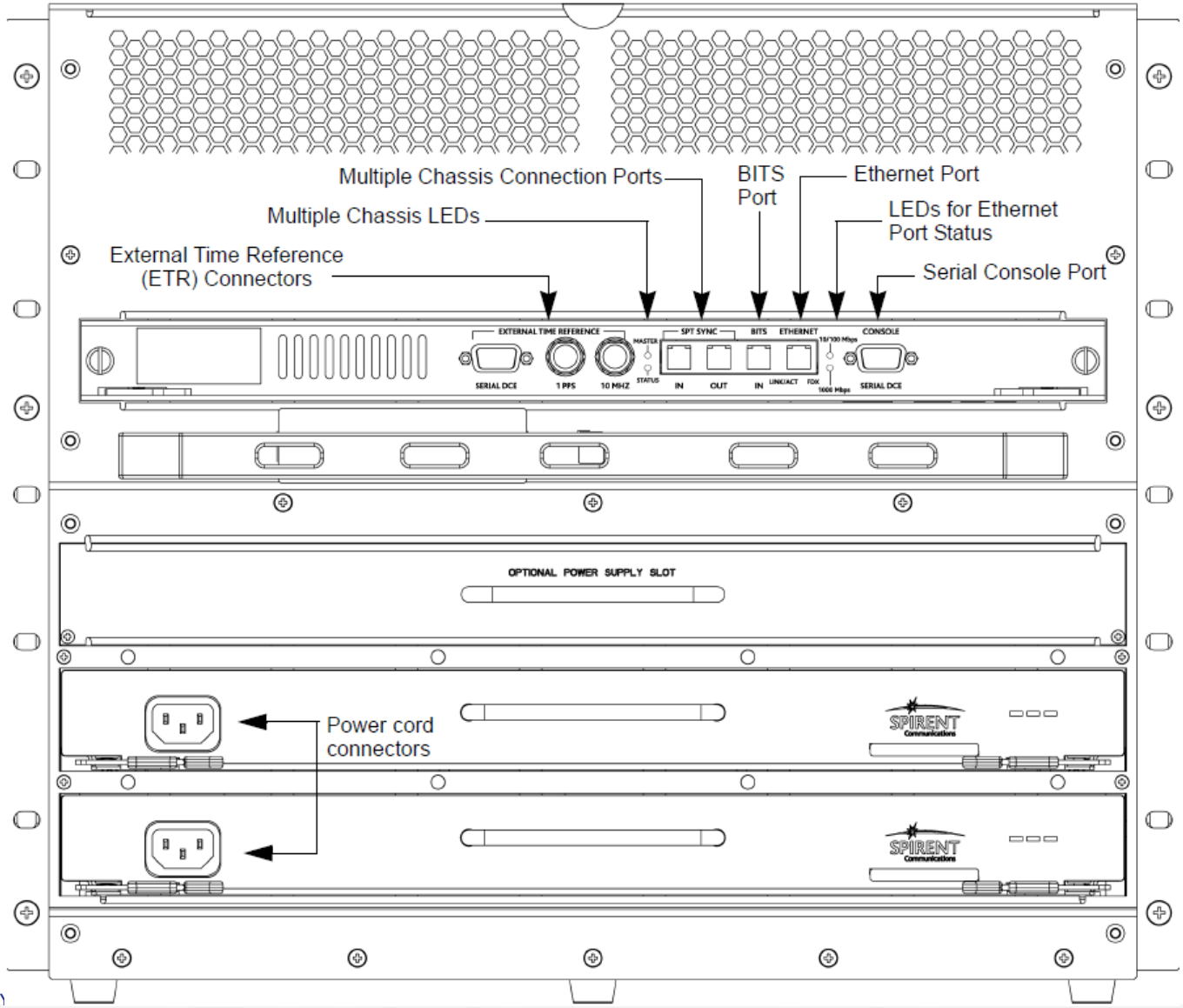
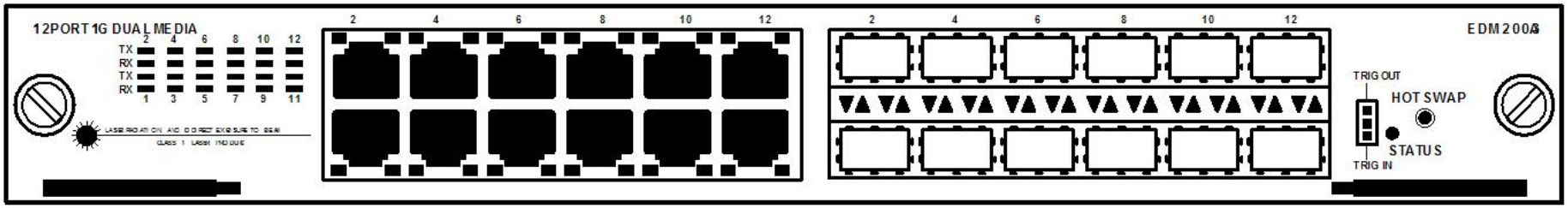
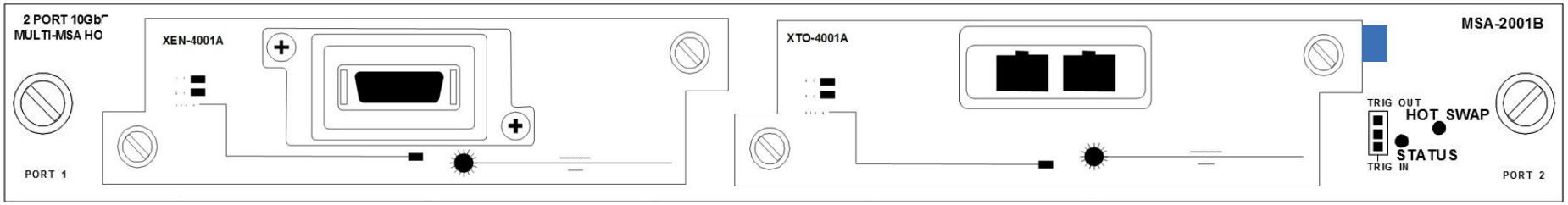
CHS-9000A 机箱连接



Spirent TestCenter 测试模块操作

- 模块指示灯；
- 所有模块可热插拔；
- 光模块支持情况





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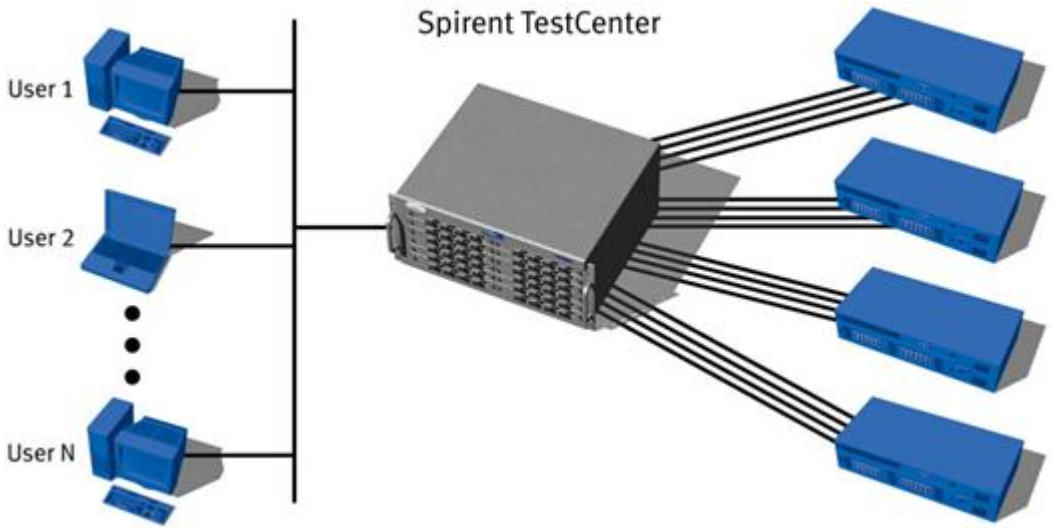
STC 系统管理

- 管理网络与测试网络；
- 多用户操作；
- 软件license是基于机箱的；
- STC 软件 与Firmware 版本必须匹配



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STC 管理

- STC 客户端软件
  - Support.spirent.com下载 或者 3.60之后的版本支持从机箱下载
- 连接STC机箱；
- 占用STC端口；
- 设备信息查看：Equipment Information
- 软件许可管理：License management
- STC 升级与Firmware 管理

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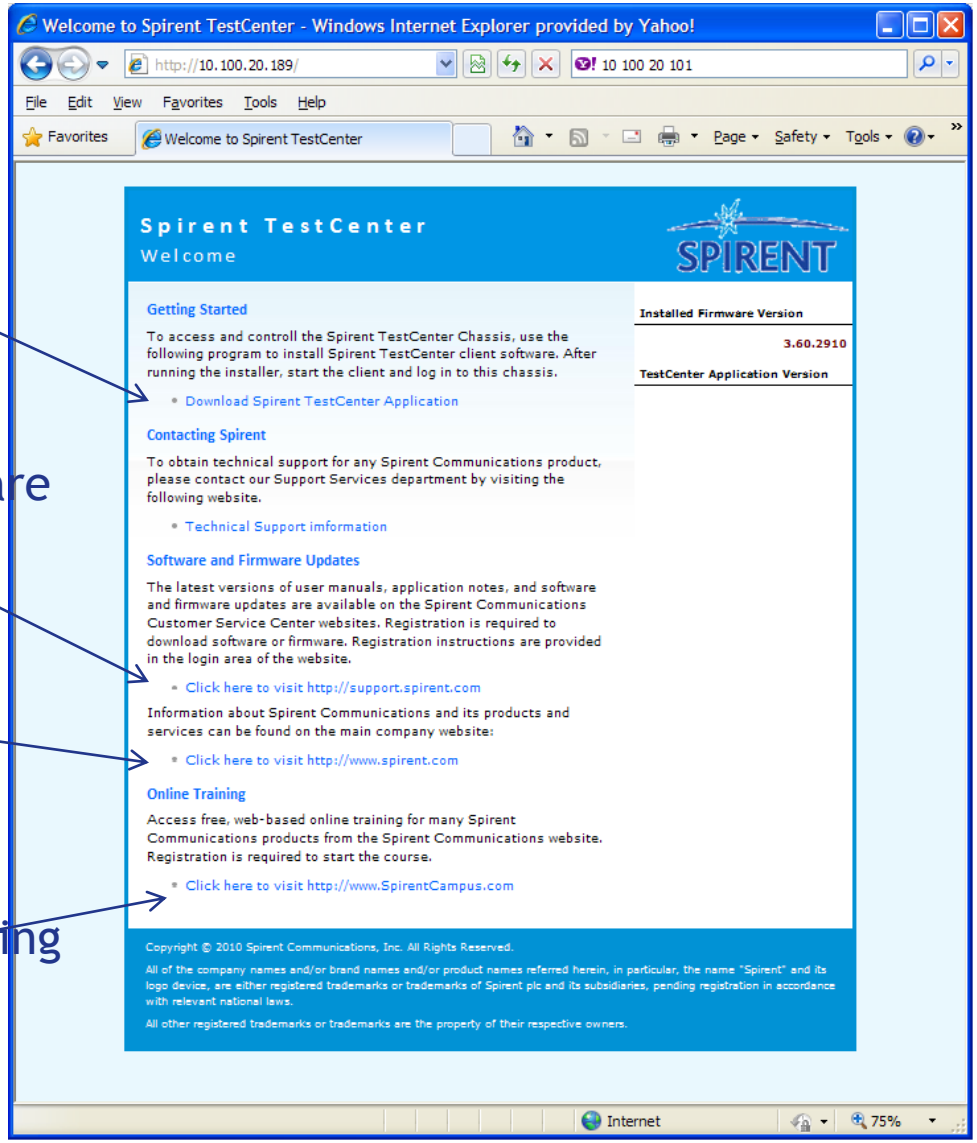
WebClient Example

Download Client

Download Firmware

Download Docs

Access Online Training



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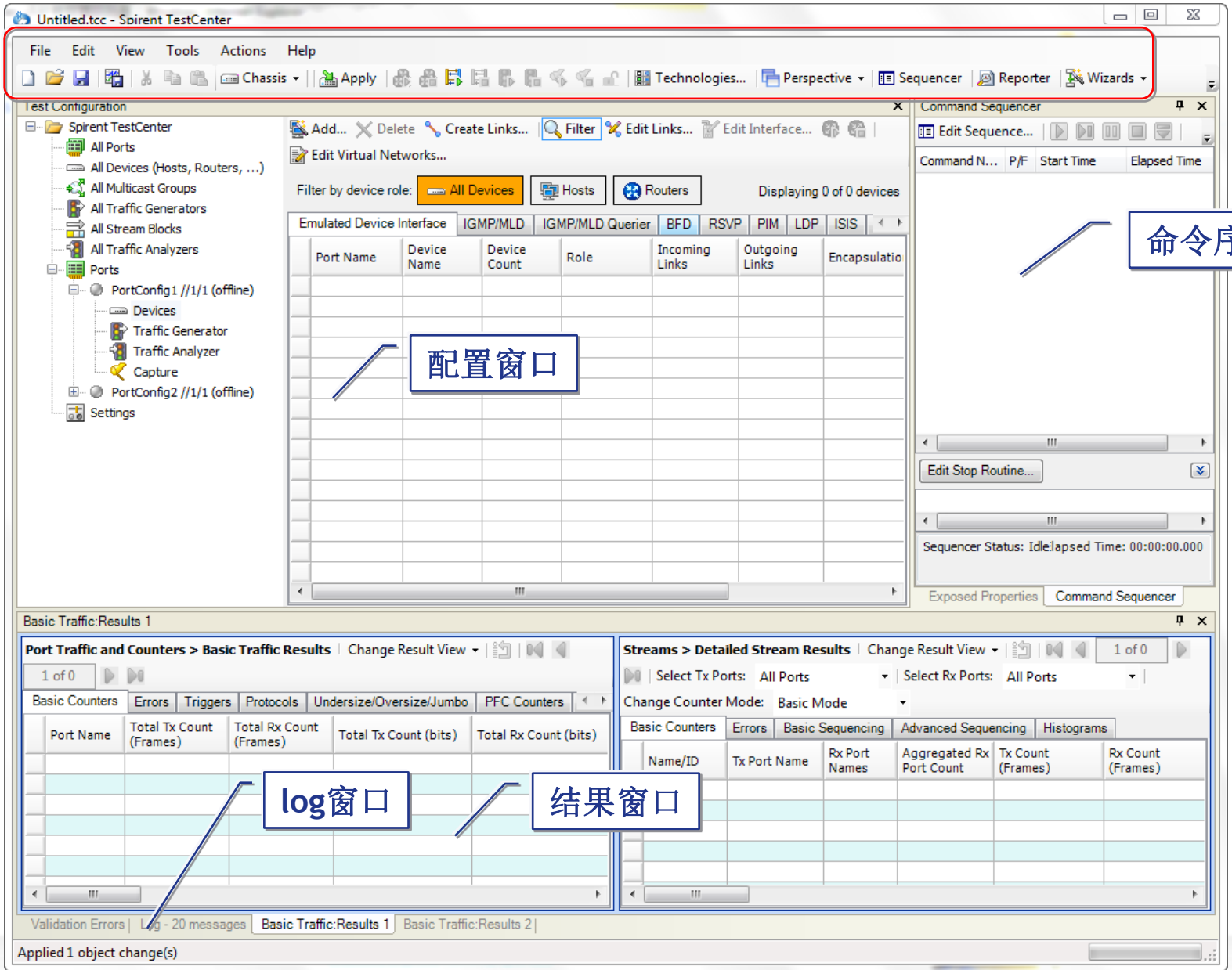
Spirent TestCenter软件界面



Spirent TestCenter软件界面

- 菜单
- 工具栏
- 配置窗口
- 结果窗口
- Log 窗口
- Command Sequencer窗口

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Spirent TestCenter软件—基本概念

- Device Block
- Stream Block
  - Bound Stream Block
  - Raw Stream Block
- 发包调度模式

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Device

- Device 是在端口上配置的一系列的节点：Endpoints或者Device Object. 类似于PC节点或者路由器设备接口等；
- Device 的角色（role）
  - Host Vs. Router
- Host的用途：
  - 用于创建Traffic 是设定的源/目的的节点
  - 支持PC终端和最后一条网络设备或服务器之间的协议交互（例如：IGMP/PPPOX/IPTV/DHCP/SIP/L2TP/IPV6等）
  - 模拟3层或2层VPN里面的终端节点
  - ARP/Ping 的相应
- Router 的用途：
  - 用于模拟路由器/交换机的接口或设备
  - 模拟路由协议与被测设备进行路由协议相关的交互（例如：RIP/OSPF/BGP等。）

DeviceBlock

- Device Block 就是具有相同特征，并且按照一定规律变化的设备的集合；

No	Port	Name	EthIIIf1.SrcMac	VlanIf1.VlanId	Ipv4If1.Addr	Ipv4If1.Gateway
1	PortConfig1 //1/1...	Device 1	00:10:94:00:00:01	100	1.1.1.1	1.1.1.1
2	PortConfig1 //1/1...	Device 1	00:10:94:00:00:02	100	1.1.1.2	1.1.1.1
3	PortConfig1 //1/1...	Device 1	00:10:94:00:00:03	100	1.1.1.3	1.1.1.1
4	PortConfig1 //1/1...	Device 1	00:10:94:00:00:04	100	1.1.1.4	1.1.1.1
5	PortConfig1 //1/1...	Device 1	00:10:94:00:00:05	100	1.1.1.5	1.1.1.1
6	PortConfig1 //1/1...	Device 2	00:10:94:00:00:06	101	1.2.1.1	1.2.1.1
7	PortConfig1 //1/1...	Device 2	00:10:94:00:00:07	101	1.2.1.2	1.2.1.1
8	PortConfig1 //1/1...	Device 2	00:10:94:00:00:08	101	1.2.1.3	1.2.1.1
9	PortConfig1 //1/1...	Device 2	00:10:94:00:00:09	101	1.2.1.4	1.2.1.1
10	PortConfig1 //1/1...	Device 2	00:10:94:00:00:0a	101	1.2.1.5	1.2.1.1
11	PortConfig1 //1/1...	Device 3	00:10:94:00:00:0b	102	1.3.1.1	1.3.1.1
12	PortConfig1 //1/1...	Device 3	00:10:94:00:00:0c	102	1.3.1.2	1.3.1.1
13	PortConfig1 //1/1...	Device 3	00:10:94:00:00:0d	102	1.3.1.3	1.3.1.1
14	PortConfig1 //1/1...	Device 3	00:10:94:00:00:0e	102	1.3.1.4	1.3.1.1
15	PortConfig1 //1/1...	Device 3	00:10:94:00:00:0f	102	1.3.1.5	1.3.1.1
16	PortConfig1 //1/1...	Device 4	00:10:94:00:00:10	103	1.4.1.1	1.4.1.1
17	PortConfig1 //1/1...	Device 4	00:10:94:00:00:11	103	1.4.1.2	1.4.1.1
18	PortConfig1 //1/1...	Device 4	00:10:94:00:00:12	103	1.4.1.3	1.4.1.1
19	PortConfig1 //1/1...	Device 4	00:10:94:00:00:13	103	1.4.1.4	1.4.1.1
20	PortConfig1 //1/1...	Device 4	00:10:94:00:00:14	103	1.4.1.5	1.4.1.1
21	PortConfig1 //1/1...	Device 5	00:10:94:00:00:15	104	1.5.1.1	1.5.1.1
22	PortConfig1 //1/1...	Device 5	00:10:94:00:00:16	104	1.5.1.2	1.5.1.1
23	PortConfig1 //1/1...	Device 5	00:10:94:00:00:17	104	1.5.1.3	1.5.1.1
24	PortConfig1 //1/1...	Device 5	00:10:94:00:00:18	104	1.5.1.4	1.5.1.1
25	PortConfig1 //1/1...	Device 5	00:10:94:00:00:19	104	1.5.1.5	1.5.1.1

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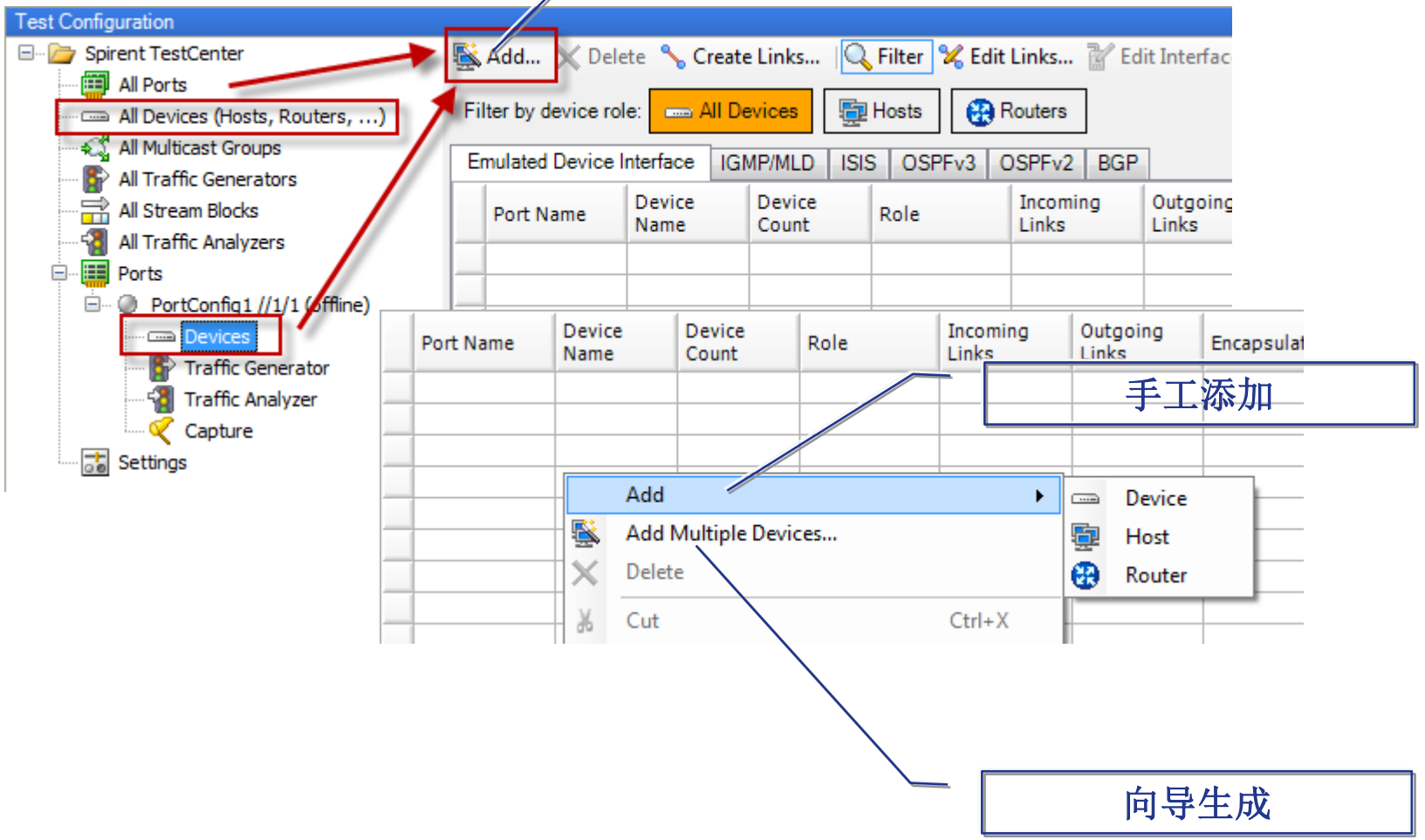
DeviceBlock的生成

向导生成



手工添加

向导生成

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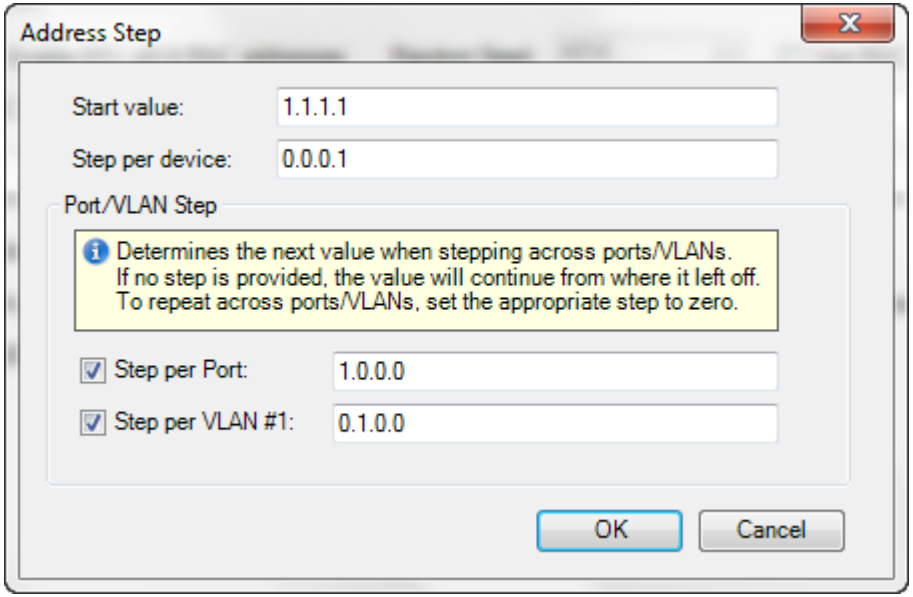
Device Block 配置举例

- Device count
- Device Block mode
- Steps



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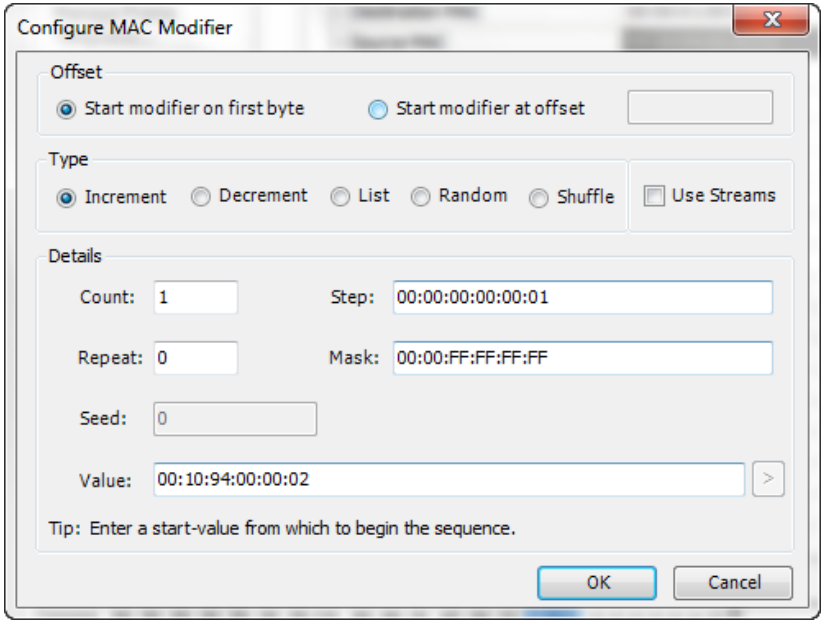
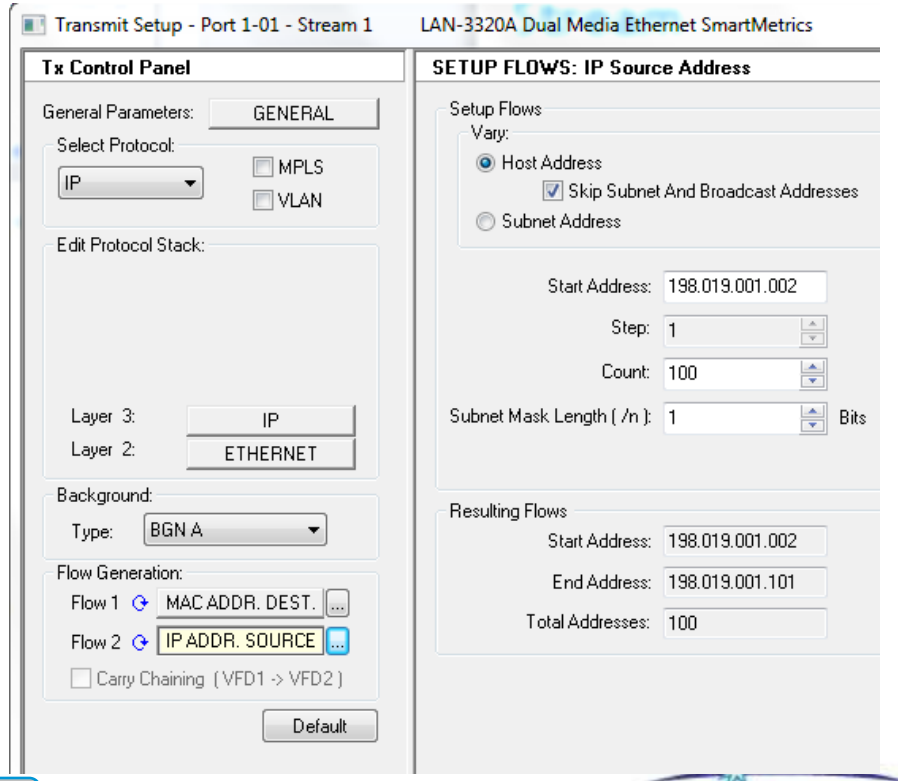
Stream

- Flow：Flow有独立特征的数据包的序列；
- Stream：有一定规律变化flow的集合；
- STC Stream vs. SMB Stream





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StreamBlock 类型与配置

- StreamBlock是一组具有相同基本参数Stream的集合
  - Frame length
  - Types of Header
  - Load/Rate
  - Duration
  - Priority
  - Fill Pattern
- Bound StreamBlock
- Raw StreamBlock

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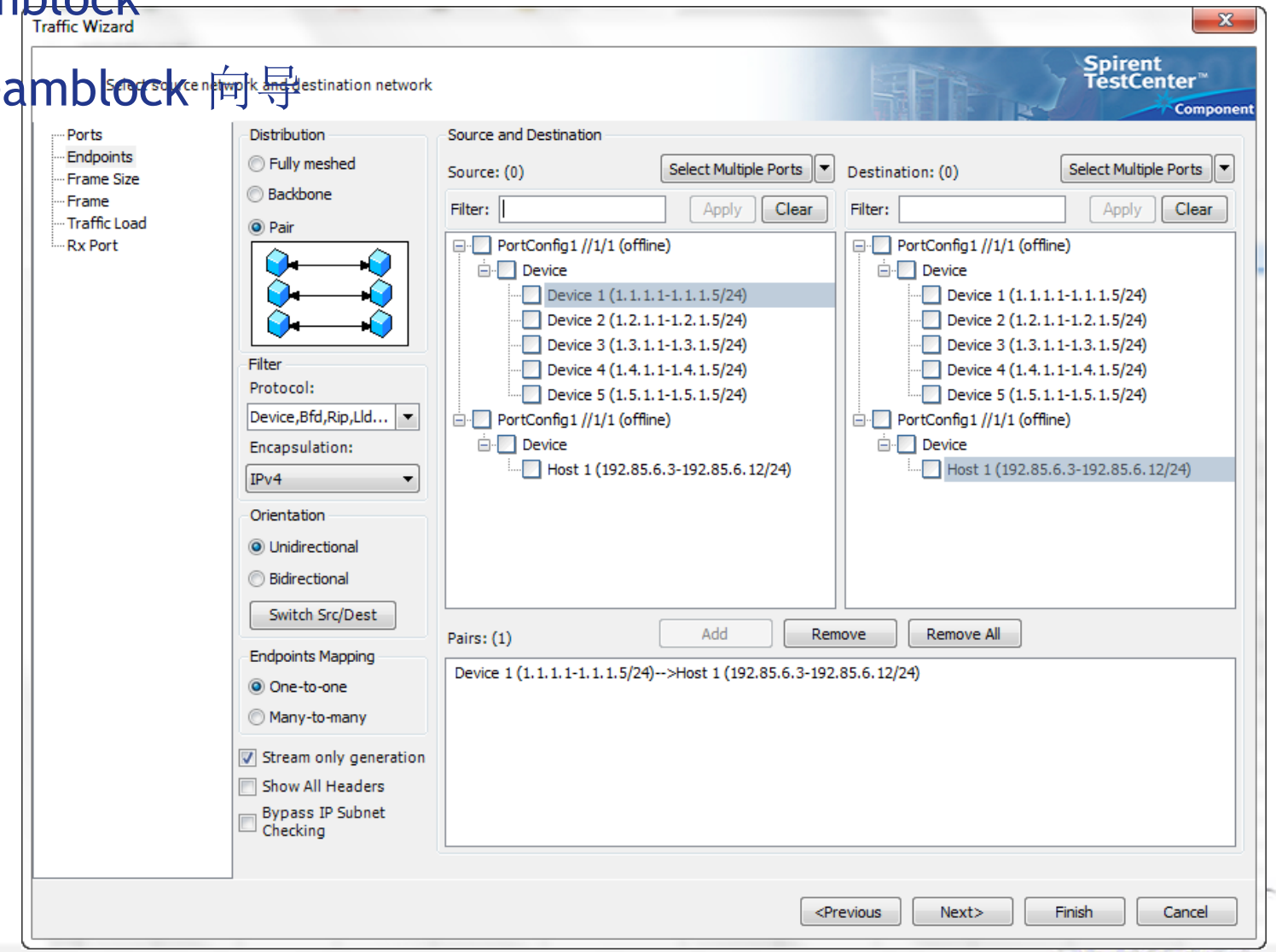
StreamBlock 的生成

- Raw streamblock
- Bound Streamblock 向导



The Spirent Signature Field

Inverse of Sequence Byte0	Stream ID (MSB) Byte3	Stream ID Byte2	Stream ID Byte1			
Stream ID Byte0	Sequence (MSB) Byte5	Sequence Byte4	Sequence Byte3			
Sequence Byte2	Sequence Byte1	Sequence Byte0	Timestamp (2.5ns) Byte3			
Timestamp (2.5ns) Byte2	Timestamp (2.5ns) Byte1	Timestamp (2.5ns) Byte0	TS (2.5ns) (bits 37:32)	PR BS	las t	
Crc16 Byte1	Crc16 Byte0	TCP UDP Checksum Cheater (Byte1)	TCP UDP Checksum Cheater (Byte0)			

- Now 20 bytes, but oriented at the end of the *Datagram* (IP packet)
  - Automatically compensates for Ethernet padding
- 32 bits of stream ID (up to 4 billion test streams possible)
- 10 nanosecond resolution
  - May be enhanced to 2.5ns for future modules
- Built in UDP/TCP checksum cheater field
- Signature is scrambled so not to influence repetitive patterns
  - This is useful for HDLC formatted links to keep byte stuffing to a minimum
- PRBS and Last bit are used to indicate a PRBS fill pattern present and timestamp referenced to end of frame

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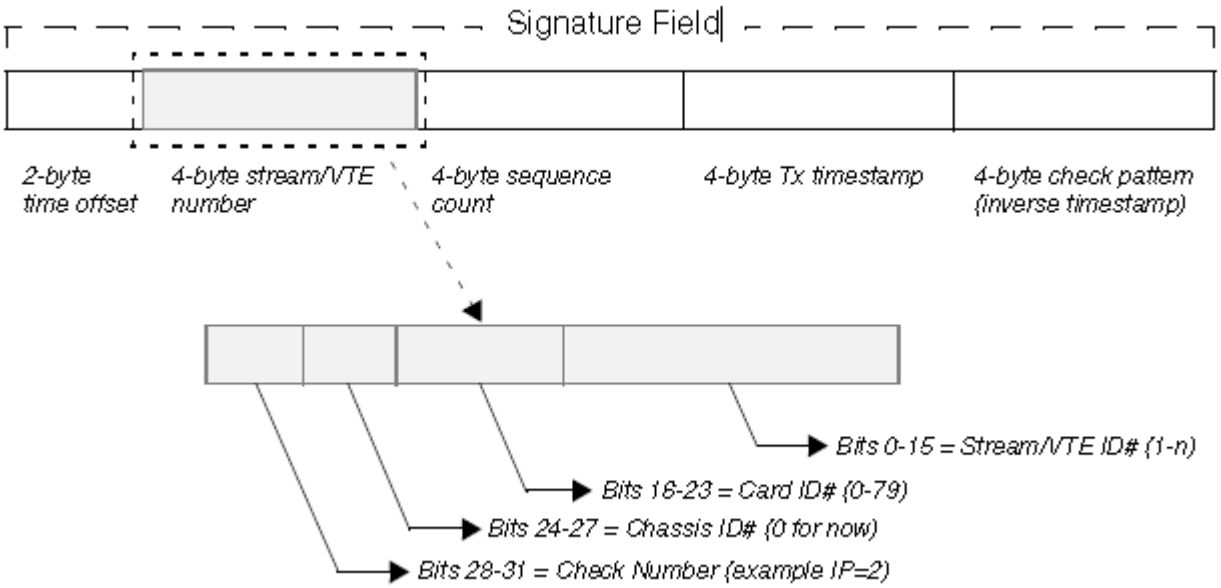
SMB Signature field



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STC 发包调度模式

- Port Based
- Rate Based
- Priority Based
- Manual Based

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Port Based相关参数

- Burst size
- Inter Burst gap
- Inter frame gap

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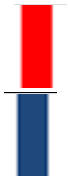
Rate Based mode

- 从端口上看速率是恒定的
- 对于单独的流来说速率是有可能有突发的

Stream Block A

Stream Block B



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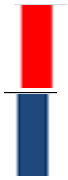
Priority Based Mode

- 从端口上看速率是非恒定的
- 对于单独的流来说，高优先级被优先调度。
- 高优先级的速率基本是恒定的

Stream Block A

Stream Block B



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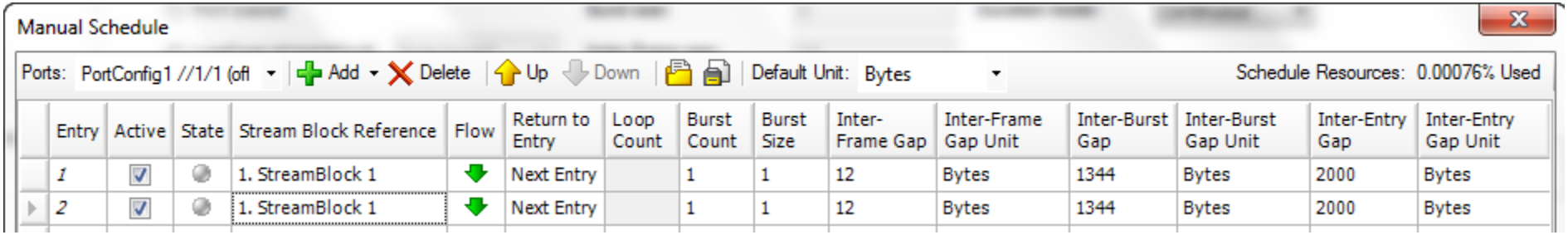
Manual Based

- Inter Frame Gap
- Inter Burst Gap
- Inter Entry Gap
- Next Entry



Entry	Active	State	Stream Block Reference	Flow	Return to Entry	Loop Count	Burst Count	Burst Size	Inter-Frame Gap	Inter-Frame Gap Unit	Inter-Burst Gap	Inter-Burst Gap Unit	Inter-Entry Gap	Inter-Entry Gap Unit
1	☑		1. StreamBlock 1		Next Entry		1	1	12	Bytes	1344	Bytes	2000	Bytes
2	☑		1. StreamBlock 1		Next Entry		1	1	12	Bytes	1344	Bytes	2000	Bytes

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Spirent TestCenter软件—结果查看

- 端口结果统计
- 基于Stream Block结果统计
- 基于Stream 结果统计
- 基于过滤Stream 结果统计
- 感兴趣流结果统计
- 图形统计

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议程

- 思博伦仪表介绍
- Spirent TestCenter硬件组成
- Spirent TestCenter软件界面操作介绍
- RFC 2544 介绍
- 接入设备测试方法
- 测试例演示
- Q & A

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测试方法学概述

- A **Conformance** test consists of verifying the device's behavior in correspondence with the standards, conventions, rules.
- A **Functional** test consists of verifying that the device does everything it is supposed to do (i.e., protocol support, filters, management, etc.).
- A **Performance** test consists of "stress testing" the device to see how it behaves under loaded conditions.
- A **Passive** test consists of Protocol analysis. This can be accomplished either intrusively or non-intrusively.

RFC 2544 概述

- "Benchmarking Methodology for Network Interconnect Devices"
- Describes various parameters used for the test (i.e., frame sizes)
- Benchmarking Tests described by RFC 2544 are as follows:
  - Throughput——吞吐量
  - Latency——时延
  - Frame Loss Rate——丢帧率
  - Back-to-Back Frames——背对背
  - Systems Recovery
  - Reset

Throughput ——吞吐量

- 吞吐量：在不丢包或者小于允许丢包比例情况下被测试转发设备最大传输速率
- 每次试验，测试仪按照指定帧长和速率发出流量，被测设备转发。测试仪接收端口进行收包统计，如果有丢包进行降速，如没有丢包增加发包速率，再次测试
- 吞吐量查找算法：RFC2544没有明确规定查找算法，通常采用二分法。STC RFC2544支持：二分法、步进方式和组合方式
- 标准建议测试帧长： 64, 128, 256, 512, 1024, 1280, 1518
- 标准建议测试时间：大于等于60秒

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Latency ——时延

- 时延：测试被测设备平均、最大、最小的转发时延
- Latency on STC：时延分布区间
- Latency 类型
  - 直通转发
  - 存储转发
- STC 特性：Jitter ——时延抖动

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Frame Loss Rate——丢帧率

- 丢帧率：在固定负载情况下，被测设备所丢帧的比例
- 通常从高向低速率测试，如果最高的两次测试没有出现丢帧，则结束测试
- 丢帧率 VS 吞吐量

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Back-to-Back 背对背

- 背对背：用来测试被测设备所能接收转发背对背以太网帧的能力，所谓背对背以太网报文是指报文之间帧间隙最小（12bytes）。
- 通常用来测试被测设备的缓存能力，但对于当今线速转发的路由器或者交换机，较少测试该项目。

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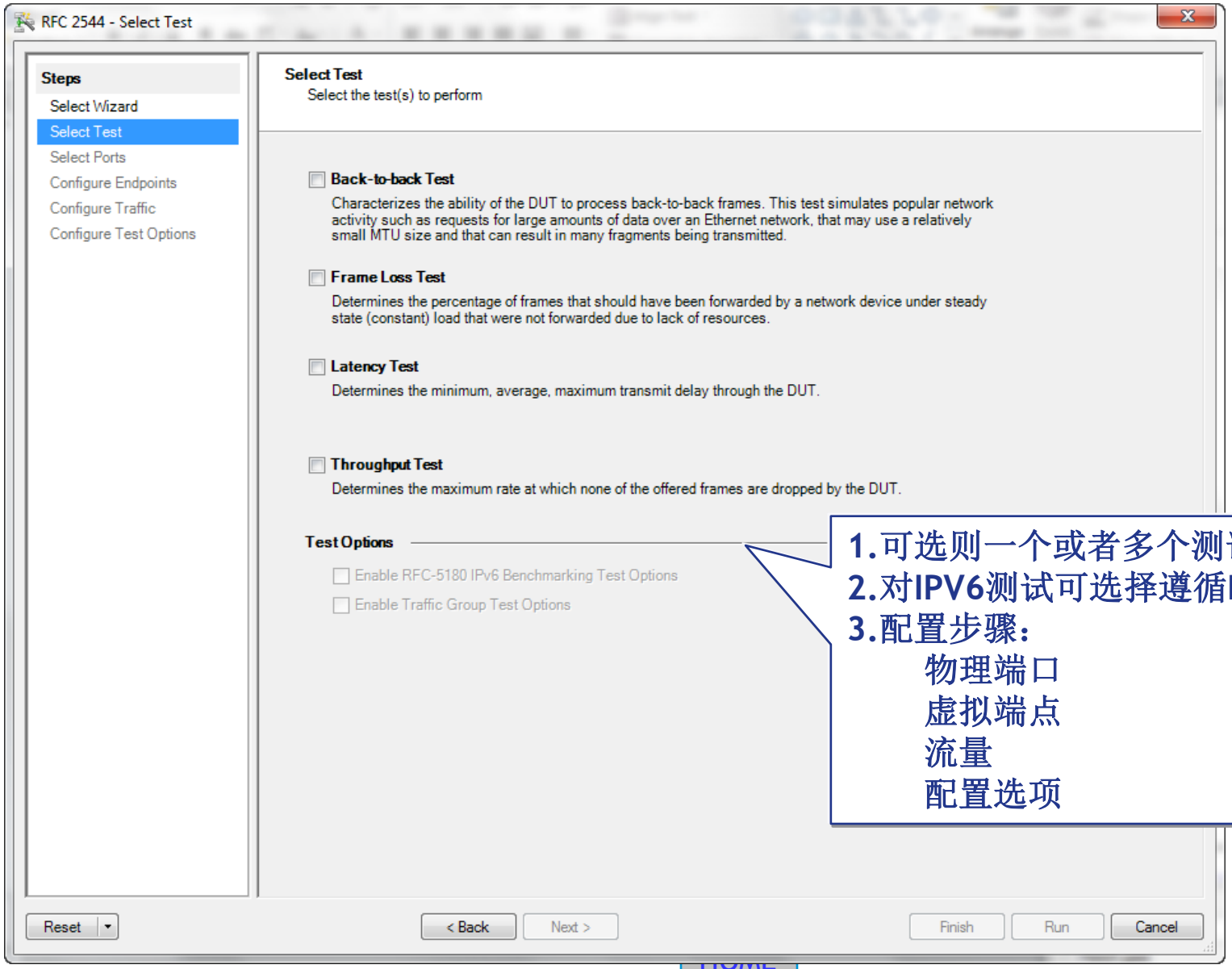
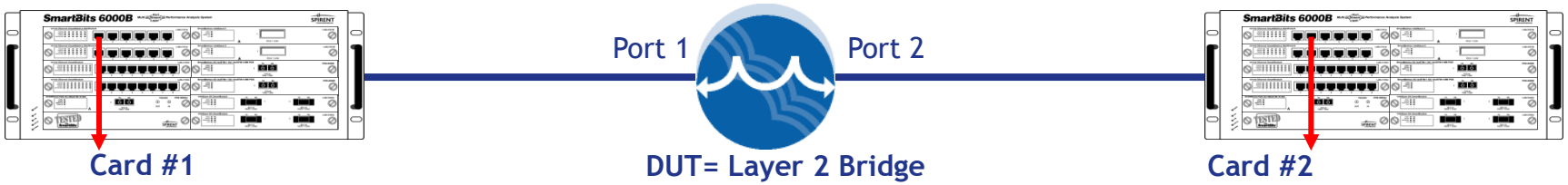
STC RFC 2544 测试



1.可选则一个或者多个测试顺序进行；
2.对IPV6测试可选择遵循RFC5180
3.配置步骤：
- 物理端口
- 虚拟端点
- 流量
- 配置选项

Layer 2 Learning – "Router Test" Unchecked

- The MAC Address table update shown below occurs at the beginning of a test (i.e., during the Learning Phase).
- Traffic is shown in only one direction (i.e., uni-directional). When you send Bi-directional traffic the table update will occur in both directions.



1. Card # 2 Sends a Learning Packet to Bridge

2. Bridge's MAC Address Table is Updated

3. Card # 1 Sends Traffic to Card # 2

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Layer 3 Learning – "Router Test" Checked

- The exchange below occurs at the beginning of a test (i.e., during the Learning Phase).
- This exchange describes traffic in only one direction (i.e., uni-directional). When you send Bi-directional traffic the exchange will occur in both directions.

Card #1
Protocol=IP
MAC Dest=080002068922
MAC=000000000001
Card IP=192.168.99.2
Router's IP=192.168.99.1

DUT=Layer 3 Router
Protocol=IP
MAC Port1=080002068922
IP Port1=192.168.99.1
MAC Port2=080002898856
IP Port2=192.168.88.1

Card #2
Protocol=IP
MAC Dest=080002898856
MAC=000000000002
Card IP=192.168.88.2
Router's IP=192.168.88.1

1. Card #1 Sends a Packet to Card #2 →
2. Causes Router to ARP Card #2 →
3. Card #2 sends an ARP Reply ←
4. Router's ARP Cache is Updated
5. Card #1 Sends test Packets to Card #2 →

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接入设备测试

- DHCP
  - Server
  - Client
  - Relay Agent
- PPPoX
  - Server
  - Client
- IGMP
  - V1/V2/V3
  - Querier/Client
  - RFC 3918
- 802.1x
- ANCP
- DHCP-PD/V6
  - Server
  - Client
- IPV6 autoconfiguration
- MLD
  - V1/V2
  - Querier /Client
  - RFC 3918
- IPTV

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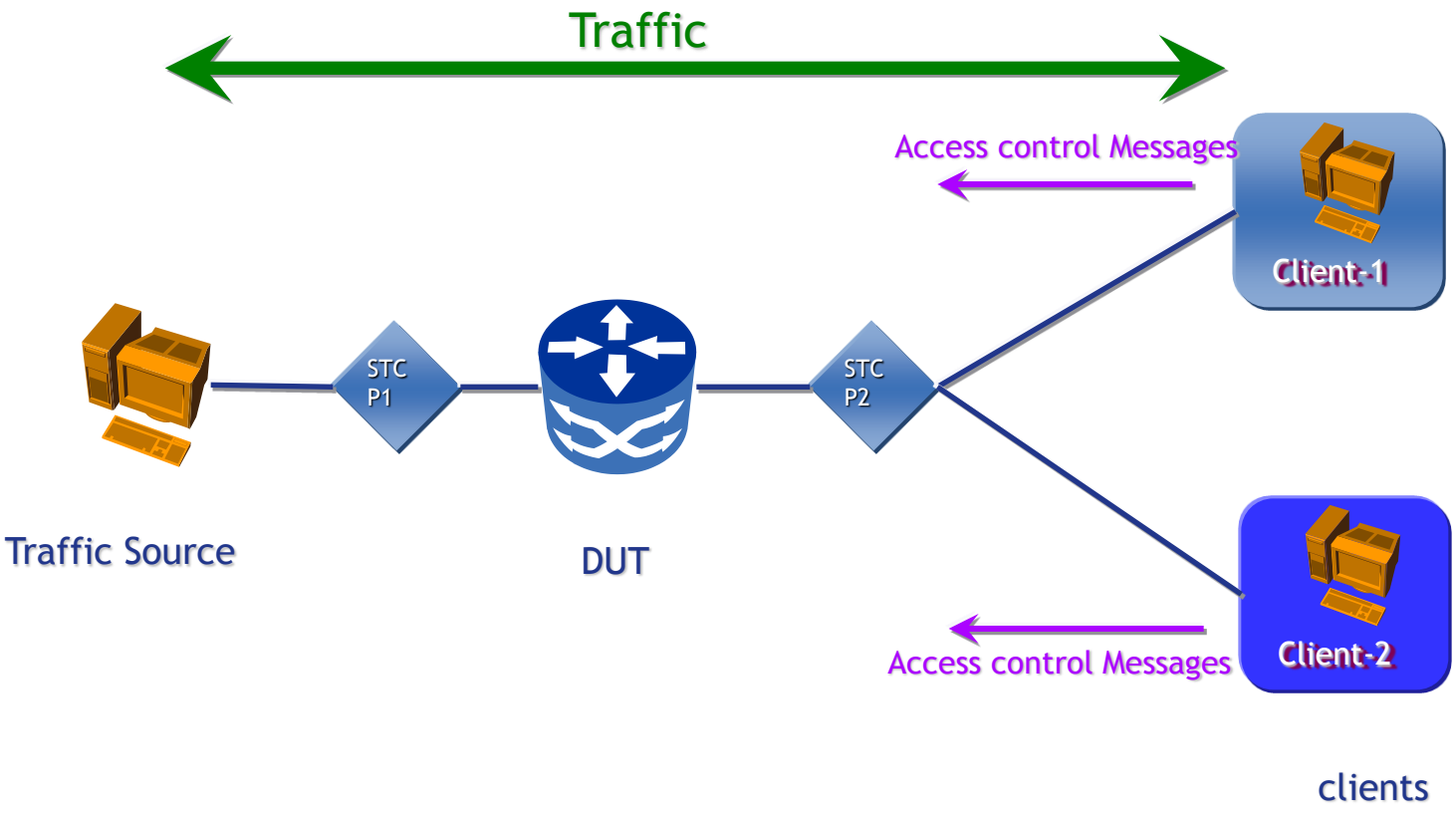
Access Test with STC



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测试步骤

- 主机配置与协议模拟
- 生成流量
- 手工交互式测试
  - 协议模拟与查看结果
  - 发送流量与查看结果
- 命令序列—Command Serquencer在接入测试中的应用

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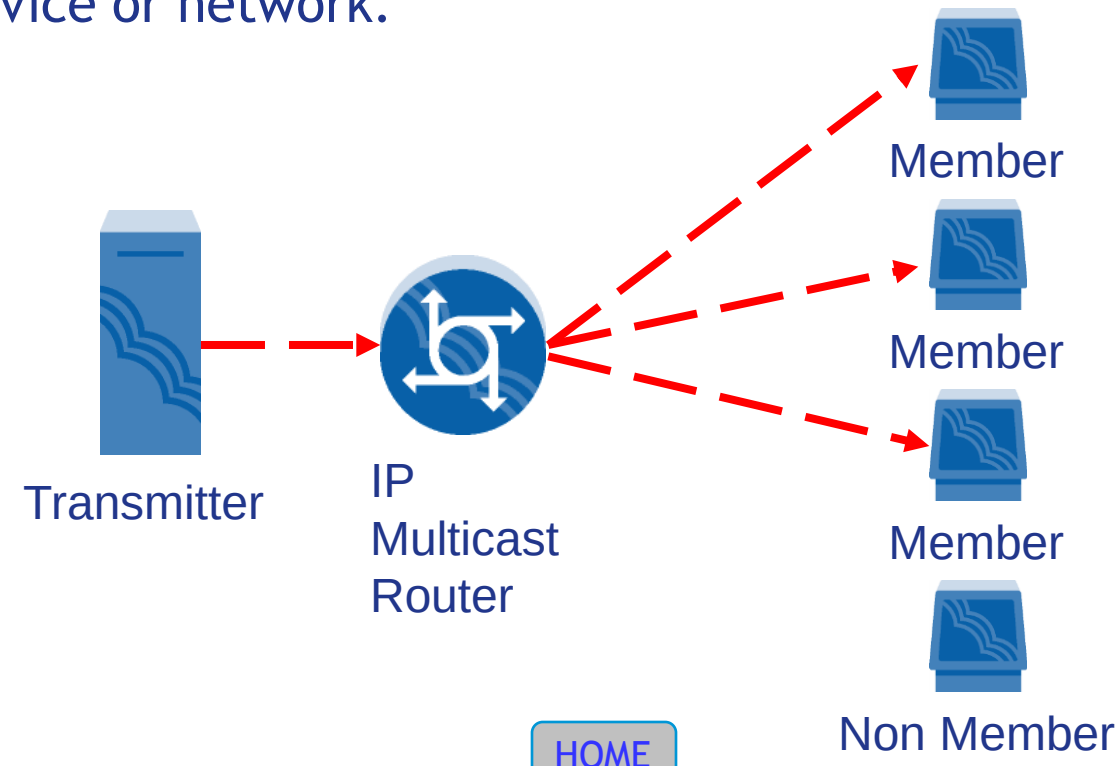
组播测试

- Used to test IP multicast routers, switches, and networks.
- Used to test both Layer 2 and Layer 3 IP multicast devices.
- It consists of automated tests based on RFC 2432.
- Allows you to see the total effect an IP multicast application will have on the device or network.



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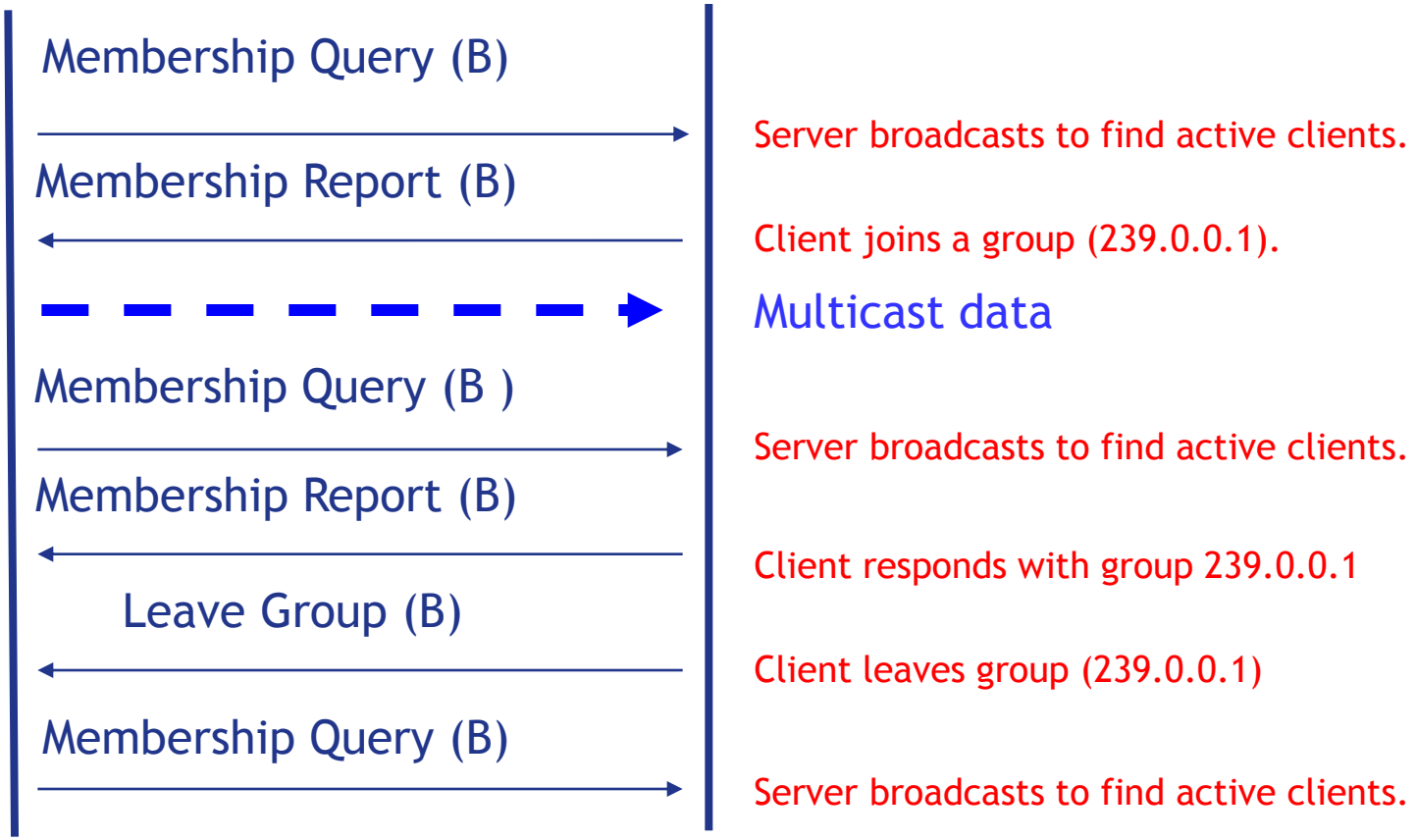
IGMP 协议基本流程



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STC 测试组播

- IGMP Client （Join、Leave）
- IGMP Querier
- IPV4 组播：IGMP V1/V2/V3
- IPV6 组播：MLD V1/V2
- 组播扩展：
  - RFC 3918测试套件
  - IPTV 测试

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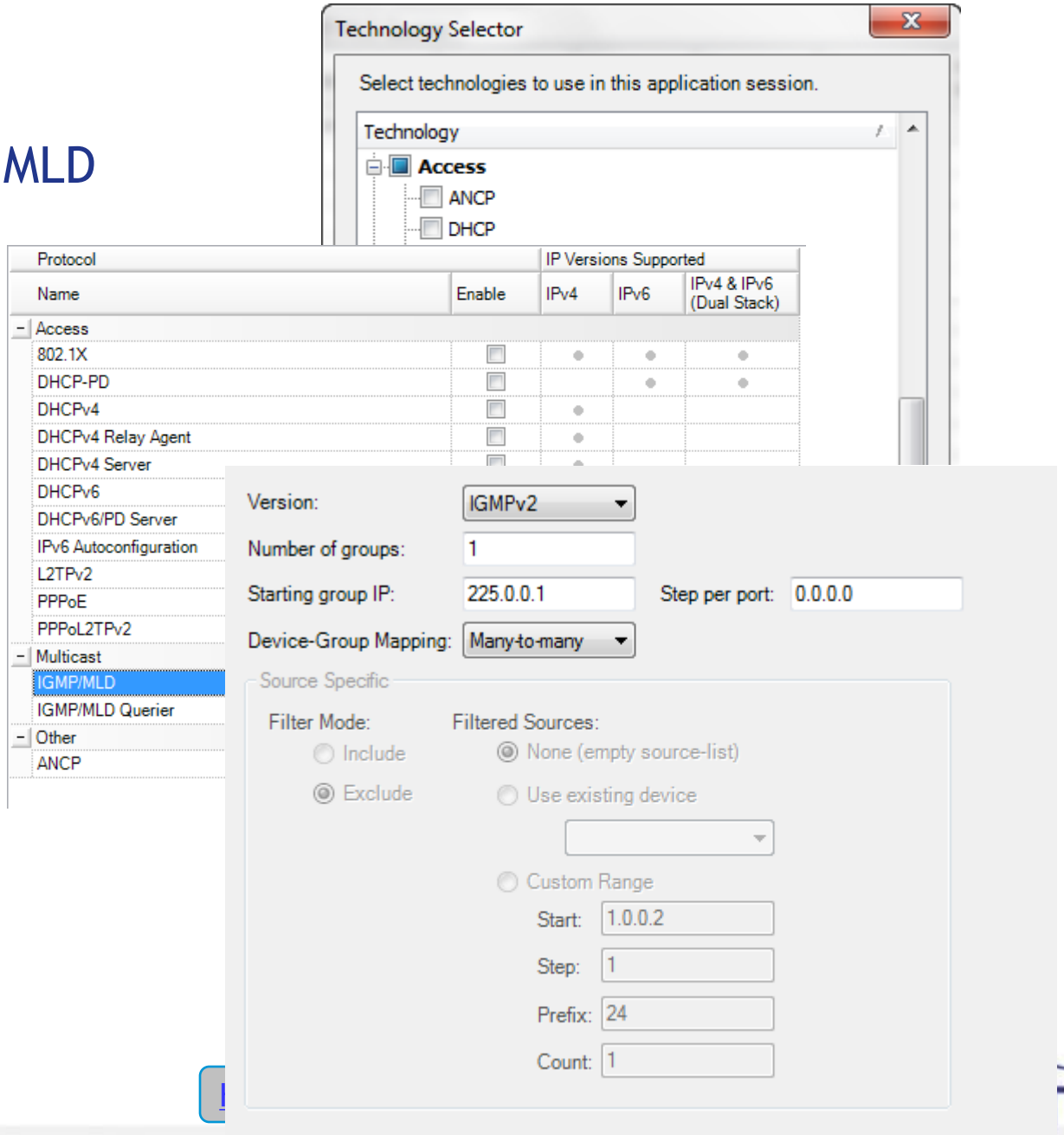
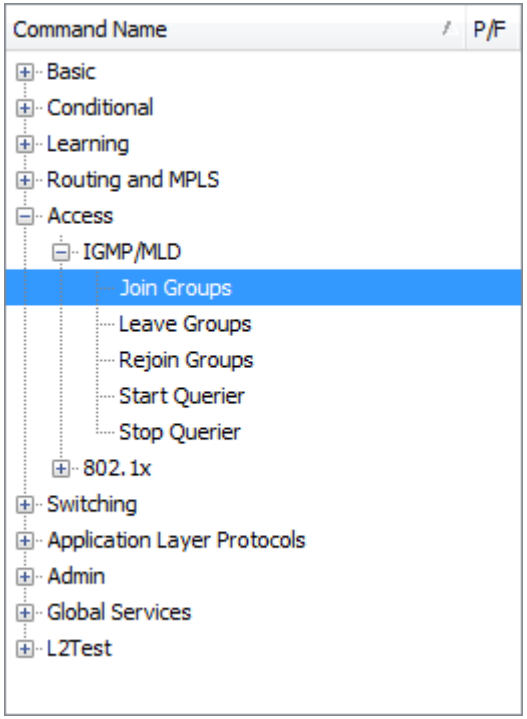
STC 组播配置

- 选择协议类型 IGMP/MLD
- 创建IGMP Device
  - 向导创建
  - 手工创建



组播配置

- 数据配置：向导——Bound Stream Block
- 组播 Command Sequencer



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IGMP 配置选项

- One-to-one / One-to-many
- 计算加入离开时延
- IGMP 报文发送速率控制
- Unsolicited Report Interval
- 强制一个初始加入报文
- IGMP V3/MLD V2选项
  - 过滤源地址配置

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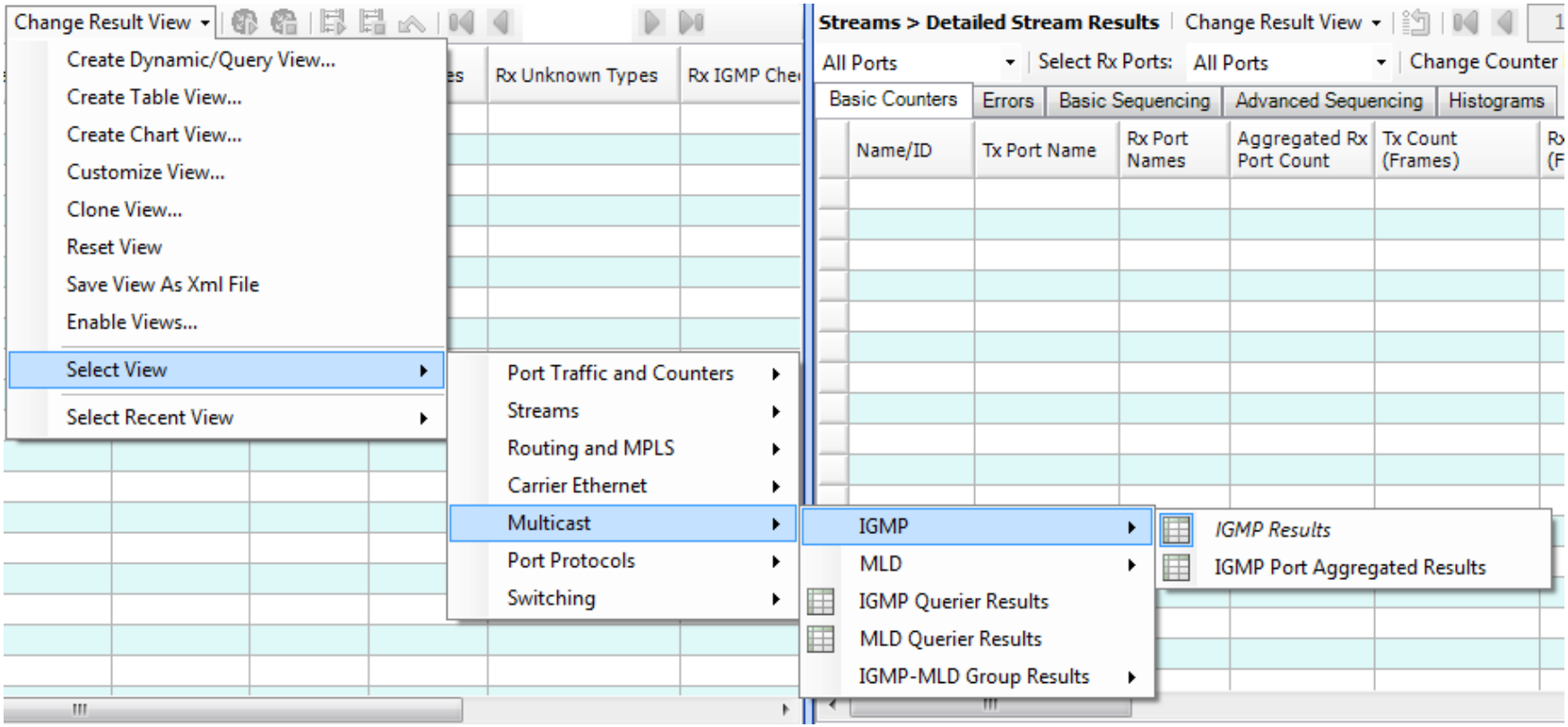
STC 组播结果查看



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组播容量测试步骤

- 例如被测设备支持200个组
- 发送组播流量到200或者大于200个组的流量；这时候接收端口应该收不到组播报文；
- 组播客户端发送成员报告Membership report；
- 查看接收端口，应该收到200个组的组播报文
- 之后在接收端口发送离开报文
- 查看接收端口，应该不再收到组播报文

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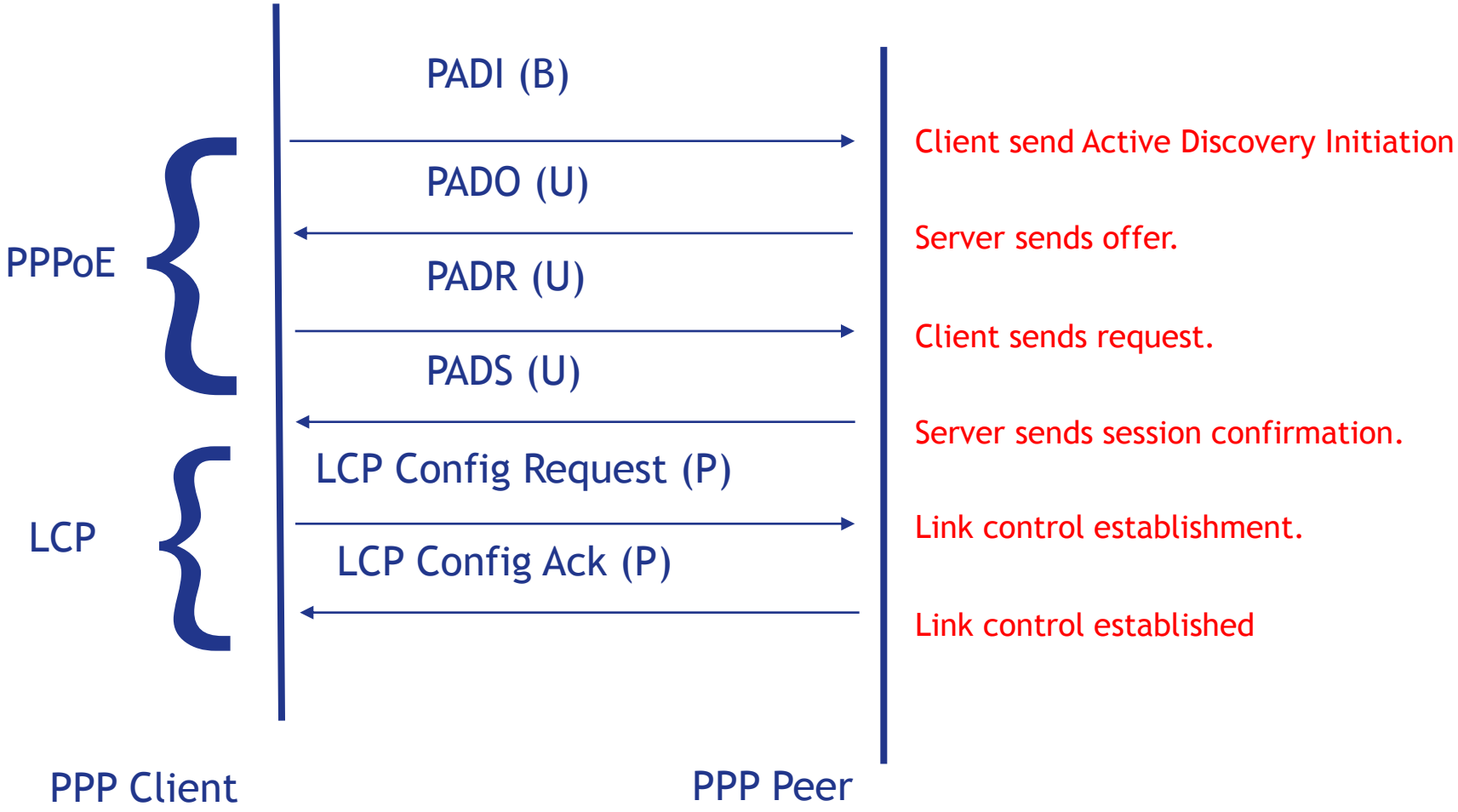
IGMP RFCs

- RFC-2236 by Fenner
  - Internet Group Management Protocol, Version 2
  - http://www.ietf.org/rfc/rfc2236.txt?number=2236
- RFC-2715 edited by Thaler
  - Interoperability Rules for Multicast Routing Protocols
  - http://www.ietf.org/rfc/rfc2715.txt?number=2715
- RFC-3376 edited by Caine, Deering, Kouvelas, Fenner, Thyagarajan
  - Internet Group Management Protocol, Version 3
  - http://www.ietf.org/rfc/rfc3376.txt?number=3376

PPPOE 协议流程1



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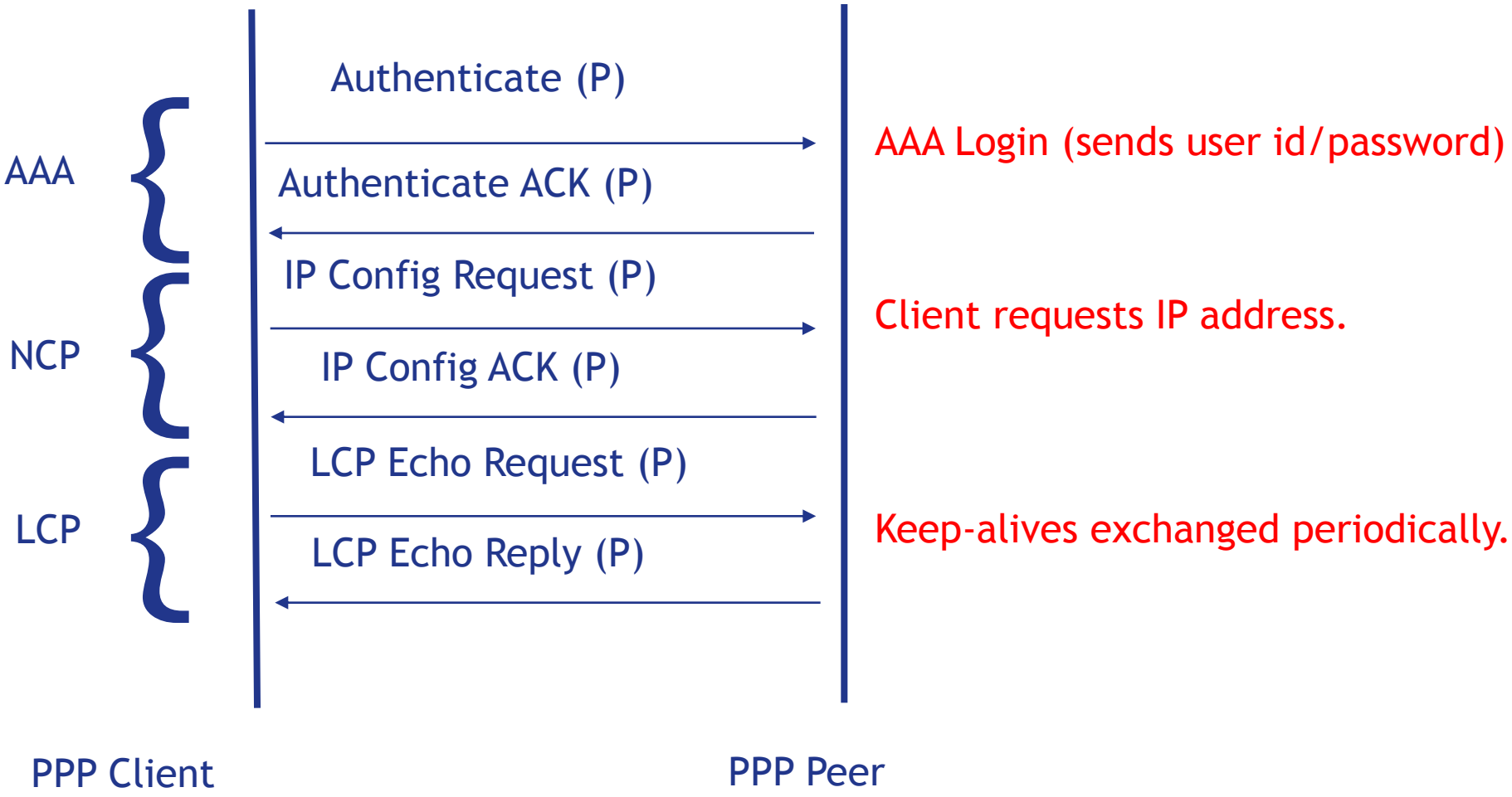
PPPOE 协议流程2



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STC PPPOE配置

- 选择协议类型 PPPoX
- 创建PPPOE Device
  - 向导创建
  - 手工创建
- 模拟模式 Server/Client
- PPP 相关选项 LCP/NCP
- 认证配置
- IPCP 封装：IPV4/IPV6/IPV4V6
- 用户自定义选项

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PPPOE 配置

- PPPOE Server配置
  - Echo Vendor-Specific Tags in PADO
  - Echo Vendor-Specific Tags in PADS
  - PPPOE IPV4 Address Start/ Step/ Count
  - Force Connect mode /threshold /Server interactive Timer

- 数据配置：向导——Bound Stream Block
- 组播 Command Sequencer

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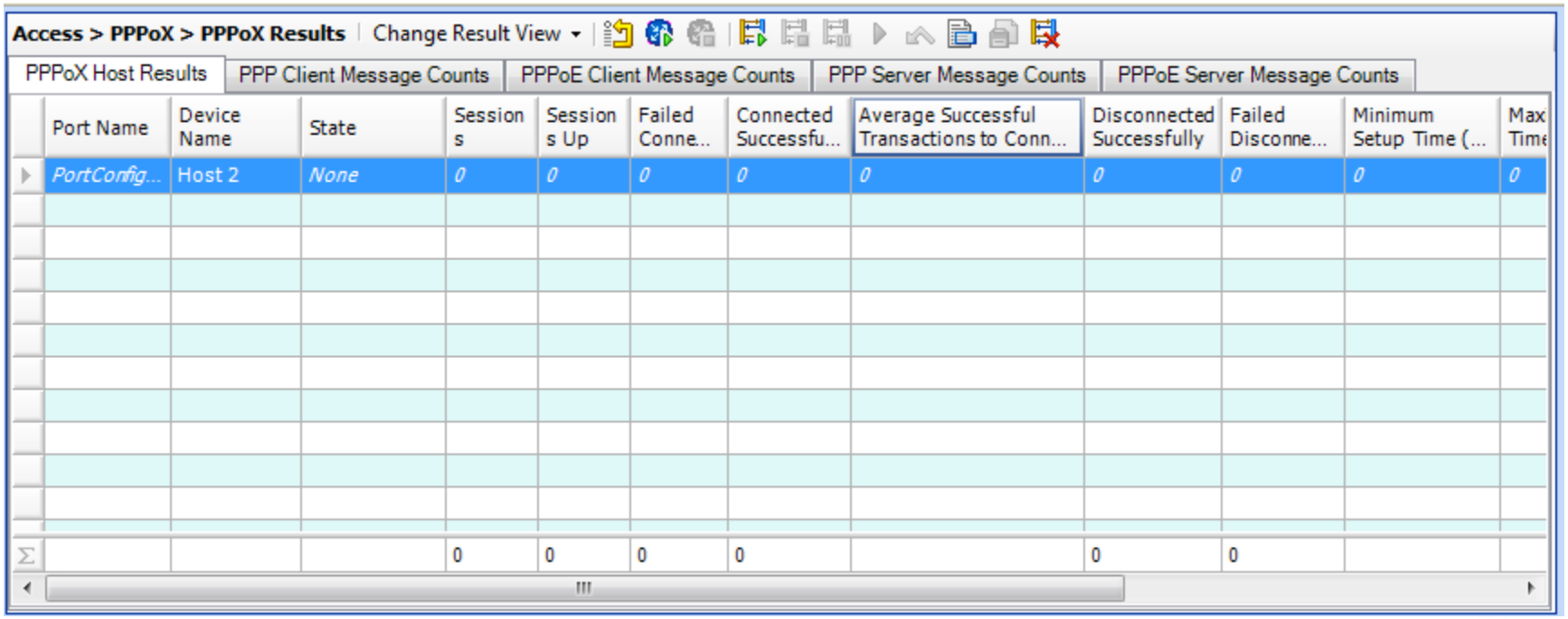
STC PPPOE结果查看

- View PPPOE Session information
- 查看PPPOE 相关结果



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STC DHCP 配置

- DHCP 协议流程
- STC DHCP 配置
- STC DHCP 流量生成
- STC DHCP 命令序列
- STC DHCP 结果查看

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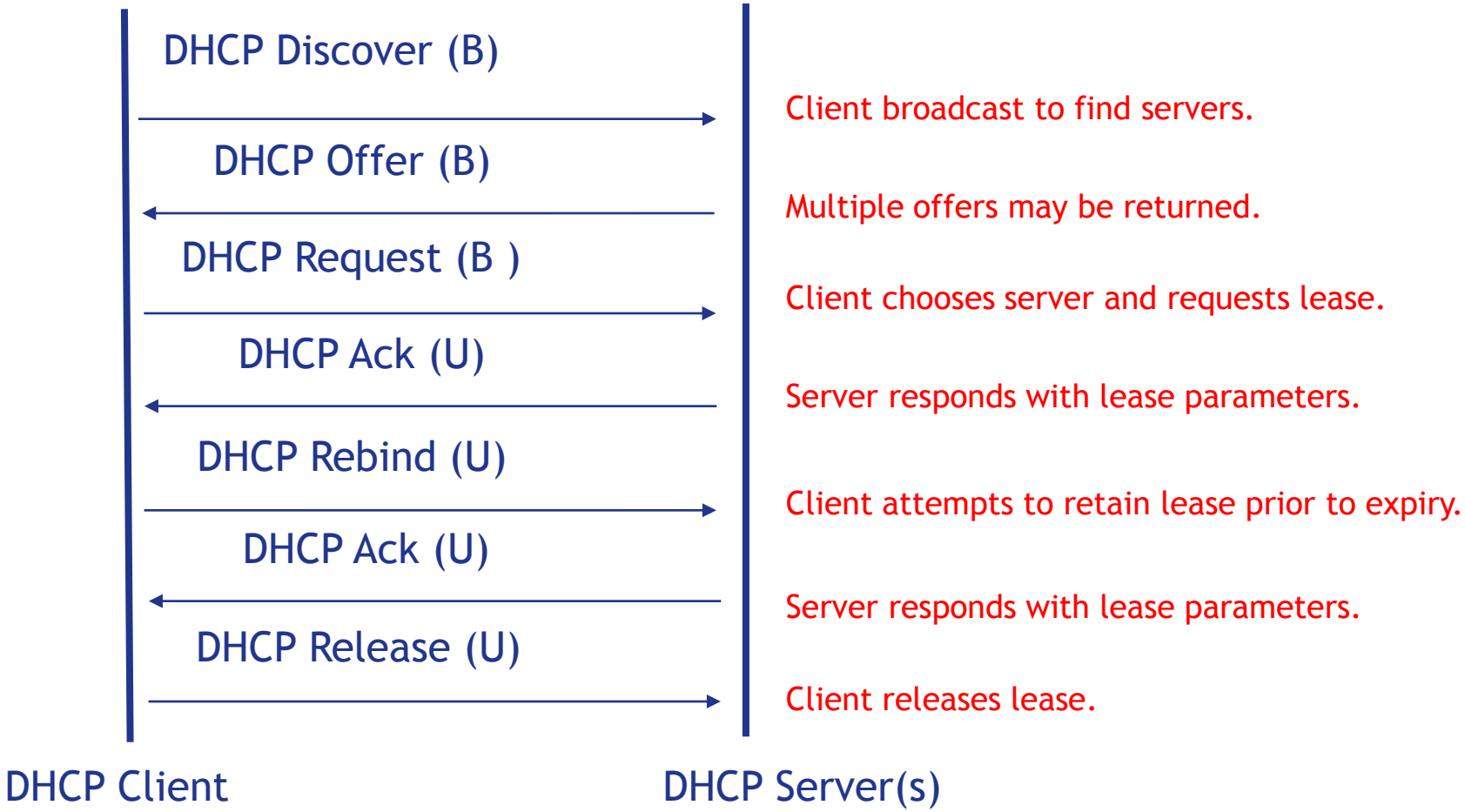
DHCP 协议流程



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STC DHCPv4 Client 配置

- 选择协议类型 DHCP
- 创建DHCP
  - 向导创建
  - 手工创建
- Enable Router Option/Router Option [3]
- 用户自定义选项

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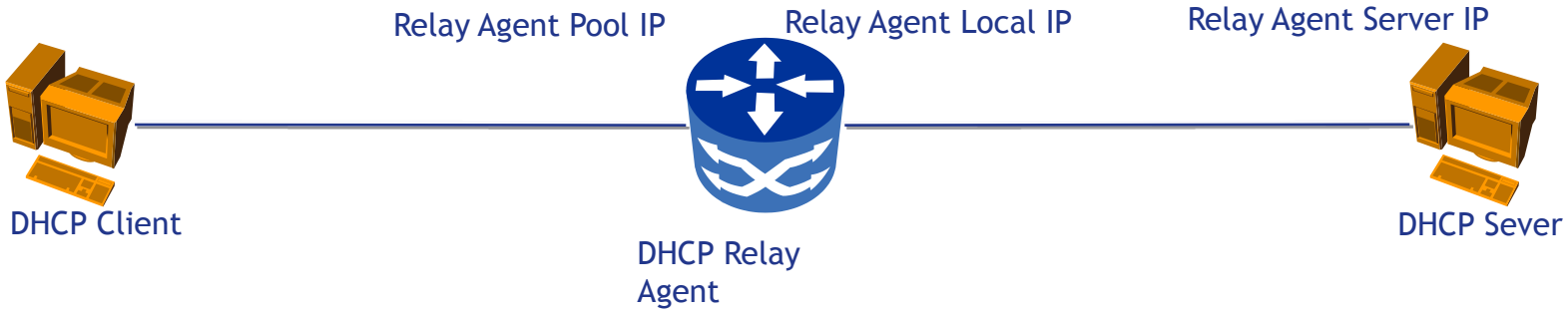
STC DHCPv4 Client with Relay Agent配置

- 创建向导或者手工
- 拓扑模拟Relay Agent、非拓扑模拟 Client&Relay Agent
  - Relay Agent Local IP：代理连接Server 的接口地址
  - Relay Agent Server IP：代理指向服务器的地址
  - Relay Agent Pool IP：代理连接客户端的接口地址
  - Enable Relay Agent Circuit ID
  - Enable Relay Agent Remote ID



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STC DHCPv4 Server 配置

- 选择协议类型 DHCP
- 创建DHCP Server
  - 向导创建
  - 手工创建
- Pool Address start
- Relay Agent Pool 配置

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STC DHCPv6/PD Client 配置

- 选择协议类型 DHCPv6/PD
- 创建DHCPv6/PD
  - 向导创建
  - 手工创建
- Requested Starting Prefix/Address
- 用户自定义选项

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STC DHCPv6/PD Server 配置

- 选择协议类型 DHCPv6/PD
- 创建DHCPv6/PD
  - 向导创建
  - 手工创建
- Prefix/Address Pool Start
- Additional Pool
- 用户自定义选项

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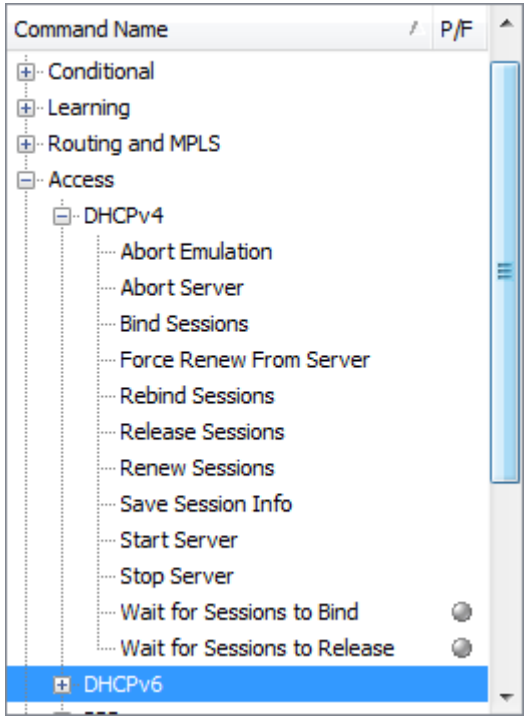
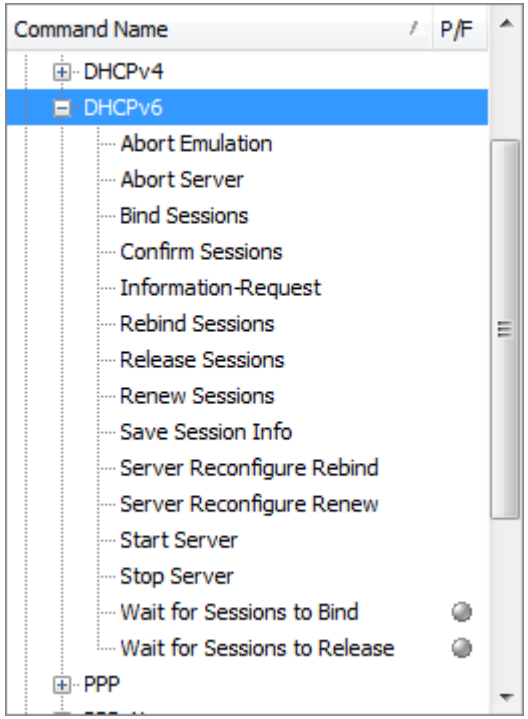
DHCP 流量向导与命令序列

- Bound Stream生成
- Command sequencer





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STC DHCP 结果查看

- View DHCP Session information
- 查看DHCP 相关结果

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Q&A

THANK YOU !

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