

**ProCurve Secure Router 7000dl Series**  
**BT Exact Interoperability Testing**  
**High-Level Management Report (Phases 1 & 2)**  
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**1 Executive Summary**

This high-level management report summarises the results obtained and conclusions drawn from the BT Exact Interoperability Testing of the ProCurve Secure Router 7000dl Series.

The Phase 1 tests results demonstrated the interoperability of WAN interfaces and encapsulations and backup interfaces. All supported routing protocols including OSPF, eBGP and RIP were shown to interwork with Cisco routers. IPSec VPNs to Cisco routers were also demonstrated successfully. The built-in stateful firewall and NAT were evaluated along with other security features and yielded positive results. Finally, router management protocols were investigated and general router operations performed.

Phase 2 testing verified interworking with HDLC encapsulation, Multilink FR and GRE over IPSec with OSPF/RIP. One major issue was seen whereby obsolete routing information remains in the routing table even after the routing cache is cleared, this will be further investigated by HP.

It is concluded, based upon the test results and experiences, that the ProCurve Secure Router 7000dl Series has, in the considered opinion of the BT Exact, demonstrated interoperability, functionality and operational features mandated by service providers and enterprises.

<b>ProCurve Secure Router 7000dl Series Evaluation Phase 1 - Summary of Test Results</b>		
<b>Test</b>	<b>Condition</b>	<b>Result</b>
10/100 Ethernet	Interoperability with Cisco 6000/5000 Catalyst Switches.	Pass
Frame Relay	Interoperability with Cisco 7200VXR router for the following interfaces: 1xT1, 2xT1, 1xT1+DSX-1, 1xE1, 2xE1, 1xE1+G.703, 8xT1/E1, 1xSerial (V.35/X.21)	Pass
PPP	Interoperability with Cisco 7200VXR router for the following interfaces: 1xT1, 2xT1, 1xT1+DSX-1, 1xE1, 2xE1, 1xE1+G.703, 8xT1/E1, 1xSerial (V.35/X.21)	Pass
PAP/CHAP Authentication	Interoperability with Cisco 7200VXR router.	Pass
OSPF	Interoperability with Cisco 7200VXR router for the following conditions: Single & multi-area configurations, redistribution & summarization, neighbour authentication, point-to-point and broadcast network support, LSA processing.	Pass
eBGP	Interoperability with Cisco 7200VXR router for the following conditions: eBGP peers with multi-hop scenarios, MD5 peer authentication.	Pass

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<b>ProCurve Secure Router 7000dl Series Evaluation Phase 1 - Summary of Test Results</b>		
<b>Test</b>	<b>Condition</b>	<b>Result</b>
RIP v1/v2	Interoperability with Cisco 7200VXR router	Pass
QoS	Verification of the following: Packet classification based on TCP, UDP, and IP headers and IP Precedence or DSCP values, marking using IP Precedence and DSCP values. FIFO, WFQ, PQ scheduling mechanisms for PPP and Frame Relay WAN interfaces. Frame Relay fragmentation and traffic shaping.	Pass
Firewall, NAT, ACLs	Validate stateful firewall, NAT source/destination IP address translation, Access Control List packet filtering	Pass
IPSec VPN	Gateway interoperability based on the following configurations: ProCurve-to-ProCurve & ProCurve-to-Cisco	Pass
Management	Validate SNMP MIB read/write access, SNMP trap generation, Telnet, TFTP, FTP, SNTTP	Pass

<b>ProCurve Secure Router 7000dl Series Evaluation Phase 2 - Summary of Test Results</b>		
<b>Test</b>	<b>Condition</b>	<b>Result</b>
HDLC Encapsulation	Interoperability with Cisco 7200VXR router	Pass
Multilink Frame Relay	Interoperability with Cisco 7200VXR router for the following interfaces: 1xE1, 2xE1/T1, 1xT1+DSX-1, 1xE1+G.703, 8xT1/E1, 1xSerial (V.35/X.21)	Pass
GRE over IPSec with OSPF/RIPv1	Interoperability with Cisco 3600 router. Tunnel mode tested only. Validated GRE keepalives, check key and debugging. Verified OSPF/RIPv1 updates were encrypted/decrypted and sent across tunnel correctly.	Pass

## **2 Introduction**

ProCurve Networking by HP has developed a product line of branch office routers, the ProCurve Secure Router 7000dl Series, which supports a range of IP routing protocols and WAN interface modules. The product line comprises two routers, the Secure Router 7102dl and the Secure Router 7203dl.

ProCurve Networking has sought an independent evaluation of these routers to ensure interoperability with the products of other leading vendors e.g. Cisco and specifically with respect to WAN technologies/encapsulations and IP routing protocols. Furthermore, the evaluation seeks to demonstrate that the ProCurve Secure Routers address the level of functionality and breadth of operational features mandated by service providers and enterprises alike. The evaluation was scoped as not to establish compliance with applicable industry standards or to determine the performance characteristics of the routers.

BT Exact has been commissioned by ProCurve Networking to undertake this evaluation.

### 3 Test Environment and Scope

The evaluation was conducted at the BT Exact Network Integration Facility, Adastral Park, Ipswich, UK.

The testing was split into two phases. The first phase concentrated on interoperability testing of various WAN interfaces & routing protocols with Cisco routers. The second phase extended the testing to cover enhanced features i.e HDLC, Multilink FR & GRE over IPsec with OSPF/RIP.

The same test environment was used for both phases of testing. Four ProCurve Secure Routers were connected via various WAN interfaces to an MPLS/BGP VPN service provider model comprising multiple Cisco routers and switches. The ProCurve Secure Routers were deployed in the context of customer site routers and as part of a common VPN.

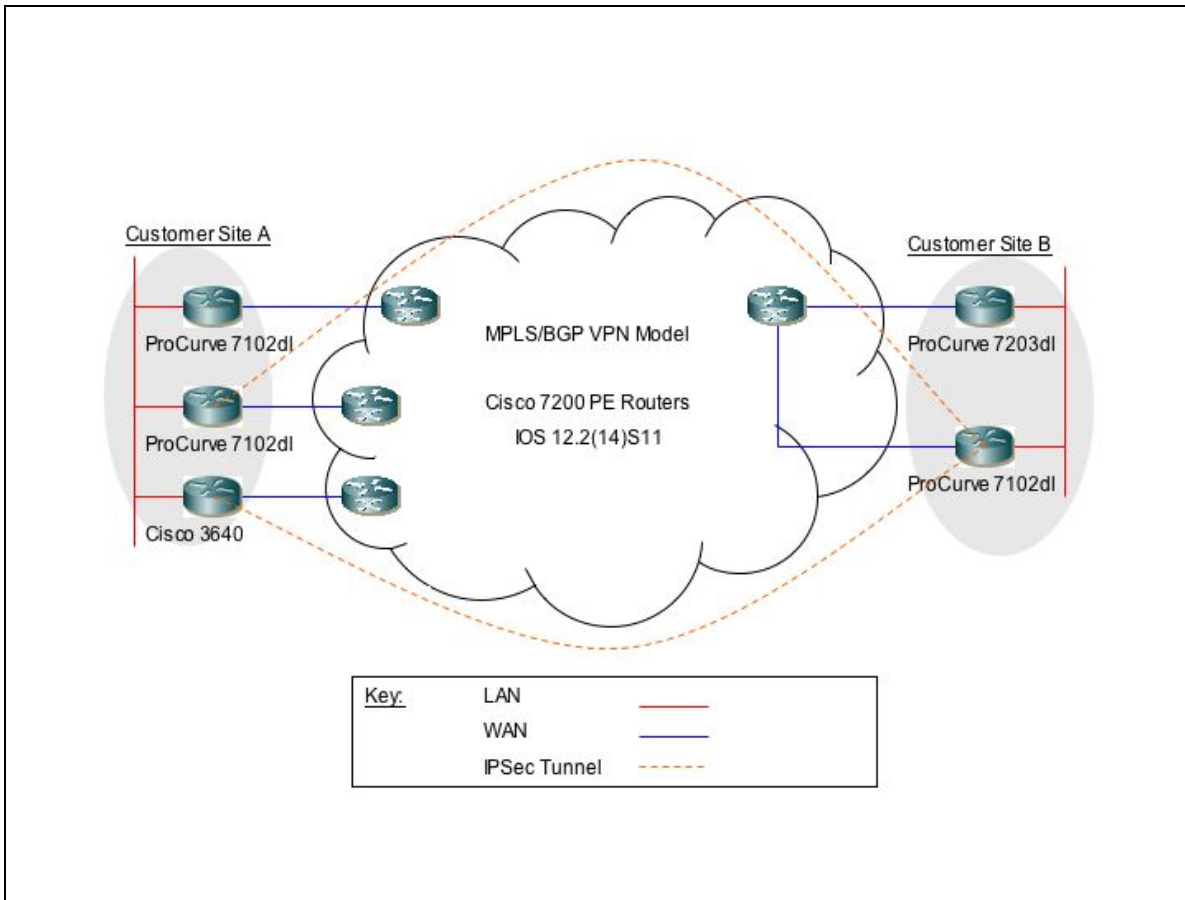


Figure 1 – ProCurve Secure Router Evaluation High-Level Topology

The scope of both phases of testing is presented below,

ProCurve Secure Router 7000dl Series Evaluation Phase 1 Scope	
Router Handling	CLI; Image and Configuration File Management; Operational Functionality
Built-In LAN Interfaces	10/100Mbps Ethernet
WAN Interface Modules	1xT1; 2xT1; 1xT1 + DSX-1; 1xE1; 2xE1; 1xE1 + G703; 8xT1/E1 and 1xSerial (V.35 / X.21)
WAN Backup Interface Modules	1xISDN BRI S/T; Analogue Modem V.90
WAN Data Link Encapsulations	PPP; Frame-Relay; Multilink-PPP

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<b>ProCurve Secure Router 7000dl Series Evaluation Phase 1 Scope</b>	
IP Routing Protocols	RIP (Versions 1 and 2); OSPF; eBGP; Static Routes
Security and Packet Filters	NAT and built-in Firewall; Access Control Lists; AAA including RADIUS; Penetration and Vulnerabilities;
QoS Functionality	Packet Classification and Marking (IP Precedence and DSCP); Queuing/Scheduling (FIFO, Priority Queuing, Weighted Fair Queuing); Policing/Shaping (Frame-Relay Traffic Shaping, CAR); Congestion Avoidance (WRED)
IPSec VPN	ProCurve-to-ProCurve; ProCurve-to-Cisco; Tunnel Mode; IKE; IPSec
Management	Syslog; SNMP; Telnet; FTP; TFTP; NTP

<b>ProCurve Secure Router 7000dl Series Evaluation Phase 2 Scope</b>	
HDLC Encapsulation	ProCurve-to-Cisco; Configuration & general interworking.
Multilink Frame Relay	ProCurve-to-Cisco; Mixture of single-port & multiport WAN interfaces including 8xE1/T1. Resilience; Trouble shooting/Debugging.
GRE over IPSec with OSPF/RIP	ProCurve-to-Cisco; Implementation of GRE tunnel over IPSec with OSPF/RIP; Verification of OSPF/RIP updates being encrypted; Trouble shooting/Debugging.

#### 4 Summary of Test Results

Generic router handling including in-band and out-of-band CLI access; CLI operation and function (e.g. configuration editing and context-sensitive help); OS and configuration file management and general router operations (e.g. reboots and power cycles) were all evaluated.

The two built-in Ethernet LAN interfaces were tested for combinations of speed (10Mbps and 100Mbps) and duplex (full and half). No issues were recorded. Additionally, the Ethernet interfaces were shown to support auto-negotiation when connected to both Cisco 6000 and 5000 Series Catalyst switches.

All ProCurve Secure Router WAN interface modules were demonstrated to be interoperable with the equivalent interfaces of a Cisco 7200VXR router for both Frame-Relay and PPP encapsulations. Cisco, ANSI and ITU Frame-Relay LMI types were tested. Both PAP and CHAP PPP authentication modes were tested along with one-way and two-way challenges. Time constraints did not permit the testing of Multilink PPP.

The ISDN BRI S/T WAN backup interface was shown to successfully establish a session, via a BT System X ISDN exchange model, to an E1 ISDN PRI interface implemented on a Cisco 7200VXR router, following the failure of the primary WAN interface. PPP was configured as the data link layer encapsulation. No issues were recorded.

OSPF was found to function correctly in a dual vendor ProCurve/Cisco environment. The scope of testing included, but was not limited to, single and multi area configurations; redistribution and summarisation; neighbour authentication; point-to-point and broadcast network support and LSA processing. Two minor issues were noted. The first concerned the omission of OSPF neighbour information from the CLI and the second related to the inability to configure the OSPF metric and metric-type when redistributing routes into OSPF. These were determined to be cosmetic CLI issues. The two issues were reported to ProCurve Networking and have since been resolved to the satisfaction of BT Exact. No further issues were observed.

BGP was demonstrated to successfully form eBGP peers (including multi-hop scenarios) and to support MD5 peer authentication. Prefix-lists were used to filter updates and path selection based upon path attributes was determined to be as expected. iBGP is not currently supported, however, iBGP is not

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considered to be a specific requirement for the target market; route-reflector functionality is omitted on the same basis.

RIP was tested without any issues recorded.

Classless routing was evaluated along with route selection based upon the administrative distance of routing protocols. Static and default routing with specified IP next-hops and egress interfaces were demonstrated to function correctly. Software loopback interfaces for peering of routing protocols were also tested satisfactorily.

QoS testing addressed packet classification and marking, queuing and scheduling mechanisms and policing and shaping mechanisms. Packet classification based upon TCP, UDP and IP headers and IP Precedence or DSCP values were configured and verified. Packet marking using IP Precedence and DSCP values was also verified. FIFO, WFQ and PQ scheduling mechanisms were proven for both PPP and Frame-Relay encapsulated WAN interfaces. It was observed that the application PQ to a PPP WAN interface caused a brief service interruption. ProCurve Networking is investigating this issue. Finally, Frame-Relay fragmentation and traffic shaping were evaluated. Congestion avoidance mechanisms e.g. RED or WRED are currently unsupported.

Security testing concentrated on the built-in firewall and NAT. The firewall was proven to perform stateful inspection of traffic flows and a subset of the known traffic profiles supported by 'Attack Protection Engine' were tested. The implementation of NAT supported both source and destination IP address translations; Many-to-One (Overload) translations and One-to-One translations. Access Control Lists were applied to interfaces and telnet lines to perform packet filtering and restrict telnet sessions respectively. Prefix-Lists were used to control routing protocol updates.

Basic site-to-site IPSec VPNs were tested across the MPLS/BGP VPN model. ProCurve-to-ProCurve and ProCurve-to-Cisco scenarios were demonstrated successfully for various IKE Policy attribute combinations with pre-shared keys and various IPSec Transform Set combinations in tunnel mode. No issues were noted.

Router management evaluated local and remote syslog event logging; SNMP MIB read/write access and the generation of SNMP traps. An SNMPwalk of the router revealed that only limited set of MIBs (system and interface MIBs) was implemented. ProCurve Networking has advised that this will be increased in the future. Telnet, TFTP, FTP and SFTP were also tested. No issues were recorded.

HDLC encapsulation was tested to function correctly and connectivity was established with the Cisco 7206VXR router. Although debugging commands were available in the HP SROS, however no output was seen. Also, an issue was seen whereby the HDLC interface could not be configured as a next-hop. This was fixed and tested in the v22 release of the OS.

Multilink Frame Relay was tested to operate correctly. A variety of single-port & multi-port interfaces were used and no issues were seen. Resilience was tested to function as expected with service outage times of approximately 30 seconds.

GRE tunneling was configured to operate over IPSec with OSPF routing. End to end connectivity was established using extended pings with LAN IP addresses as the source. OSPF LSA's were seen to be encrypted/decrypted and sent to the remote Cisco 3600 router. The MTU size had to be changed when tunnel keys were used, this is expected as the IP packet size increases. It was seen that if the MTU size is not set to 1464 bytes the OSPF process tries to form an adjacency but fails.

RIPv1 protocol was also tested and routing updates were encrypted and received correctly at the remote end.

In addition to the results of the formal testing, the opinions of the test engineer regarding the general operation and functionality of the two ProCurve Secure Routers and the ability of ProCurve Networking to resolve technical support issues have been considered. The test engineer has determined that the general operation and functionality of the routers are on a par with similar products of other vendors and that the technical support received to date has been comprehensive, accurate, timely and professional.

## 5 Conclusion

The results and experiences borne out by the evaluation were very encouraging.

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BT Exact has concluded, given the scope of testing conducted, that the ProCurve Secure Router 7000dl Series successfully demonstrates the levels of interoperability and functionality mandated by both service providers and enterprises.

Moreover, BT Exact is satisfied that the combinations of hardware and software evaluated address the depth of technical and operational features and exhibit the stability and robustness expected of a product targeted at the branch office sector of the router market.

## 6 Document Information

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### 6.2 Source

This document is stored electronically in LiveLink and is located in, \\BT Exact Networks Engineering\Projects\IP&DPI Projects\ICT - BT Retail\HP ProCurve\EXA06732 HP ProCurve Router Testing

### 6.3 History

Issue	Date	Author	Comments
Draft 0.a	15 <sup>th</sup> March 2005	James Churchward	
Issue 1.0	22 <sup>nd</sup> March 2005	James Churchward	Issued following BT Exact internal review.
Draft 1.a	25 <sup>th</sup> April 2005	Jameel Khan	Updated with Phase 2 test results.
Issue 2.0	25 <sup>th</sup> April 2005	Jameel Khan	Issued following BT Exact internal review.

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