Ascend

PERFORMANCE TESTING

MAX 4004 testing by The Tolly Group

TEST SUMMARY:

The Tolly Group, an independent performance testing agency, conducted tests to assess the performance and scalability of the MAX™ 4004 WAN Access Concentrator. The Tolly Group conducted the tests in Q3 1996. The code revision level used on the MAX 4004 was 4.6bp12.

The test methodology and test bed were set up to simulate a real life operating environment as much as possible. The test bed consisted of 48 remote PC clients communicating to a central FTP server over a MAX 4004. (See attachment I for details on the test bed set up and methodology.)

Scalability was verified by running up to 48 simultaneous PC sessions using 48 analog connections and up to 48 sessions with two ISDN B-channels.

Performance was measured as a per client throughput of live FTP transfers with all clients simultaneously running over either analog connections or ISDN B-channels. This is a key measurement because it reflects how the product is used in a real life environment.

TEST FINDINGS:

The Tolly Group tests confirm that the MAX 4004 can scale up to 96 ISDN B-channel sessions and up to 48 analog sessions (test bed limit) with only minimal change in per user throughput. The performance measured during the analog test (with no compression) varied from roughly 28 kbps (throughput for 1 call) to 26 kbps (average throughput per client for 48 calls). This variation (about 7%) falls within the boundary of testing error.

More performance tests have been scheduled with the Tolly Group later this year, including performing similar tests on Ascend's key competitors. It should be noted that our competitors are doing lab tests that claim to show performance problems with Ascend's products; but, these are not tests that closely simulate the way in which the products are used in a real life environment.

The Tolly test results validate Ascend's scalability claims and refute the statements made by our competitors that the MAX 400X product family does not scale and that the MAX 400X drops calls intermittently. During the tests done by The Tolly Group on the MAX 4004, no calls were dropped intermittently.

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TEST RESULTS:

Analog Test (no compression)

Number of clients	Average throughput per client (bps)	File Type
1	28,049.01	Text
24	28,245.49	Text
48	25,981.49	Text

Source: The Tolly Group

TEST DETAILS

The analog test was done by establishing analog connections directly from the PCs via internal modem. Each modem was connected to a PBX that was in turn connected directly to the central MAX 4004 via 2 T1 lines (See attachment I for Testbed diagram). Using the Windows 95 platform, the clients used Dial-up networking to make a connection to the MAX 4004.

Equipment used for the test

LAN: 10 Mbps Ethernet, CentreCom 30/2 TR concentrator, Cat 5 UTP cabling

WAN: Asynchronous connections (total of 48), NEC Electra Level 2 PBX (clock source), RJ-11 four-wire, T1 connections (2) from MAX 4004 (clock source), RJ-45 eight-wire wiring

Analyzer: Network General Expert Sniffer, Ethernet Topology

PC Clients: Crystal Group 486 DX/2, 32 Megabytes RAM, Windows 95 operating system, Win95 TCP/IP, Microsoft FTP application, 3Com 3C509 Ethernet adapter, Practical Peripherals internal 28.8 bps modem

Management station: Sun SPARCstation 5, 32 Megabytes RAM, Solaris OS, Sun Ethernet, Ascend RADIUS Server

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ATTACHMENT I

Test Methodology and Test Bed

Performance of the MAX 4004 was determined by measuring the FTP throughput of up to 48 remote node PC clients downloading files via FTP from a central UNIX server. Each Windows 95 PC (client) was connected to the UNIX server by dialing the MAX 4004 via either an asynchronous or ISDN connection. The MAX 4004 linked each remote connection to the central Ethernet LAN to which the UNIX server was connected. Performance was measured with varying number of clients up to a maximum of 48 with analog connections and up to 96 ISDN B-channel connections.

The clients ran Microsoft FTP from a MS-DOS window. The throughput of all clients was determined by measuring the total number of bytes transferred from the server to all clients during a sample measurement and dividing by the time of the sample. The sample was taken from a network analyzer attached to the central Ethernet LAN. The throughput was measured in bits/second.

Analog

Analog connections were established directly from the PC via an internal modem. Each modem was connected to a PBX that was in turn connected directly to the central MAX 4004 via two T1 lines (See attached diagram Testbed 1a: Analog Performance). Using the Windows 95 platform, the clients used dial-up networking to make a connection to the MAX 4004.

ISDN

ISDN connections were made from remote ISDN routers located on a remote Ethernet for each client (total of 48 routers and 48 remote Ethernet segments). Each client's ISDN connection was a single BRI (two B-channels) connection. The 48 ISDN routers communicated to four intermediate MAX 4004s that in turn connected to the central MAX 4004 via T1 lines (one T1 line per intermediate MAX 4004). The intermediate MAX 4004s multiplexed the ISDN data from the 48 incoming ISDN connections (12 ISDN BRIs per intermediate MAX 4004) directly to the central MAX 4004 by bit-streaming the ISDN data in its native form over the synchronous connections. The two intermediate MAX 4004s in essence acted as an ISDN switch. The built-in IP feature on Windows '95 of the client PC was used via an Ethernet adapter in each PC to communicate over the ISDN router to the central FTP server. See the attached diagram Testbed 1b: ISDN performance.

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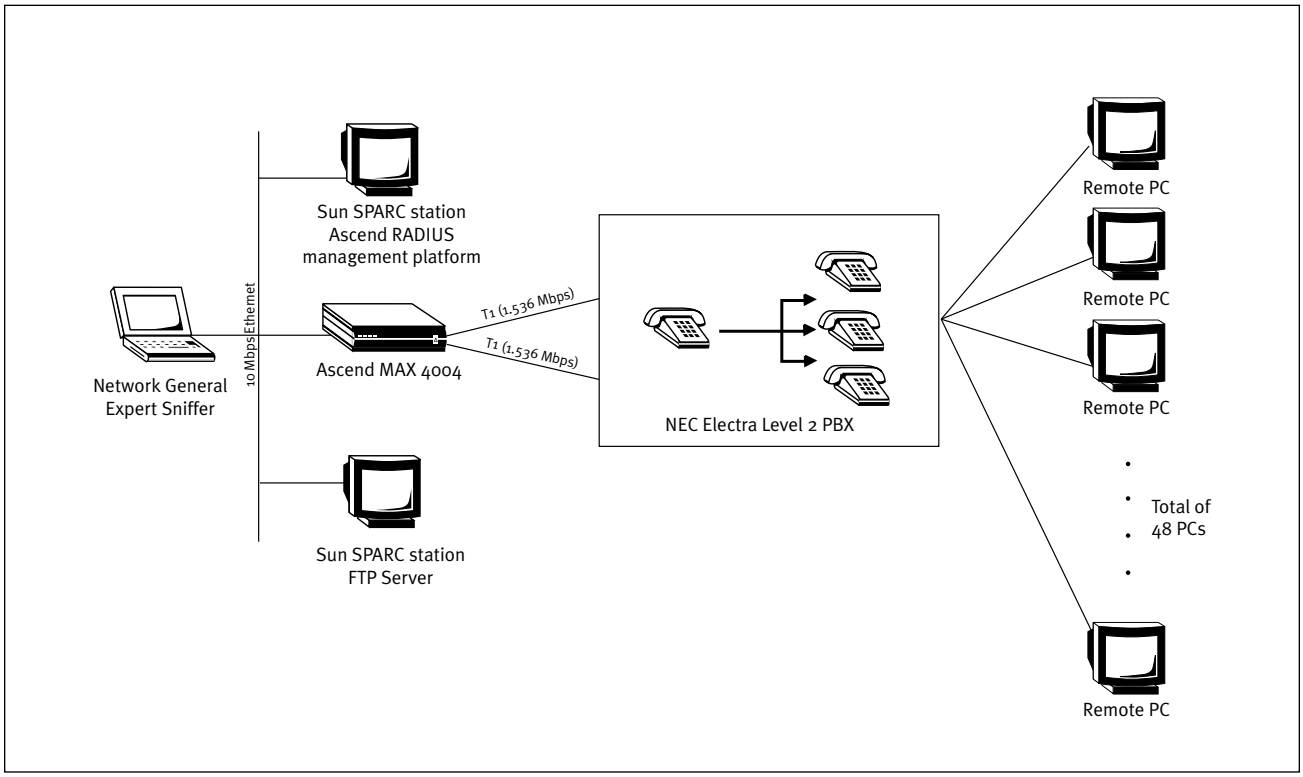
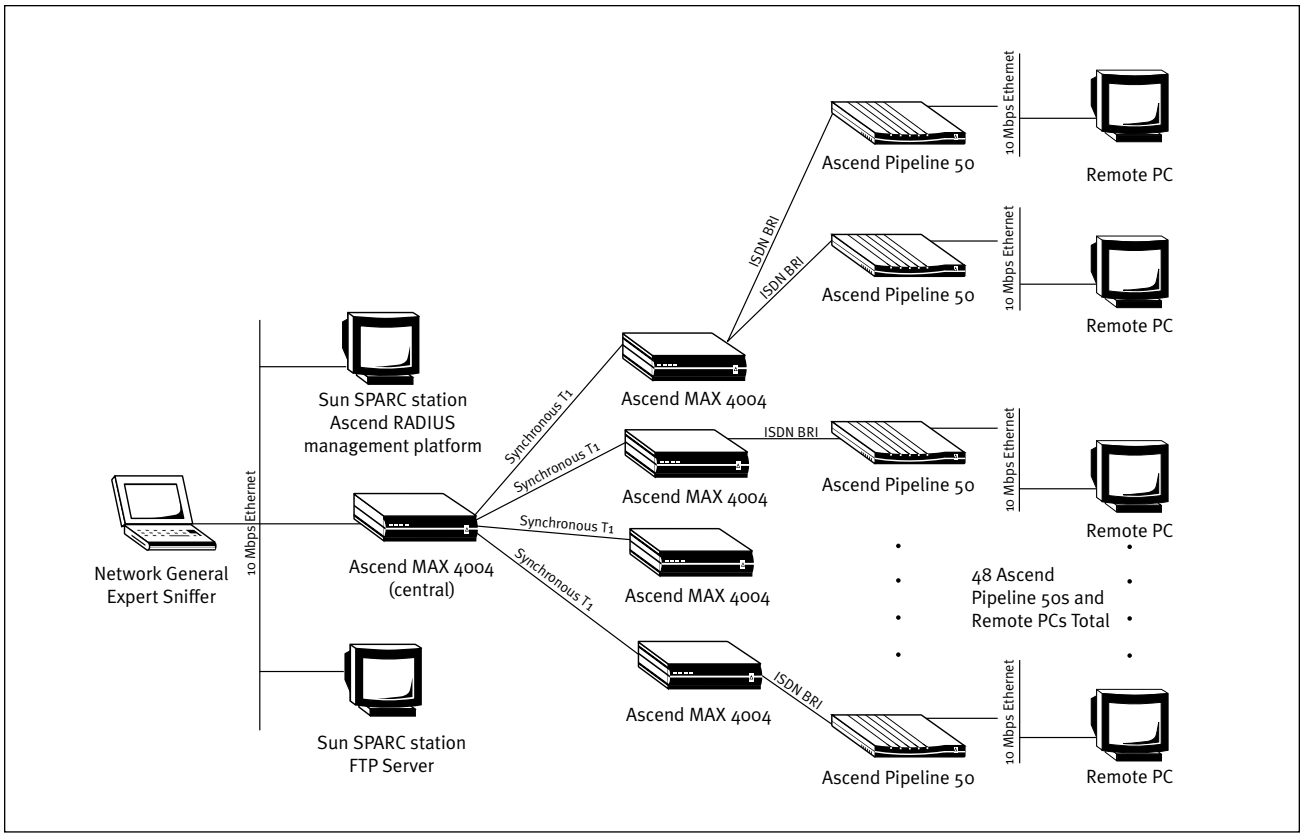


Source: The Tolly Group, September 1996

Testbed 1a: Analog Performance



Source: The Tolly Group, September 1996

Testbed 1b: ISDN Performance

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