



Broadband Services Overview

Erin Dunne

Edunne@verticalsystems.com

Vertical Systems Group

Manager of Research Services

<http://www.verticalsystems.com>

781.329.0900

Contact:

Erin Dunne

Vertical Systems Group, Inc.

Manager of Research Services

781-329-0900

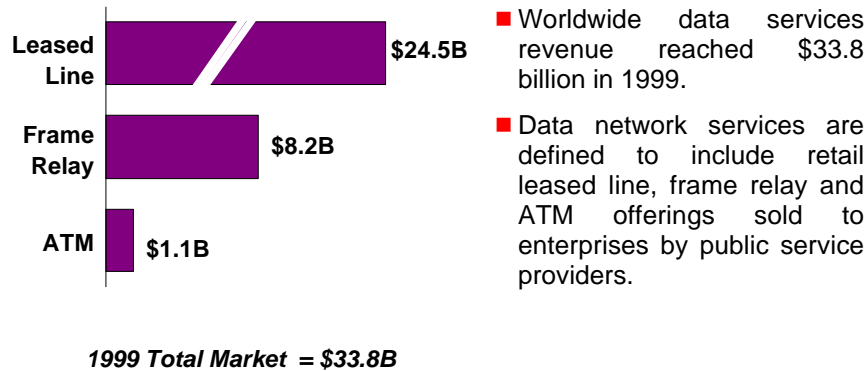
781-329-6471 (fax)

edunne@verticalsystems.com

www.verticalsystems.com

1999 Worldwide Data Services Market

1999 WORLDWIDE REVENUE Dedicated Access Data Services



- Big picture of the broadband dedicated access services market
- Vertical Systems Group defines this market to include retail leased line, frame relay and ATM offerings sold to enterprises by public service providers like IXC's, ILECs, PTTs, etc.
- Worldwide data services revenue reached almost \$34 billion by the end of 1999, with the U.S. accounting for half of the total market. Leased lines are the most prevalent dedicated network service in the world, accounting for \$24.5 billion or 73% of 1999 total market revenue. Frame relay is the next largest, contributing \$8.2 billion or 24% of the worldwide total. ATM revenue accounts for 3% of the total.
- What this displays -
 - leased lines continue to be a very substantial market -- more than doubling FR and ATM's combined revenue
 - Frame relay has developed into a substantial market.
 - ATM is a small native services market but the primary application for ATM is an underlying architecture for other network services. This equipment revenue is not reflected here.

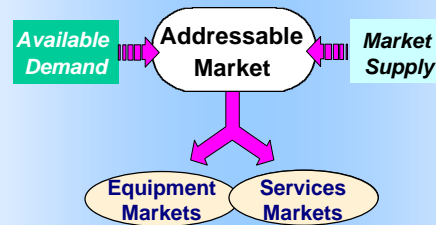
TOPICS

- ❖ Frame Relay Services Market
- ❖ ATM Services Market
- ❖ Leased Line Services Market
- ❖ Bandwidth Demand
- ❖ Bandwidth by Application

- During this presentation, I will supply market detail on these top three network services -- leased lines, frame relay, ATM. Towards the end of the presentation I will talk about the bandwidth supplied by these services and how applications like IP utilize them as a transport technology. I will also briefly discuss how different applications, specifically IP, utilize these services as transport.
- All data in my presentation has been excerpted from Vertical's latest research report called the ***Broadband Industry Update***. If any if you would like additional information on this report, send me an email and I will get you the detail. My e-mail was listed on the front page of this presentation.

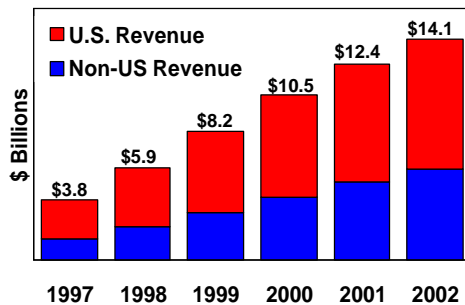
Vertical's Research Methodology

AVAILABLE DEMAND vs. MARKET SUPPLY



- Vertical Systems Group is a market research and management consulting firm specializing in the networking industry. We specialize in providing our clients with defensible quantification of emerging services and equipment markets.
- Vertical spends about 70 percent of our time tracking available demand. We've developed a database over the last 10 years that tracks the buying habits of a statistically significant portion of U.S. data networking users. We survey these users quarterly. They supply us information on their network topologies, and vendor selection and network migration plans.
- We are also in constant contact with the service providers and equipment vendors. These companies provide us with data which helps us quantify the market supply side of the equation.
- Our analysts continually reconcile the available demand with the market supply. We then utilize proprietary modeling techniques to formulate the market projections you'll see throughout my presentation.

WORLDWIDE FRAME RELAY SERVICE MARKET U.S. and Non-U.S. Revenue



- The U.S. and Non-U.S. market segments accounted for 63% and 37% respectively of the \$8.2 billion worldwide frame relay market in 1999.
- Frame relay service revenue in the U.S. is projected to grow at a CAGR of 22% from \$3.7 billion in 1998 to \$8.3 billion in 2002.
- Non-U.S. revenue is projected to grow more rapidly at a CAGR of 29% to \$5.8 billion, up from \$2.1 billion in 1998.

Worldwide

- Frame relay is offered by hundreds of providers worldwide including U.S.-based IXC's, ILECs and CLECs, global providers, PTTs and other carriers throughout the world.
- I don't plan to discuss market share here but major carriers are the leading vendors
- The worldwide market for frame relay services continues to grow steadily with revenue projected to reach \$14 billion in 2002, a 25% CAGR from almost \$6 billion in 1998. Market figures are based on public UNI frame relay services offered at access rates that range from 56/64 kbps to T3/E3 in the following regions: U.S., Europe, Asia-Pacific, Canada, Rest of World.
- While the U.S. represents the most sizable market for frame relay services, Non-U.S. markets are projected to grow more rapidly through the projection time frame. Between 1998 and 2002, revenue growth is projected at a CAGR of 29% for all Non-U.S. markets combined versus 22% for the U.S..

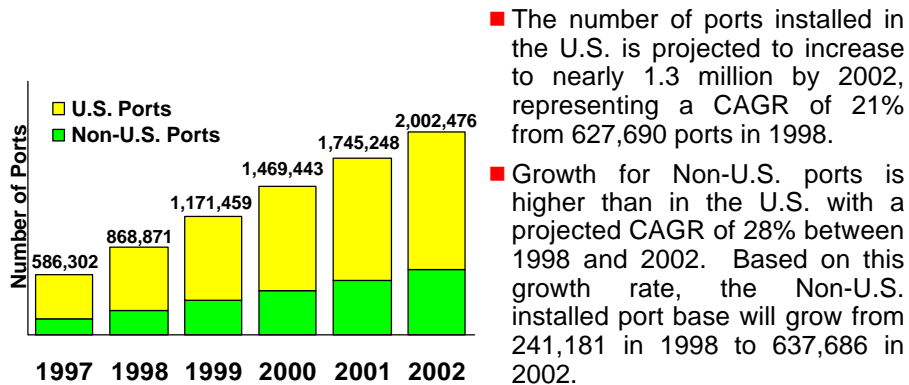
U.S.

- The public frame relay services market continues to steadily build up in the U.S. Revenue reached \$5 billion in 1999 and is projected to exceed \$8 billion in 2002.
- Year-to-year U.S. FR growth is projected to gradually slow from 38% in 1999 to 11% in 2002.

High level trends based on Non-U.S. geographical segment:

- Europe is the largest regional market for frame relay services outside of the U.S..
- Almost half of all Non-U.S. revenue is generated in Europe where public frame relay service is currently available in every country.
- Asia/Pacific is the fastest growing market worldwide.
- Canada represents the smallest market and has the smallest expected growth rate.
- Industrialized countries in the ROW region to contribute significant revenue.

WORLDWIDE FRAME RELAY SERVICE MARKET U.S. and Non-U.S. Ports



Worldwide

- Worldwide demand for frame relay service ports is projected to grow to more than 2 million by 2002. Port counts are based on frame relay UNI subscriber ports provisioned and billable as of the end of the year.
- 302,588 new ports were provisioned in 1999 and increased the worldwide installed base 35% to almost 1.2 million frame relay ports.

U.S.

- U.S. ports comprised almost three-quarters of total 1999 worldwide ports. The U.S. port base will exceed 1 million in 2000.

Non-U.S.

- New port growth is highest in the Asia/Pacific region as a result of improving economic conditions. Port growth between 1998 and 2002 for Europe is projected at 25%. Canada and the ROW regions are each projected to grow at 23% in this time frame.

U.S. FRAME RELAY SERVICE MARKET 1998 vs. 1999 Service Deployment

	1998	1999	Change
# of Installed Enterprises	29,940	32,560	2,620
# of Provisioned Access Ports			
Low Speed (64 kbps & lower)	409,710	546,367	136,657
High Speed (FT1 & higher)	217,980	290,763	72,783
Total Provisioned Ports	627,690	837,130	209,440

- 2,620 New enterprises installed Frame relay in 1999, increasing the total number of enterprises using public frame relay services in the U.S. to 32,560. The peak number of new enterprise installations for frame relay service was 9,250 in 1997.
- Market demand for new public Frame relay installations will remain steady until 2002 when the number of initial customers begins to drop off. Base attrition to alternative service technologies is not significant in this time frame and a minimal number of public frame relay customers have plans to convert their entire frame relay networks to other technologies.
- **Ports by Speed**
- 837,130 frame relay ports were installed in the U.S. at the end of 1999.
- Low speed ports (64k and below) account for almost 55,000 ports or 65% of this total.
- High speed ports (FT1 and above) account for the other 35% but are increasing at a faster rate than low speed ports.
- The number of FT3 and T3 ports is small, but growing rapidly.

U.S. FRAME RELAY SERVICE MARKET 1999 Port Distribution & 2000 Growth by Industry

Most Installed Ports

1. Transportation / Hospitality / Travel Services
2. Banks & Savings Institutions
3. Retail & Wholesale
4. Insurance / Healthcare
5. Financial Services / Brokerage

Highest Port Growth

1. Business Services
2. State / Local Government
3. Computer / Electronics
4. Automotive & Consumer Goods
5. Agriculture / Forestry / Mining / Petroleum

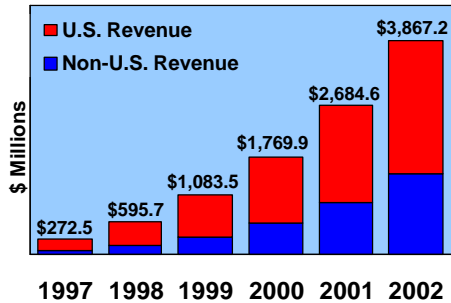
1999

- The distribution of Frame relay ports by industry shows that organizations with a large number of remote locations like hotel chains, banks, retail sites, etc. are among the most significant customers for public frame relay in the U.S. Port distribution is calculated using the 1999 installed base of 837,130 ports.
- Three industries each account for more than 10% of total ports. Transportation, hospitality and travel enterprises have the largest percentage of installed ports. The second largest industry is banks and savings institutions, followed by the retail and wholesale industry.

2000

- As we saw on the previous slide, port growth for public frame relay services in 2000 is projected at 24% across all industries.
- Business services is the industry with the highest port growth rate for 2000. This industry also had the highest port growth rate in 1999.
- State and local government entities, and the computer and electronics industries have the next largest projected port growth rates.
- The industry with the largest installed port base in 1999 - transportation, hospitality and travel – has a slightly lower growth rate but has the most new ports planned in 2000.

WORLDWIDE ATM SERVICE MARKET U.S. and Non-U.S. Revenue



- U.S. ATM UNI service revenue is growing at a CAGR of 53% from \$441 million in 1998 to \$2.4 billion in 2002.
- Non-U.S. revenue is projected at a 75% CAGR to \$1.5 billion, up from \$155 million in 1998.
- The U.S. accounts for 71% of 1999 worldwide ATM market revenue.

Worldwide

- ATM UNI services are offered by local and inter exchange providers in the U.S.. PTTs, global services vendors and other carriers provide ATM services in Canada and countries throughout Europe and the Asia/Pacific region. Availability in other areas of the world is limited due primarily to the lack of broadband facilities.
- ATM services topped \$1 billion worldwide in 1999. Market figures are based on the delivery of ATM UNI services to retail business customers at speeds ranging from T1/E1 up to OC-12 and above. This figure does not include ATM based services revenue like LAN interconnect or LAN extension services.
- Growth worldwide is projected at a CAGR of 60% from \$596 million in 1998 to \$3.9 billion by 2002.

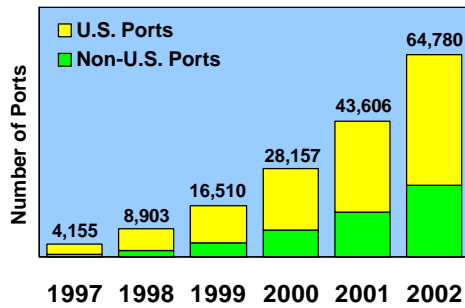
U.S.

- The U.S. represents the largest market opportunity for ATM service providers. Over 70% of the ATM service market today is in the U.S.
- Revenue in 1999 reached almost \$771 million, up 75% from \$441 million in 1998.
- U.S. ATM revenue is projected to grow to \$2.4 billion in 2002

Non-U.S.

- Although current market demand for ATM services outside the U.S. is spotty, revenue for the Non-U.S. market segment doubled to \$313 million in 1999.
- Europe is the largest Non-U.S. market with more than half of total 1999 Non-U.S. market revenue.
- Asia/Pacific is the second largest and fastest growing region
- Canada and the Rest of the World regions together will contribute about \$79 million.

WORLDWIDE ATM SERVICE MARKET U.S. and Non-U.S. Ports



- The installed base of ATM UNI service ports reached 16,510 by the end of 1999.
- U.S. ports are projected to grow to 41,914 by 2002, representing a CAGR of 57% from 6,961 ports in 1998.
- By 2002, the installed base of ATM ports outside the U.S. will reach 22,866, based on a projected 85% CAGR in this time frame.

Worldwide

- 16,510 ATM UNI service ports were installed throughout the world at the end of 1999. This figure includes all port speeds from T1/E1 to OC-12 and above.

U.S.

- Three quarters of total ATM ports worldwide are installed in the U.S. now. U.S. ports are projected to grow to almost 42,000 by 2002.

Non-U.S.

- Non-U.S. ports will exceed 22,000 by 2002. Port demand outside the U.S. is highest for countries in Europe where the installed base is projected to exceed 10,000 by the end of 2002.

U.S. ATM SERVICE MARKET 1998 vs. 1999 Service Deployment

	1998	1999	% Chg
# of Installed Enterprises	820	1,202	+ 47%
# of Provisioned Ports			
Low Speed (T1)	3,540	6,137	2,597
High Speed (FT3 – OC12+)	3,421	6,058	2,637
Total Provisioned Ports	6,961	12,195	5,234

Enterprises

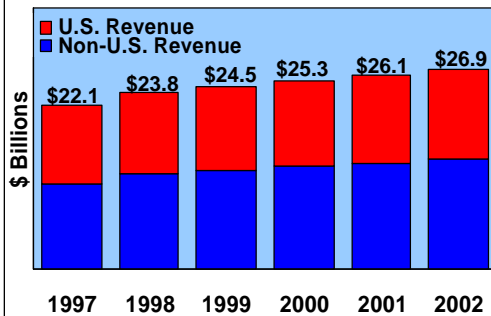
- 382 new U.S. ATM service customers in 1999 boosted the ATM installed base 47% to 1,202 enterprises. To keep this in perspective, the number of installed public frame relay customers at Y/E 1999 was more than 32,500 enterprises.

Ports By Speed

- More than 5,200 new ATM UNI access ports were deployed in 1999 increasing the U.S. installed base 75%. Totals include all access rates for provisioned (i.e., billable) ports.
- T1 is the most widely deployed access speed for ATM ports provisioned in the U.S.. T1 ATM ports comprise half of the total year end ATM port base.
- High speed ports which are defined as FT3 and above comprise the other half of the port base.
- Fractional T3 is the fastest growing access port rate with an increase of 141% in 1999. FT3 port installations are projected to surge with the deployment of competitively priced IMA services.
- T3 ports account for almost 30% of the total 1999 ATM port base. Demand for T3 ports is up 65% in 1999, driven by metro-based enterprises and FR/ATM Interworking customers.
- Retail orders from ISPs are driving OC-3 and OC-12 port demand. These ports represent 8% of 1999 installed ports.

U.S. RETAIL LEASED LINE MARKET

RETAIL LEASED LINE MARKET
Service Revenue 1997 - 2002

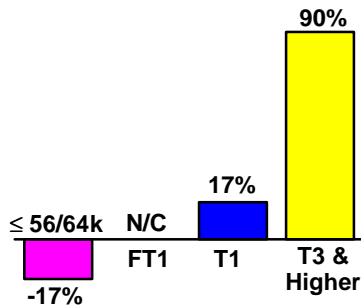


- Leased lines are the most widely used carrier-based service for enterprise networking worldwide with revenue projected to increase at a compound annual growth rate of 3.0% from 1998 to \$26.9 billion in 2002.
- In comparison, this figure far exceeds the combined worldwide revenue for frame relay and ATM services which are projected to reach \$14.1 billion and \$3.8 billion respectively by 2002.

- Leased lines are the most widely used public network service for dedicated access in the world. Market revenue is projected to reach almost \$27 billion worldwide in 2002, a 3% CAGR from 1998. Leased line revenue is split almost evenly between the U.S. and Non-U.S. regions.
- Projection figures are based on revenue generated from end-to-end leased lines sold by carriers to enterprises for use in private network environments. Not included in this analysis are wholesale circuits, internal carrier facilities, and local access circuits for other services (e.g., frame relay, ATM, etc.). Some examples of leased line networks are router-based intranets, T1/T3 multiplexer networks, SNA networks and private cell and packet networks.
- Revenue growth for leased lines is slowing as a result of increased competition, the consolidation of lower speed circuits onto more cost effective higher speed connections, and the migration of leased lines to other service provider distance insensitive alternatives including frame relay, ATM and VPN services.
- U.S. leased line revenue is growing at a cagr of 2.2% from \$11.0 billion in 1998 to \$12.1 billion in 2002. Despite the limited outlook for growth, the U.S. leased line base will remain a substantial source of revenue for service providers.
- Non-U.S. revenue is projected to grow at a 3.9% CAGR from \$12.7 billion in 1998 to \$14.8 billion in 2002. The Non-U.S. market is eroding more slowly than the U.S. market as many countries lack network service alternatives to leased lines like frame relay or ATM.

U.S. RETAIL LEASED LINE MARKET 1999 – 2002 Line Change by Speed

U.S. RETAIL LEASED LINE MARKET
% of Lines by Speed 1999 - 2002

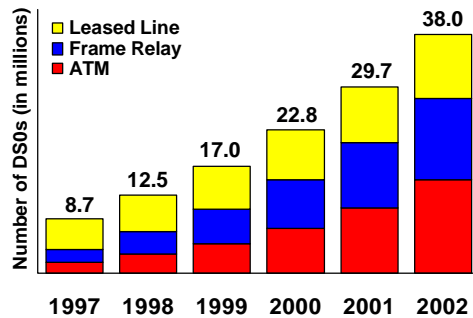


- The installed base of 56/64 kbps and lower speed lines is projected to decline 17% between 1999 and 2002.
- The net change for FT1 lines in this time frame is negligible.
- T1 base installations will increase by 17% with the addition of 20,110 lines.
- Demand for T3 circuits is projected to result in a 90% increase in the installed base.

- Total leased lines installed in the U.S. are projected to drop from 558,280 in 1999 to 512,900 in 2002. This decrease is attributed primarily to erosion in the extensive base of 56/64 kbps and lower speed circuits. However, total bandwidth based on DS0 equivalents is projected to increase significantly during this time period due to a rise in the number of higher speed circuits.
- Leased line base change is due to a number of factors including new leased line additions, upgrades from lower to higher speed circuits, consolidations of multiple low speed lines onto fewer high speed lines and circuit disconnects due to service conversions (e.g., leased line to frame relay).
- T3 and higher circuits have the smallest installed base, but the highest growth rate.
- T1 lines are projected to increase steadily from 117,740 in 1999 to 137,850 in 2002.
- FT1 lines have a negligible growth rate between 1999 and 2002 with units peaking in 2000. More ubiquitous availability of competitive SDSL services is expected to negatively impact FT1 demand in this time frame. SDSL provides FT1 speeds at lower costs than traditional FT1 leased lines.
- Counts for 56/64 kbps and lower speed circuits have been declining steadily. This reduction is driven by the migration of enterprise data traffic onto public services (e.g., frame relay, VPNs, etc.) as well as the upgrade of installed lines to higher speeds (e.g., multiple 56/64 kbps lines to T1, etc.).

BANDWIDTH DEMAND U.S. DS0 Bandwidth Demand

U.S. DS0 BANDWIDTH DEMAND
Number of DS0s



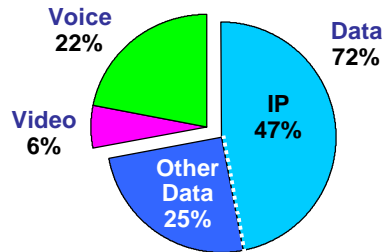
■ Enterprise demand for dedicated bandwidth in the U.S. is projected to increase at a CAGR of 32% from 12.5 million DS0s in 1998 to 38.0 DS0s by 2002. Figures are based on DS0 equivalents for retail leased line, public frame relay and public ATM services combined.

■ Leased lines account for more total bandwidth than either frame relay or ATM services until 2001.

- Enterprise demand for dedicated bandwidth in the U.S. is projected to increase at a CAGR of 32% from 12.5 million DS0s in 1998 to 38.0 DS0s by 2002. Figures are based on aggregate bandwidth demand based on DS0 equivalents for U.S. retail leased line, public frame relay and public ATM services combined. DS0 (i.e., 64 kbps) bandwidth equivalents are calculated by multiplying line or port counts by the associated number of DS0s by speed.
- Leased lines account for more total bandwidth than either frame relay or ATM services until 2001. Growth to 10.3 million DS0s by 2002 is projected for leased line bandwidth based on a CAGR of 16% from 1998.
- Frame relay bandwidth is projected to hit 12.8 million DS0s in 2002, a 36% CAGR from 3.8 M in 1998.
- ATM bandwidth growth is fastest overall with a CAGR of 50% in this time period. ATM bandwidth will surpass both frame relay and leased lines in 2001 due to rising demand for broadband speed ports.

BANDWIDTH DEMAND U.S. DS0 Bandwidth by Application

1999 U.S. DS0 BANDWIDTH UTILIZATION ATM, Frame Relay, Leased Lines



- Data applications are driving the surge in enterprise bandwidth demand. Data applications utilize an estimated 72% of all dedicated DS0 bandwidth. Almost half of this is IP.
- Voice applications utilize 22% of dedicated network services bandwidth overall.
- The remaining 6% of total bandwidth installed supports video or multimedia applications.

- Here is how the bandwidth, provided by ATM, frame relay and leased line services, is being used.
- Data applications are driving the surge in enterprise bandwidth demand. Based on the 1999 U.S. installed base of retail leased lines, frame relay and ATM services combined, data applications utilize an estimated 72% of all dedicated DS0 bandwidth, Voice applications utilize 22% and The remaining 6% of total bandwidth installed supports video or multimedia applications.
- The most prevalent data application is IP. IP is a layer 3 protocol used for internetworking applications in the enterprise environment. Dedicated leased lines, frame relay and ATM services are widely used for wide area transport of IP and other higher layer data networking protocols (e.g., SNA, IPX, etc.). As you can see, IP applications account for almost half of total bandwidth utilization.
- IP applications utilize these services because they provide performance and reliability that the internet is not sufficient for yet. Pure IP networks not ubiquitous yet.