INTERNET GROWTH 2006

TRAFFIC ON THE INTERNET
Traffic on the Internet

A

B & C Consulting Services Report

From the

“Lightwave Series”

For

IGI Consulting, Inc.

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Internet Growth — 2006
Traffic on the Internet

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The Lightwave Network Series of Reports

Note to Report Owner: As a registered owner of this Lightwave Report, you are entitled to a discount on additional Lightwave Reports. For details, call IGI at 1-800-323-1088.

This report is part of the Lightwave Network series offered by IGI Consulting Inc. and prepared by B & C Consulting Services. The Lightwave Network series of reports is an integrated, consistent approach to developing an understanding of the entire optical network as well as of the major systems comprising that network. Each of the individual reports offers (1) a discussion of the technologies involved in the primary system of the report; (2) an applications review; (3) a detailed analysis of the market drivers impacting the subject system; (4) a listing of all of the major vendors of the subject systems as well as a discussion of their products; and (5) forecasts of market results as well as prices for the subject systems.

These reports are developed in such a manner so that each one is a complete standalone document for its primary subject, but they are also consistent across the entire network to allow a broader understanding of the overall network.

The following are the reports of the Lightwave Network series. They are all available through www.igigroup.com.

General Market Reports

- "The Next Generation Network — Will the RBOCs Be Googled Up?" This report provides a forecast of the nature and components of the NGN based on the activities of major players. As a part of its review of network activities, the threat to the established carriers (the RBOCs in particular) from new competitors (e.g., Google) is characterized. Extensive market forecasts for major NGN parts are included.

- "The Market after the Mergers — The Telecom Economy Today — 2005" This report looks at the underlying causes of the mergers; discusses the coming structure of the telecommunications landscape; and forecasts capital expenditures (by company and by major carrier classifications). Forecasts capital by major carrier program; forecasts market share by carrier class; forecasts traffic, high-speed accesses, and other fundamental statistics; and provides a day-by-day history of the events around the mergers.

- "Telecom Market in Transition — 2005, The Lightwave is Going to Shine Again!" This report forecasts the capital expenditures for
telecommunications through 2009, as well as forecasts the nature of the coming industry.

- "The Telecom Market: A Delayed Recovery" This report is an update of "The Return of the Telco Market," including all of the unanticipated factors from the earlier report. This report provides a new forecast for high-speed access lines, new network traffic forecasts, and new capital forecasts for major carriers.

- "Recovery from the Edge — Lightwave Segment Forecasts" This report provides market forecasts for each of the nine segments of the Lightwave. It is also a companion report to "Return of the Telco Market — When?"

- "The Winners and Losers — The Coming Landscape of the Lightwave" This report is intended to forecast the structure of the new (post-recession) telecom market. It is a companion report to "The Return of the Telco Market — When?"

- "The Return of the Telco Market — When?" This report deals exclusively with the question of when the telecom recession will end and provides a methodology of analysis of the recession.

- "The Lightwave Post 9-11" This is an update of the "Riding the Lightwave Down and Back Up" It provides a completely adjusted set of market forecasts for the nine sectors of the Lightwave Network based on the impacts of the September 11, 2001, attacks on America.

- "Riding the Lightwave Down and Back Up" This report reviews the previous market forecasts for the Lightwave Network and revises those forecasts in light of the 2000-2001 downturn. New forecasts are provided for each of the nine areas of the Lightwave Network, as well as an analysis of the downturn.

- "Riding the Lightwave" This report is an overview of the entire Lightwave Network. It provides a nine-part taxonomy (which is used throughout the series) for the network, a discussion of key issues in each area, a listing of vendors in each area, and market forecasts for each area.

Specific Systems Reports

- "On the R-OADM to the Lightwave Network" This is the fourth of the author's reports on R-OADMs. The focus of this report is on Wavelength Selective Switches, in addition to the full coverage of R-OADM s — descriptions, technologies, vendors (systems and components), applications, and market forecasts.

- "IPTV — The Telcos' New Light Sword" This report considers the various architectures for residential access; the various alternatives for video
deployment and emphasis on IPTV. The plans of each of the RBOCs related to video are described.

- "FTTP — Going Strong in 2005" This report is an update on earlier work on FTTP. It is a completely standalone document with all of the application and design information of the previous report, as well as new information on the progress of FTTP and RBOC plans for video. It also explores in new depth the differences among the RBOCs in approach to FTTP and video on FTTP.

- "Components for R-OADMs — 2005" This report discusses the major components and subassemblies involved in various approaches to R-OADMs. It provides application information as well as comprehensive forecasts.

- "R-OADMs — Key to Upgrading the Newly Merged Networks" This report is an update of earlier reports on R-OADMs. It specifically focuses on the applications R-OADMs will have in the new networks resulting from the RBOCs purchasing the major IXCs. It includes extensive market and technical material on the subject.

- "Voice on the Lightwave — VoIP" This report addresses network VoIP and how the growth of network VoIP will influence the telecom market. It includes extensive market forecasts, and material on the applications of network VoIP.

- "FTTP — a 2004 Perspective" This is an update of its FTTP predecessor report. It was prepared after significant announcements had been made by the RBOCs concerning FTTP and the RFP.

- "R-OADMs — Still Here in 2004!" This is a complete update of the earlier report on R-OADMs. It includes all new activity since the last report, new forecasts with extended periods; and information on the newest approach to R-OADMs by means of Waveguide Selective Switches. It also includes all the market, application and technical material of the earlier report.

- "FTTP — The RBOCs' Light Sword?" This report was issued in late 2003, but well before the results of the RBOCs' RFP were announced. The report provided a comprehensive view of the FTTP plan, including the technology, vendors, and market. The report offered several scenarios for possible FTTP deployments, and identified the most likely deployment plan, along with the most likely vendors.

- "R-OADMs — the Lightwave under Control" This report describes the developing class of optical systems known as Reconfigurable Optical Add/Drop Multiplexers. These systems will facilitate the automatic control of optical networks and offer the potential of significant capital and operational savings to carriers. This report discusses the applications, candidate technologies, market forecasts (systems and components), and vendors.
• "Broadband Access — The Window to the Lightwave" This is a late-2002 update on all aspects of high-speed access to optical networks. It contains extensive material, forecasts, and technical descriptions of every aspect of this most important area.

• "Switching the Lightwave — 2001 Update" This is an update to the very popular "Switching the Lightwave" This is a complete, standalone document incorporating all the material from "Switching the Lightwave," but with a complete revision to the Vendors section, as well as completely new forecasts. Also, new technologies are covered that developed in the year since the original report was written.

• "Metro Lightwave" This report covers all aspects of metropolitan networks, including economic models, market forecasts, and extensive discussions of the available equipment.

• "Residential Networks" This report is taken from "Bringing the Lightwave Home" and covers all types of home networks.

• "Residential Gateways" This report is taken from "Bringing the Lightwave Home" and covers only residential gateways, a concept developed by the author in the mid-1990s.

• "Broadband Residential Access" This report is taken from "Bringing the Lightwave Home," and covers only the access networks.

• "Bringing the Lightwave Home" This is a comprehensive report on all aspects of the residential access network, and its immediate appendages. It includes the access networks themselves (telco, PONs, cable, and radio), residential gateways, and home networks.

• "Terabit Routers" This report deals exclusively with the very large routers known as Terabit Routers, intended for the network core. The report illustrates their applications and discusses why they are needed in the network.

• "Metro DWDM" This report deals extensively with M-DWDM (it is the originator of the term) and DWDM.

• "Switching the Lightwave" This report is an exhaustive review of the subject of optical switches and cross-connects. As with all of the Lightwave Systems reports, it includes technology discussions, market forecasts, and extensive listings of vendors and discussion of their products.
General Reports on the Network

- "How Much Is Enough?" This report reviews the bandwidth demand currently needed in FTTX deployment and forecasts that demand out to 2010. It also reviews alternatives for serving this demand and forecasts changes for the major carriers.

- "Who's Who in Optical Networking" The unprecedented growth in the national networks, based almost exclusively by the growth in Internet traffic, has caused a scramble by service providers and equipment vendors to develop the most economical and appropriate approaches to meet this growth. Naturally, this demand-driven market has also resulted in many new entrants, both service providers and equipment developers. Since the collapse of the telco markets and the 9-11 attack, many of these new entrants (and some old ones) have departed, or have vastly changed their product slates. In the last few years, the network has become extremely confusing from a number of points of view. This report not only identifies those vendors and the type of equipment they provide, but it also presents a logical way to understand the interrelationships of their equipment types.

- "Buying the Lightwave" This report brings together many of the techniques used in the other reports of the series and from the author’s consulting practice, to value DWDM and other optical network equipment. It provides ways to estimate costs, benchmark costs, models for evaluating M-DWDM vs. SONET for metropolitan networks, and models for evaluating mesh vs. ring architectures.
Internet Growth 2006 — Conclusions

The following material is presented at the front of this report for the reader’s convenience. All of the major conclusions from this report are here, with a section reference for more details.

Approach to Forecasting Traffic on the Internet

- Traffic on the Internet comes from sessions by individuals on (primarily) computers doing various tasks.
- Internet Traffic = Number of Users X Average traffic per user

High-Speed Access Lines

- Our current forecast for high-speed access lines, although it has served us well, is out of date, and needs revising.
- xDSL lines will overtake cable modems in mid-2007.
- High-speed access line will grow strongly for the next two years and then the market will start to reach saturation. The growth rate will slow as the penetration rate nears 80% in 2010.
- Computer penetration will move up from its stagnation of recent years to reach the high 80%s by 2010.
- Virtually everyone with a computer will have high-speed access by the end of the period.

Traffic Forecast for High-Speed Users

- Our current forecast for high-speed line average throughput in the busy hour is too low.
- High-Speed users spend more time online than dial-up users; they are more frequent users of the Internet; they do many more things; the things they do are far more complex and involve more bandwidth; and these trends are accelerating.
- There are many high-bandwidth uses now for the Internet that were unforeseen when our previous throughput estimates were made.
- A change in the way the busy hour calculation is made is justified, based on observations of actual traffic at Internet NAPs. The actual busy hour is much closer to the average hour than previously thought.
- The average busy hour throughput can best be calculated by estimating its major components, and changes over time in those components.
- File sharing is the major component of high-speed traffic, and the largest component of file sharing is sharing of video files. This trend also grows over time — video becomes even more predominant.
• The resulting new forecast for high-speed access traffic is substantially higher than the old forecast (about 2.5 times higher).

Dial-Up Traffic

• Dial-up access will become a thing of the past in the timeframe of this forecast (2010).
• Dial-up traffic will reduce dramatically over this period.

FTTP Traffic

• FTTP traffic will demonstrate a higher usage than high-speed accesses just as, and for the same reasons as, high-speed lines have higher usage than dial-up lines.
• FTTP lines will reach over 9,000,000 customers served by the end of the period.
• FTTP traffic will become a major factor in Total Internet Traffic by the end of the period.

Total Internet Traffic

• Total Internet traffic will reach over 2,000 kilo-terabytes per month by the end of this period.
• High-speed access traffic will dominate the Internet during this entire period, but by the end of the period, FTTP will become a major factor.

International Traffic

• The major portion of the International traffic (incident on the US) is trans-Atlantic, but trans-Pacific is growing faster and catching up.
• By the end of the period, this will be a major source of total backbone traffic in the US.

VoIP Traffic

• VoIP network customers in the US will reach 20,000,000+ by the end of this period.
• VoIP traffic will reach about 70 terabytes per month, but it is a very minor factor on the network.

Other Data Networks

• These networks are in the process of changing from ATM/Frame Relay to IP based.
• Total traffic on these networks will reach about 24,000 terabytes per month.

**Private Line Networks**

• These networks will continue to grow and prosper.
• Traffic on these networks will reach almost 80,000 terabytes per month by the end of the period.

**Voice Traffic**

• Voice traffic (long-distance traffic) will continue to grow at about 8% for a few years and then slowly decline (in growth rate) by the end of the period.

**Total Backbone Traffic**

• Total backbone traffic will grow to almost 3,500 kilo-terabytes per month by the end of the period.
• The major components of the traffic will be (in order) high-speed traffic, international traffic, and FTTP traffic. Everything else is very small.
• Our forecast for the growth rate of the Internet is about 50% per year. (1.5 times year-over-year).

**Appendixes**

• There is a great deal of reference material in the Appendixes to help the reader with some of the traffic concepts in this report.
• IPTV traffic is not included in the report but is described in Appendix I. Note that if it were included with other traffic, it would dwarf everything else. Of course, this assumes that the major Telcos go forward with the now-planned IPTV initiatives.
Introduction

This report forecasts how much traffic will be carried on the Internet backbone and on the total national North American network (excluding closed, special networks, e.g., cable TV networks and other closed video networks). Given this statement of purpose for the report, it is interesting to note that there really is no Internet backbone or North American network, in the sense of an individual entity. In the past, one could, indeed, speak of and measure the backbone traffic on the North American network. The old AT&T reported traffic loads between its Class 1 offices and the relative traffic carried on its high-usage subnet. These were real numbers that could be very accurately measured, monitored, and used as the basis of forecasts for growth.

Several things have happened since that very pristine state of affairs existed. First of all, the traffic then was practically all voice (or voice-band data) and its origin was carefully studied and analyzed with extensive data available. Also, in those past times, one entity (the old AT&T) had ownership of virtually the entire network. (There were only three to five Class 3 offices owned by anyone other than AT&T companies and no Class 2s or 1s by anyone else). Now, the traffic is almost all data, and the idea of an identifiable backbone network no longer exists. True, a very few companies carry a majority of the Internet backbone traffic (including the new AT&T and Verizon), but many carriers have a significant minority percentage. Network Access Points (NAPs) are now somewhat equivalent to the old Class 1 offices, but there are many of them owned by many different carriers. Also, the traffic now comes from a multitude of secondary subtending networks owned by a multitude of entities. While the relationship of the various classes of offices in the old national network was very clear and defined, the relationship between and among the NAPs and their subtending networks (the "network of networks," as the Internet has been called) is almost completely undefined.

Given this state of confusion and lack of physical reality of an Internet backbone, you, dear reader, may question the benefit of a report like this one. The direct answer is that while the physical reality is no longer identifiable and measurable, the amount and growth of traffic going across our (somewhat imaginary) Internet backbone still is very real and of great importance. It is the growth of this traffic that:

- Determines the need for equipment additions by the multitudes of carriers contributing to the various segments of this network of networks
- Supports facility additions (fiber and fiber routes)
- Requires additions to cable company networks (for high-speed) data
- Defines the need for higher-speed accesses and all the equipment associated with providing that extra speed
• Supports the ever increasing need for safety of data, continuity of service, and privacy of data
• Suggests the growing value of advertising and similar activities on the Internet

We recently published a report, “How Much Bandwidth Is Enough in the Access Network,” addressing the question of how much bandwidth service providers needed to plan for in the last-mile plant. That report evaluated end-user tendencies to use bandwidth for video (primarily) and data access (voice is so small that it is only considered peripherally). This report considers the "big picture" of how much traffic is carried on the backbone network. So, the “How Much is Enough…” report is concerned with micro issues, while this report is concerned with macro issues.

This report will begin with a discussion of our basic approach to forecasting Internet traffic. It will continue with our new forecasts for high-speed access growth; forecasts for the various segments of the usage on access lines (e-mail, searches, file sharing, instant messaging, and miscellaneous, as well as subdivisions of some of these). Then we will provide our new forecasts for the traffic from high-speed access lines; FTTP traffic; dial-up data lines; overseas traffic forecasts; with forecasts for various special segments — VoIP, other data networks, private lines networks, long-distance voice, etc. Finally, we will bring all of the parts together for total network forecasts. As the report proceeds through this list of traffic sources, we will provide sketches to illustrate the location of the traffic segment in the network. Major conclusions from the report are presented in a separate section.

The Appendixes provide a discussion of IPTV and a forecast for IPTV traffic. Also, extensive material is in the Appendixes, to help the reader with the various traffic concepts in this report.