Cable Modems Essay, Research Paper

Two modem technologies have emerged over the past year for switched data communications services. Cable Modems operate over two-way hybrid fiber/coax and provide user rates as high as 10 Mbps. ADSL Modems (Asymmetric Digital Subscriber Lines) operate over existing copper telephone lines and provide rates as high as 9 Mbps. Both technologies address the large markets for Internet access, remote LAN access for work at home and telecommuting, and network access for the hundreds of millions of personal computers in place today and to be sold over the next ten years.

Cable modems may offer more raw speed than ADSL, but that advantage is compromised by inevitable reductions in available cable modem speed. Cable modems share a line with tens of other users; as more users join a line, the capacity available to any one inevitably drops. The top speeds of both technologies will not be usable for years anyway. Internet server speeds, network delays, and personal computer limitations will hold usable rates at or below 2 Mbps for some time. ADSL offers higher security and reliability profiles. Both technologies are at about the same state of maturity and integration. Cable modems may offer a less expensive network solution because of its shared architecture, but that differential is more than offset by infrastructure costs required to upgrade existing networks.

The largest advantage of ADSL, and it is a significant one, is the number of telephone lines already installed that can support ADSL, or prospectively available with network upgrades. Today the global ratio is in the order of 400 million to 6 million, or about 60 to 1. Aggressive upgrades will not improve the ratio to better than 10 to 1 in the next five or six years. Even in the United States the ratio today is in the order of 20 to 1, and will not likely get better for CATV suppliers than 3 to 1 over the next five or six years.

The end of 1997 will have sold two hundred million personal computers. At present run rates, another 240 million will be added by 2001 as PCs start to approach the global population of televisions. Small offices and residences will absorb at least 25% of them, or 100 million. Forester has projected 6 million cable modems will be installed by the year 2000. With suitable pricing, telephone company connections could be triple that number, yielding an altogether reasonable figure of 25 million personal computer users operating at megabit rates as the century turns.

BASIC MODEM TECHNOLOGIES

Cable Modems. While cable modems come in many forms, the most typical create a downstream data stream out of one of the 6 MHz TV channels that occupy range above 50 MHz (and more likely 550 MHz). An upstream channel carved out of the currently unused band between 5 and 50 MHz. Using 64 QAM, a downstream channel can realize about 30 Mbps (the speed of 10 Mbps refers to PC rates associated with Ethernet connections). Upstream rates vary considerably from vendor to vendor. The downstream channel is continuous, but divided into cells or packets, with addresses in each packet determining who actually receives a particular packet. The upstream channel has a media access control that slot user packets or cells into a single channel. To avoid collisions, the system gates each upstream packet onto the network with control signals embedded in the downstream information stream. (Some cable modem configurations divide the upstream into frequency channels and allocate a channel to each !

user. Others combine the two multiplexing methods. A few modem companies are proposing techniques like spread spectrum or code division multiplexing to provide more robustness in the presence of ingress noise.) Cable modem rates do not depend upon coaxial cable distance, as amplifiers in the cable network boost signal power sufficiently to give every user enough. Variation in cable modem capacity will depend rather on ingress noise in the line itself and the number of simultaneous users seeking access to a shared line.

ADSL. Asymmetric Digital Subscriber Lines locate modems on either end of existing copper telephone lines. As the name suggests, they realize downstream speeds up to 9 Mbps, but upstream speeds up to 640 Kbps. As ADSL operates point-to-point, it does not need media access control, and each user gets the full rate available continuously. However, ADSL modem speeds do depend upon line distance, and the longer lines found today may support speeds no greater than 1.5 Mbps. The average line, however, will support speeds up to 6 Mbps. Variable rate ADSL modems will adapt to line length, offering high-speed service to almost all telephone subscribers

Cable Modems and ADSL have comparable capabilities and both can be built into broadband IP-based infrastructures. However, other issues remain, for example security, reliability, stability, and home wiring, etc. It is likely that all of them will pale before the commercial benefits of ubiquitous access enjoyed by telephone companies and ease of network deployment enjoyed by CATV companies, but they must be considered, by operators and users alike, as the information superhighway begins, finally, to take some shape.

Security

All signals go to all cable modem users on a single coaxial line, creating serious prospects of intended or inadvertent wiretapping. ADSL, on the other hand, is inherently secure. Intended wire tapping requires invading the line itself (often underground) and knowing the modem settings established during initialization — not impossible, but very difficult. Encryption and authentication will be important parts of both systems, but necessary for cable modems. (Several cable modem vendors have put encryption into their modems.)

Reliability

Cutting a CATV line in the street or losing above ground cable in a storm will bring down all users on that line. A single streaming transmitter on a CATV line will bring down all users on that line (this problem just needs network management attention, but it must be attended to). Amplifiers in CATV networks have been problems in the past. An ADSL modem failure only affects one subscriber, and telephone lines are legendary for reliability, rain or shine.

Stability

The first user of a cable modem on a given line will have excellent service. Each additional user creates noise, loads the channel, reduces reliability, and generally degrades the quality of service for everyone on the line. Quality of service will also degrade as Internet users on a line shift from text and low graphics to high graphics and multimedia, an inevitable trend if the Internet is in any way successful. ADSL itself suffers no degradation based on traffic or number of users in the access network. However, ADSL must work into an access concentrator of some sort, which will encounter congestion during peak hours. Indeed, if the concentrator output is not greater than the speed of a single cable modem, it will have identical degradation. However, it is probably easier to add concentrator capacity than split coax nodes.

Home Wiring.

Personal computers are seldom located in a home adjacent to the television, or television coaxial cabling. Personal computers, especially ones desiring Internet access, typically sit near a telephone line. Cable modems will usually require some new wiring in the home. ADSL for PC access may at some circumstances be installed without new wiring. The exact distribution of these circumstances will not be known until many units have been deployed.

Several efforts are underway to standardize cable modems, particularly ones by IEEE 802.14 and Cable Labs (now joined by ADL in Cambridge). However, it is quite likely that quite a few will be deployed before a standard is agreed, and new transmission ideas still surface. It should be noted that CATV, as a business, has not history of standards development or enforcement.

ADSL, is a standardized, scalable technology that will live in its present form for decades. The telephone business is standards driven, and standards organizations such as ITU and T1 have long and stable histories.

In conclusion, both, but ADSL will dominate. Both technologies are coming into commercial service at about the same time — mid 1997. They deliver comparable capabilities. The inherently lower network costs of cable modems compared to ADSL access systems will be offset by higher infrastructure costs incurred by upgrading existing plant, a cost telephone companies do not have to bear. In any event, network costs for ADSL systems will be sufficiently low that telephone companies will be able to match CATV pricing strategies, if necessary. However, telephone companies are already connected to the entire customer base; CATV passes a small fraction today, and won’t pass more than 40% by 2000. Even with a tie in territories covered by both enterprises, telephone companies will achieve 70 – 80% market share over-all, in the U.S. If dial up modems can serve as an example, once central office infrastructure has been fully deployed (no more than three years), ADSL and cable modems can g!

row from low millions to tens of millions very quickly.