Making DWDM Ubiquitous

Bart Stuck and Michael Weingarten

In the telecom industry, people tend to talk about equipment as being "carrier-class" or "enterprise class"—as though there is something fundamentally different and immutable about the two. There is, of course, some logic behind this distinction: Carrier-class equipment typically has higher capacity, is more reliable and supports lots of revenue-creating advanced services, but it is deployed in relatively small unit volumes. Enterprise equipment, on the other hand, is characterized by large quantities and, relative to carrier-class, lower capacity and lower unit prices.

So when the topic of DWDM—Dense Wave Division Multiplexing—comes up, in today's environment it naturally gets categorized as carrier-class equipment. After all, who else needs the OC-1920 rates achievable by a state-of-the-art DWM system that can multiplex up to 40 wavelengths, each transmitting information at OC-48 bit rates?

It's becoming increasingly obvious, however, that the distinctions between carrier- and enterprise-class equipment are blurring. There is a fundamental structural change going on, brought about in large part by the evolution of technology, in which edge LAN functionality is moving to the core, and core transport functionality is moving to the edges. As a result, we envision a future in which demand for WDM equipment will move from intercity backbones to inter-switch local transport, and finally into local fiber rings and the local loop.

FIGURE 1 U.S. Switch Location Metrics

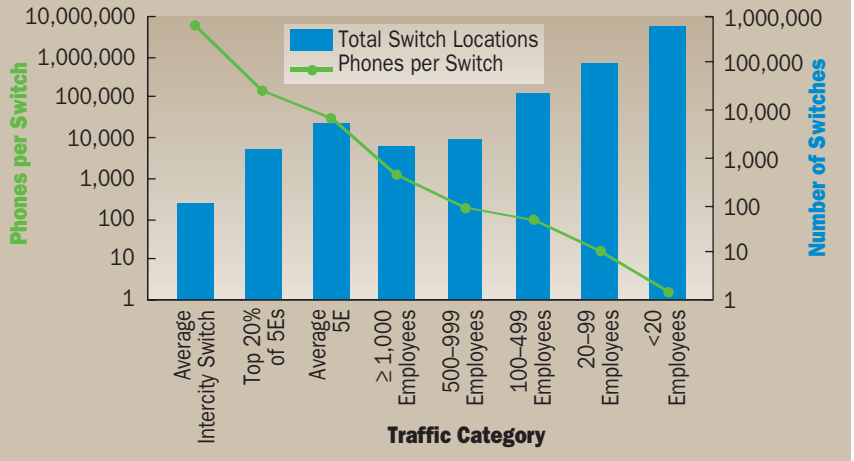
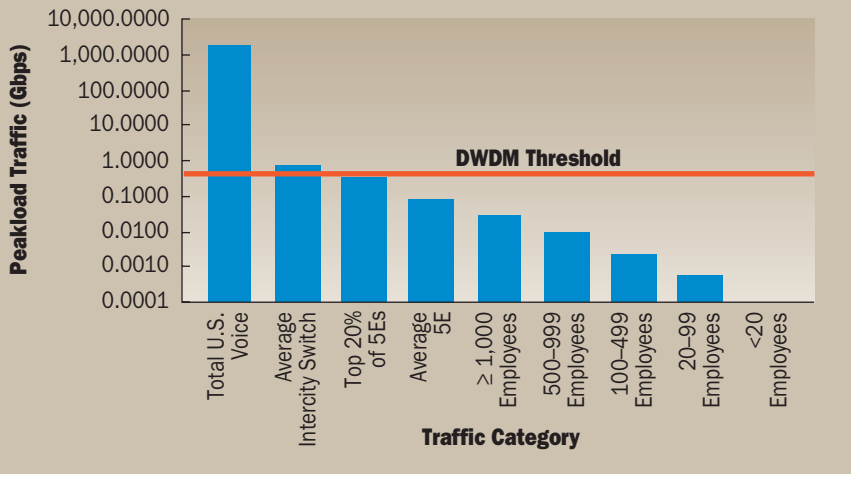


FIGURE 2 Current POTS Telephony: Peakload Gbps



The Current Voice Network

Today, of course, DWDM deserves its carrier-class status. DWDM is used to multiplex multiple optical feeds up to higher-speed rates, with the base rate OC-1 equal to 51.3 Mbps. Hence, to justify DWDM, a carrier/service provider needs transmission speeds of at least OC-12 (622 Mbps), and probably more like OC-48 (2.5 Gbps) in most applications.

To test where these speeds might be needed in the current U.S. public switched telephone network (PSTN), we estimated the system's peak-load demand for different network locations (see Figure 1). These categories include:

- The average U.S. interexchange switch (of which there are approximately 250 today).
- The average local switch (approximately 24,000).
- The average top-20th-percentile local switch (4,729).
- Business establishments in five tiers ranging from more than 1,000 to fewer than 20 employees per establishment.

As the number of switch locations increases, the number of end user stations per switch drops dramatically—from 620,000 per Class 4 interexchange switch, to 2.4 for business establishments with fewer than 20 employees.

If we apply these metrics to typical POTS peak-load loading patterns, the results indicate that at current traffic levels, DWDM is only needed at the average interexchange switch, and even here, only marginally (715 Mbps per switch, see Figure 2). Even at high-traffic local switches, the 336-Mbps traffic levels are too small to justify DWDM. The same is true of even the 6,000 largest corporate establishments (27 Mbps). So, without fundamental technological change,

Bart Stuck (bartstuck@aol.com) is president of Business Strategies LLC, (Westport, CT), a network computing and telecommunications consultancy. Michael Weingarten (michael_weingarten @monitor.com) is a telecommunications consultant with Monitor Company (Cambridge MA).