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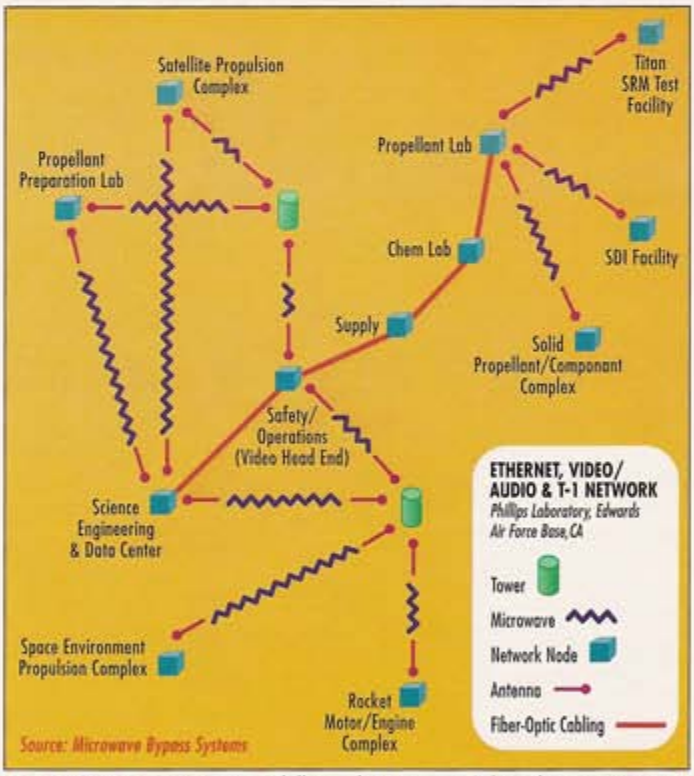
Microwave LAN Links Rocket Test Site

Wireless Ethernet carries full-motion video across the desert



MISSION ACCOMPLISHED. Phillips Laboratory on Edwards Air Force Base successfully combines Ethernet, audio/video, and T-1 links.

BY LAURA DIDIO

The scene: Fall Interop 1990. Tully Becker and Gary Stowe, two civilian computer and network engineers at Phillips Laboratory on Edwards Air Force Base (AFB), have been sent to the show on a reconnaissance mission.

Their assignment: Find the most cost-effective, reliable, and technically feasible method of interconnecting 500 scientists and researchers at 20 experimental rocket test sites across 30 square miles of desert.

The solution: Microwave Bypass Systems Inc. (MBS) in Braintree, Mass., came up with an integrated LAN that includes a series of microwave Ethernet bridges and transceivers—along with several miles of fiber and support for full-motion, real-time video.

A wireless-LAN pioneer, MBS won the contract over several competitors because of its extensive experience intercon-

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MICROWAVE LAN

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necting complex, geographically remote networks. Rob Cuomo, MBS vice president of sales and marketing, headed a team that worked with the Air Force to design and implement the network setup. One of the company's accomplishments includes a microwave backbone that operates at full Ethernet bandwidth to link 24 sites on the New England Academic Research Network (NEARnet). MBS also installed the wireless LAN interconnection links at Hanscom Air Force Base, the Smithsonian Institution, and the Dana Farber Cancer Institute.

One of many test beds located within Edwards AFB, Phillips Laboratory checks out rocket motors, firing the rockets to determine efficient propulsion levels. Because of this, Phillips Labs—which accounts for about one-sixth of the Air Force base—needs test stands that are isolated. Hence, the generous distances between the various test locations.

"If you have an application where there is nothing obstructing the line-of-sight, or if you're in an urban environment where you can't afford to dig up the streets, there is nothing better than microwave," said Jeffrey Rhodes, a former Air Force captain who was the chief engineering and operations manager in charge of procurement at Phillips. Rhodes left the Air Force late last year and is now a product engineer at Titan Advanced Digital Systems in Colorado Springs, Colo.

"At Phillips Labs we were able to run Ethernet, video, and T-1 all over the microwave. That's pretty impressive, because we were able to utilize Ethernet and T-1 on the same microwave dish just by dividing the spectrum."

LOTS OF PROTOCOLS. Interoperability was also high on the priority list for Phillips Labs' communications and computer systems division. The 20 scientific labs run a variety of network operating systems (NOSes), such as NetWare and AppleShare; supported transport protocols include TCP/IP, IPX/SPX, AppleTalk, and DECnet. The labs use the Simple Mail Transfer Protocol (SMTP) and the Simple Network Management Protocol (SNMP) and need access to locally installed Digital Equipment Corp. VAXes and Hewlett-Packard Co. (HP) minicomputers.

Novell NetWare 3.11 is the main NOS at Phillips Labs. The test facility has seven file servers; each has 25–50 nodes attached and runs cc:Mail—both local and remote programs. Additionally, lab personnel use TCP/IP-based networks for both local connections to the VAXes and HP minicomputers and for remote links to a Cray supercomputer at Kirtland AFB.

The engineers use the systems and network to perform such data-intensive tasks as computational fluid dynamics, data reduction and analysis, and statistical analysis.

"We always had state-of-the-art equipment," but the networking between the test areas and core engineering complex was "primitive to nonexistent," Rhodes said.

Microwave Bypass was chosen for the wireless LAN project, because it had the most experience and because it came up with a reliable, versatile design that incorporated both Ethernet bridging and National Television Standards Committee (NTSC) video, Rhodes said.

"We were able to speak with their other customers, such as Hanscom AFB and NEARnet, who related the positive experiences they had with running full bandwidth Ethernet and T-1 transmissions over microwave," he added.

Phillips Labs' primary application needs involved transferring large batch files and exchanging E-mail, locally and over the wide area Defense Data Network (DDN) that links the base to the Internet. The ability to transmit video data across the network would be an added plus.

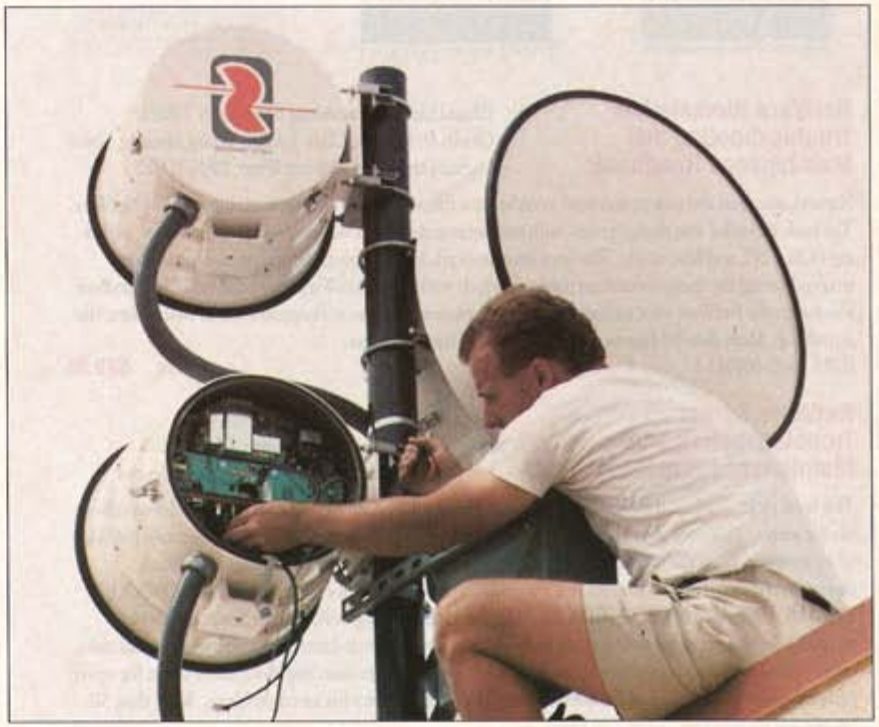
"When we had the Titan IV firing, we had to bring in a special portable microwave system to provide a video link to record the event," Rhodes said. "It was very expensive for a one-shot deal."

This past June, Phillips Labs was able to inject the video signal onto the microwave link, so everyone on the network could watch rocket test firings in real time from their desktops.

DESERT STORMS? One of the biggest obstacles to networking Phillips Labs was that some of the test centers were located as much as 10 miles apart and were separated by rough desert.

"The terrain is hilly and rocky, and there wasn't any existing infrastructure," Rhodes said. "So we had the choice of laying fiber—and it would have proven time-consuming to rip up the ground to lay the cable. Fiber was also prohibitively expensive for our limited budget. It would have cost up to $1.5 million to lay fiber cable between all the sites, and we only had $500,000 for the entire project." Microwave, on the other hand, was priced just about right.

The final cost of the wireless LAN project—consisting mainly of microwave links, but augmented by fiber-optic cable when feasible—was $500,000. By con-



WIRELESS PIONEER. Microwave Bypass was chosen to connect the Edwards AFB network.

trast, Rhodes estimates, it would have cost the Air Force approximately $400,000 to link just three or four of the 20 test sites via fiber.

Equally important, the microwave links have proven to be highly reliable.

"Initially, we were concerned about signal refraction and downtime in the event of sandstorms and windstorms in the desert," Rhodes said. "But we've never had the microwave links go down because of weather conditions. (Similarly, when Hurricane Andrew devastated Florida in late August, an MBS microwave link on the University of Miami campus survived the storm intact.)

Phillips Labs did use fiber-optic cable to connect some of the closely located buildings in the engineering complex, where there were existing underground cable conduits accessed through manholes.

"The Phillips Labs configuration is a great example of a practical integration of video, voice, and LANs utilizing both microwave and fiber," said MBS president David Theodore. "Contrary to prevailing opinion, microwave and fiber don't have to be mutually exclusive topologies. The two can complement each other to appropriately meet users' desired bandwidth and cost goals."

SPECIAL REQUIREMENTS. Besides the obvious technological and cost factors, the Phillips Labs networking project had two other requirements.

Any networking technology chosen to link the sites had to be able to withstand sudden desert sandstorms and keep on transmitting. And the technology had to be environmentally unintrusive. There could be no disruption of the desert ecosystem, nor could it adversely affect the desert tortoise, an endangered species indigenous to the region.

Once again, wireless microwave links fit the requirement perfectly.

Because rocket motors can be fired only when the wind is blowing at certain speeds and in certain directions, Phillips Labs has its own micro-meteorological weather system for tracking wind speed and direction. Lab engineers and the MBS team determined that the 60- to 200-foot-high weather towers made ideal platforms for installing the microwave links, since they offered perfect line-of-sight vantage points.

Before the wireless network was installed, the majority of the test sites at Phillips Labs were equipped only with local data acquisition computers and had no networks. The scientists and researchers at the individual sites had to save all their test data on a tape and deliver it to the computer center.

"They then had to wait for the results to be processed," Rhodes said. "Exchanging and sharing data really was done the old-fashioned way: Scientists drove the tapes from site to site. This obviously wasn't a very efficient way of doing business."

PRODUCTIVITY GAINS. The wireless installation has improved productivity at Phillips Labs in a number of areas.

"It's now much easier to communicate with and manage the personnel," Rhodes said. "And individual engineers and scientists are now much more productive, because they can log on to the network from their desktops."

Phillips Labs also can now use wireless connections to transmit real-time video images over Phillips Labs Visual Information System (PHILVUS).

Connection to PHILVUS gives the remotely located researchers and scientists a sense of community by linking them to a bulletin board that provides users with information about activities, conferences, and other events all over the base.

The wireless installation has also facilitated network management by enabling network administrators to monitor and troubleshoot the entire network from their desktops.

"Being able to simultaneously access the same file—or to copy a file from a hard disk up to the file server so users can download it—makes a big difference when you have scientists who are located miles apart," Rhodes said. ■

MAKING A MOVE. The *LAN Times* Testing Center has moved to Provo, Utah, from Salt Lake City. The new address and telephone and fax numbers are:

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