EM9006b: **News Analysis**

A Superhuman Collapse – A.T.&T.'s Troubles Show How Computers Defy Understanding Even When They Fail

By JOHN MARKOFF

The failure of American Telephone and Telegraph Company's long-distance switching system on Monday is a warning of the troubling vulnerability of the nation's complex computer networks to unpredictable breakdowns, either accidental or deliberate, computer scientists said yesterday.

The computer systems that increasingly control telephones, bank cash machines, electric power and other routine daily necessities are growing so complex that they defy human understanding, thus making it all but impossible to predict all the ways they might fail.

"When you have an extremely complex system, there can be very simple hidden failure modes that nobody has any idea about," said Peter Neumann, a computer scientist at SRI International who has studied risks involved in designing complex computer systems.

The innate peril of this computer complexity was highlighted by the A.T.&T. breakdown because the telephone company's switching network was designed with exactly this kind of breakdown in mind. Even though the system was created to prevent any single failure from incapacitating the nation's telephones, that is what happened.

Tracing the Problem

The telephone company's system has been cited as evidence that extremely complex computer systems can be virtually flawless. Indeed, some computer and military experts believe that a space-based anti-missile system composed of thousands of independent sensors and computers could act reliably.

Late yesterday, A.T.&T. officials said they had traced the problem to a faulty program running on a computer that determines which path a long-distance call takes. The faulty program, a new version of the switching software, sent a swarm of overload alarms to other computers in the network, causing widespread congestion.

The computer network should have responded by finding alternative routes for the calls; instead, about half the long-distance calls ended in busy signals or recorded messages for nine hours Monday afternoon and evening.

A.T.&T. has still not explained why the system failed to compensate for the failure of a single component, but the failure is seen as troubling evidence of how vulnerable technology-based systems are to even slight disruptions.

Rogue Program is Recalled

This vulnerability was highlighted in another way in November, 1988, when a lone graduate student disabled a nationwide computer network used by military installations, research centers and universities by inserting a rogue program that copied itself wildly throughout the system.

A.T.&T. said yesterday it does not believe its long-distance network was a victim of sabotage.

In 1980, an experimental computer data network called Arpanet that served as the basis for the network that now controls A.T.&T.'s telephone network failed unexpectedly. Afterwards, its designer determined that a failure of a small electronic circuit in a single computer coupled with a small software design error, propagated instantly through the network, stopping it instantly.

"It may turn out that something similar happened here," said Jonathan Jacky, a University of Washington computer scientist. "Both networks were supposed to have intelligence that precluded a single failure from causing a network crash."

In another example, in 1987, computer designers at TRW Inc., a large government contractor, were surprised to find that a computer network they had strung together in Europe for a United States intelligence agency was exhibiting strange, unpredictable behaviour. On close examination, the engineers discovered nothing wrong with the design of the system, which linked hundreds of computers as part of a military data communications network.

They later said they suspected that they were confronted with the mathematical concept called chaos, a way of describing otherwise unpredictable manmade and natural phenomena like turbulence in rapidly moving water or in the atmosphere.

A.T.&T.'s managers said they first became aware that something was wrong Monday when a giant map of the United States on the wall of the company's network operations center in Bedminster, N.J., began lighting up at 2:25 P.M. The lights were messages from the computers that route long-distance phone calls that they were overloaded. The trouble messages, which are displayed visually on the board, cascaded across the map.

'Just Seemed to Happen'

"It just seemed to happen," 'said William Leach, manager of A.T.&T.'s network operations center. "Poof, there it was."

Also yesterday, network designers at MCI Corporation said that they may have experienced a similar but less significant problem than A.T.&T.'s when lightning struck one of its computerized long-distance switching centers in Ft. Lauderdale, Fla. The strike disabled a network communication switch and jammed five of the company's signal transfer-point computers. But the system was able to handle the outage, successfully routing calls around the troubled areas.

MCI executives said they had installed a version of the same software that caused the A.T.&T. failure, known as Signaling System 7, last April.

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