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COVER

South African cheetah (*Acinoyx jubatus*) and her cubs. The cheetah is the single living member of the genus *Acinoyx* and is considered to be markedly divergent from the two other genera of Felidae (*Panthera* $N = 5$ species and *Felis* $N = 32\pm$ species). The cheetah as a species appears to have suffered a severe population bottleneck followed by inbreeding in its recent natural history as evidenced by an extreme paucity of biochemical genetic variation in modern populations. See page 459. [Ron Kimball, Wildlife Safari Reserve, Winston, Oregon]

Systems
Network
Architecture

IBM

To: Gina
From: Bill
Subject: IBM Technology

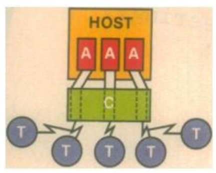
Here's the partial list I promised you of our past and present technological achievements. There are lots of things here that should be of real interest to the scientific, engineering and academic communities. What's your choice for the next topic in this series?

- Vacuum tube digital multiplier
- IBM 603/604 calculators
- Selective Sequence Electronic Calculator (SSEC)
- Tape drive vacuum column
- Naval Ordnance Research Calculator (NORC)
- Input/output channel
- IBM 608 transistor calculator
- FORTRAN
- RAMAC and disks
- First automated transistor production
- Chain and train printers
- Input/Output Control System (IOCS)
- STRETCH computer
- "Selectric" typewriter
- SABRE airline reservation system
- Removable disk pack
- Virtual machine concept
- Hypertape
- System/360 compatible family
- Operating System/360
- Solid Logic Technology
- System/360 Model 67/Time-Sharing System
- One-transistor memory cell
- Cache memory
- Relational data base
- First all-monolithic main memory
- Thin-film recording head
- Floppy disk
- Tape group code recording
- Systems Network Architecture
- Federal cryptographic standard
- Laser/electrophotographic printer
- First 64K-bit chip mass production
- First E-beam direct-write chip production
- Thermal Conduction Module
- 288K-bit memory chip
- Robotic control language

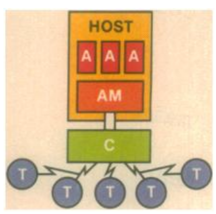
Bill -
SNA is becoming more important every day.
Let's tell that story.
Gina

Figure 1. *EVOLUTION OF SNA NETWORKS*

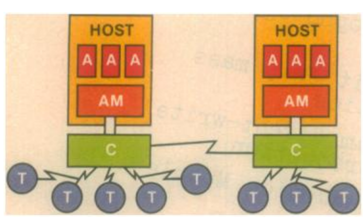
Legend:
A = *application program*
AM = *access method*
C = *communications controller (concentrator/multiplexer/front-end)*
T = *terminal or peripheral processor*
═══ *channel connection*
—Z— *communications link*



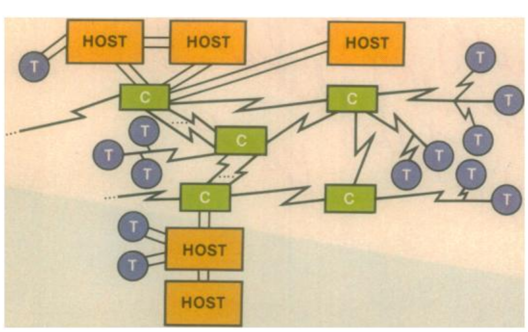
(a) In a typical pre-SNA network, communications links and terminals were dedicated to single uses or applications. All terminals on a link had to connect to the same application program, which included communications software. Usually, changing the terminal or link connections also forced the application programs to be changed.



(b) Early SNA introduced sharing of links among various application programs. A host access method permitted easy access from any terminal to any application program in the host processor. The connections could be readily changed without affecting the application programs.



(c) Subsequently, SNA configurations were enhanced to allow access between host processors for distributed processing and data-base sharing. Moreover, any terminal could access any application program at any host.



(d) Today, SNA networks can be fully meshed configurations. Parallel links between adjacent communications controllers allow increased network availability and traffic balancing. Access from host to host and terminal to host is permitted over multiple routes. The number of different types of network nodes has increased considerably, particularly among terminals and peripheral processors. SNA networks include open interconnection of both IBM and non-IBM nodes.

Advances in computing, processing and communications technologies have prompted increased interconnection of terminals, processors and communications facilities.

These various devices have been linked into networks for distributed access to processing and data-base resources.

A variety of networking applications has been developed for airline reservations, banking, store checkout, process control, remote job entry, office systems and personal computing.

Networks include a broad range of cost/function trade-offs and technologies, in such diverse components as analog/digital converters, specialized and general-purpose terminals, line concentrators and multiplexers, communications links and low- to high-capacity processors.

The networking environment requires a master interconnection strategy so that these diverse products and applications can share computational and communications facilities while interacting compatibly.

Since its introduction in 1974, IBM's Systems Network Architecture has provided the blueprint by which the capabilities of IBM networking products have evolved in an orderly fashion. SNA provides rules for all levels of interaction, from physical/electrical interconnection of computing devices and terminals to meaningful application-oriented processing.

Thus one uniform design now eliminates the complexity and inefficiencies inherent when each type of product had to have its own specialized agreement with each other type. SNA is now integrated into the whole range of IBM products—from large mainframe computers to terminals to personal computers.

By eliminating the chaos once caused by incompatible implementations, SNA allows a computer user to communicate from office to office or from continent to continent.

An important feature of SNA is the organization of functions into multiple layers. In the most basic sense, different products can be configured into networks simply by adapting them to the transmission and electrical characteristics of the media interconnecting them. But physical interconnection does not result in meaningful communication. The lower layers control only the basic transfer of bits, while the higher layers support meaningful exchange of messages and documents and allow application-

Systems Network Architecture

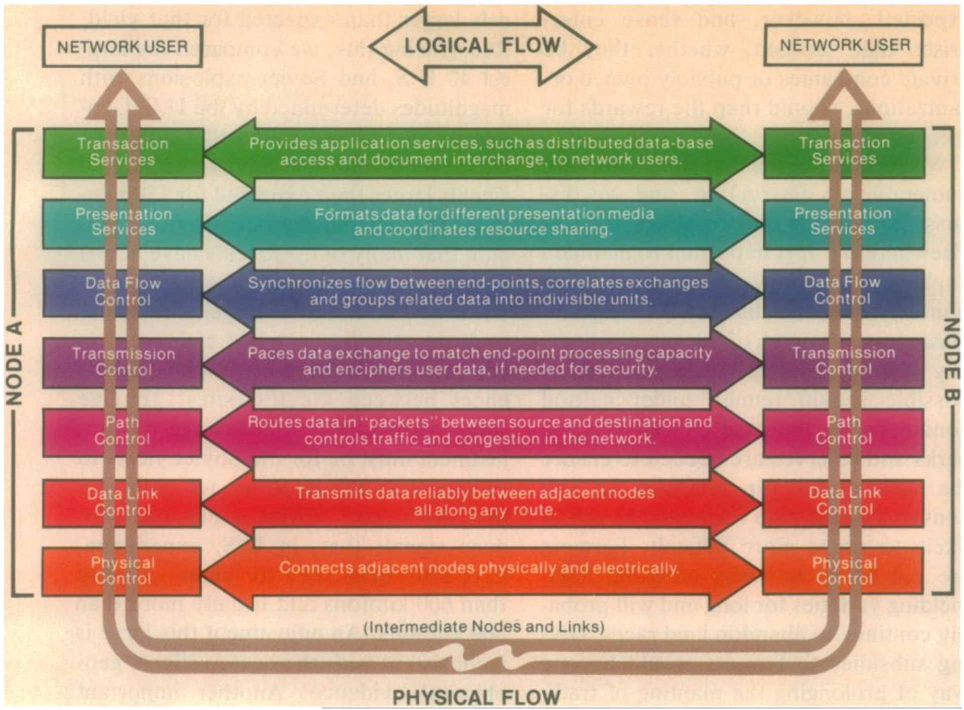


Figure 2. *Each node in an SNA network separates functions into multiple layers. Logically, a given layer in one node communicates with the corresponding layer in another node. This peer-to-peer communication relies on lower layers to transport the data.*

program interactions and data-base sharing. SNA's separation of independent functions into multiple layers means that changes in technology and capabilities can be confined to individual layers. This modular design eases adaptation to network evolution.

SNA includes a variety of functions at different layers of the architecture. For example, SNA's Synchronous Data Link Control offers increased efficiency over earlier techniques. State-of-the-art advances also have been made in traffic routing, congestion control and network availability. Additionally, SNA office systems provide document encoding uniformity and support distributed interchange, filing and retrieval services.

SNA has also incorporated protocols adopted by national and international standards organizations. This means SNA is compatible with standards such as X.25 public packet switching, High-Level Data Link Control and the Data Encryption Standard.

SNA management aids include product capabilities and software tools for planning, installing, changing, operating and maintaining networks. In today's environment, where annual growth and change typically can involve 20-50% of a network's facilities, aids such as these are critical to reduce operational expense and to foster optimal levels of network availability and performance.

IBM scientists, programmers and engineers around the world have spent collectively thousands of years of development on SNA. They continue to improve SNA's usability, manageability and performance, and also to extend its capabilities. Recent studies have focused on local-area networking, more dynamic reconfiguration within networks and interconnection of independent SNA networks.

SNA's success in reducing customer cost, while promoting ease of development of network applications, is reflected by a recent milestone — more than 10,000 large-system installations now incorporate SNA networking technology.

Systems Network Architecture is one example of IBM's commitment to product and technological leadership. Last year IBM's total worldwide investment in research, development and engineering was $3 billion. IBM®

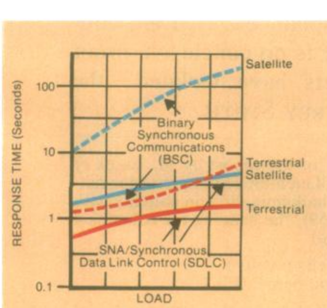


Figure 3. *Illustration of dramatic improvements in response time (using comparable display terminals) of SNA/SDLC over older data link controls such as BSC. For long-propagation-delay circuits, such as in satellite technology, the improvements in response time can be better than an order of magnitude.*

For free additional information on SNA, please write:
IBM Corporation, Dept. 605D/002
P.O. Box 12195, Research Triangle Park, NC 27709

performance. Many failures are to be expected, however, and those enterprises that succeed, whether they be private companies or publicly owned organizations, should reap the rewards for their efforts.

We certainly agree that gene banks are vulnerable to destruction, and we discuss the reasons and remedies for this elsewhere (*1*). It is important to maintain duplicate collections in different locations to reduce the chances of crop germplasm loss. As much of the genetic diversity of crops and their wild relatives as possible should remain under natural conditions. In the case of wild species, parks and reserves are needed to ensure the survival of crop relatives. In situ conservation of crop varieties, though, is likely to prove more difficult. Farmers are not likely to resist adopting high-yielding varieties for long and will probably continue to abandon land races. Giving subsidies to farmers would be one way of prolonging the planting of traditional varieties, but the administrative costs would be high; we consider this approach impractical. Planting varieties on stations is artificial, as they would no longer be integral parts of agroecosystems.

D. L. Plucknett
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1. *The Role of the CGIAR in Plant Germplasm Conservation* (Consultative Group on International Agricultural Research, Washington, D.C., 1982).

Nuclear Test Yields

In his briefing about the American Geophysical Union session on the Threshold Test Ban Treaty (News and Comment, 17 June, p. 1254), R. Jeffrey Smith misquotes us as saying that, since 1976, two U.S. nuclear explosion tests have exceeded the 150-kiloton limit of the treaty "by 33 and 75 percent, respectively." We certainly did not say this. On the contrary, we were careful to point out that very accurate radiochemical measurements show that no U.S. test has exceeded 150 kilotons since 31 March 1976. What we did say is that there is imprecision in the yield estimates based on seismic signals recorded at great distances and that occasionally 150-kiloton explosions will produce signals larger than expected for that yield. Recognizing this, we compared the largest 40 U.S. and Soviet explosions with magnitudes determined by the U.S. Geological Survey and found that only two U.S. events, but nine Soviet events, had signals larger than expected for 150 kilotons. This asymmetry raises serious concern that many of these tests have actual yields well over 150 kilotons. Our analysis included a fairly large adjustment (reducing the Soviet yield estimates) to correct for suspected geophysical differences between the test sites. To give some perspective on how large this adjustment must be for the Soviet yields to be less than 150 kilotons, we point out that the largest Soviet explosions produce signals that, in U.S. experience, have only been seen for yields of more than 600 kilotons and usually more than 800 kilotons. An adjustment this large is inconsistent with the best available geophysical evidence. Another important point conceded by nearly all involved is that the yields of the larger Soviet tests increased abruptly by about a factor of 2 in recent years. Thus, those concluding that the Soviets have not exceeded the 150-kiloton nuclear testing limit are also saying, by implication, that the Soviets did not test above 75 kilotons or so for the first several years of the treaty (when the United States was testing up to 150 kilotons). Why would they stay so far below an agreed limit? The question is not one we can answer but certainly is added cause for concern.

Ralph W. Alewine
Thomas C. Bache
Defense Advanced Research Projects Agency, 1400 Wilson Boulevard, Arlington, Virginia 22209

David Emery, the new deputy director of the Arms Control and Disarmament Agency, has consulted a variety of government seismologists and reached a different conclusion about the best available geophysical evidence. In congressional testimony on 17 May, Emery said that "by far and away the great majoriy of detonations that have occurred have been in a range which leaves little or no doubt that those particular shots have been within compliance. . . . I am convinced that there is no conclusive proof [that] the Soviets have violated" the treaty.—R. Jeffrey Smith

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Erratum: In table 1 of the report by M. Essex *et al.*, "Antibodies to cell membrane antigens associated with human T-cell leukemia virus in patients with AIDS" (20 May, p. 859), the heading for columns 4 and 5 should have read

"Cells positive
(> 40 percent)"

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Coping with Gridlock

At the recent AAAS Annual Meeting in Detroit, the Council, with barely half its members present, voted unanimously a resolution calling on the governments of the United States and the Soviet Union to negotiate a halt to the buildup of nuclear weapons of the class that threatens each side's deterrent capability.* It was not a call for a comprehensive freeze across the family of nuclear weapons, but rather a very carefully formulated proposition aimed at the most unstabilizing element in the tense standoff into which both sides have drifted.

It was not the first time that an Annual Meeting has deplored the nuclear arms race and called for serious and purposeful arms control negotiations. What is different is that, with the support of its Committee on Science, Arms Control, and National Security, the Association has moved from generalizations to a realization of the intricacy of the national security dilemma, and to a better understanding of the multiple strata of complexity that must be dealt with knowledgeably. It is not helpful, for instance, to advocate a mutually "verifiable" agreement without confronting the realities, uncertainties, and technical limitations of available verification methods. In that regard, AAAS intends to go as far as classification limits allow to prepare and publish a readable "primer" on verification to aid the general understanding of this problematic factor.

The itch for a quick fix to the nuclear nightmare seizes us all. It seizes the peoples of the Soviet Union, too, although the power structure is vigilant in suppressing the spread of a popular peace movement that might get out of hand. Yet, even with the momentum increasing for a qualitative abatement of the confrontation, it becomes clearer that the two sides have so little trust for each other that progress will be measured in inches, not in yards.

It is questionable whether a bargain struck in some manner to level off and reduce nuclear risk would be durable in the absence of a supporting framework of mutual stakes and interests. It would take more than a brief summit meeting and a handshake to produce such a framework. Given the ideological differences, it would take a lot of doing, but there is every reason to probe for openings in that direction even as the tedious arms control talks are resumed. The National Academy of Sciences, notwithstanding profound differences with the Soviets over human rights practices, has succeeded in preserving tenuous contacts with its counterpart institution in the interest of building trust. It may appear to be a small light in a spreading darkness, but its range of magnification is considerable.

As the texture of peace hangs each year by fewer and fewer threads, the need to reinforce arms negotiations with supportive joint initiatives becomes more compelling. Economic, scientific, and cultural ties should be seen as strategic instead of tactical. They provide a framework, an infrastructure, that is grounded to mutual interests and advantages, and they begin to assemble the countervailing array of connections that can in some measure abate distrust and create bilateral stakes that are themselves stabilizing. Each side has technological capabilities and scientific assets that could, without risk to either side's national security, be pooled. Ample and productive precedents already exist in such fields as astronomy, medicine, astronautics, and polar research.

The present danger is serious indeed. There is every reason to search for agreements to ease the nuclear gridlock. But if, at the same time, a broader basis for increasing mutual trust is not sought and found, the edge of crisis could yet draw blood.—William D. Carey

*Copies of the Council resolution are available from the Committee on Science, Arms Control, and National Security, AAAS, 1776 Massachusetts Avenue, NW, Washington, D.C. 20036.