The Reservisor Automated Airline Reservation System: Combining Communications and Computing

JON EKLUND

Shortly after the beginnings of the computer in the mid-1940s, a machine appeared that was the first in a long line of important commercial systems integrating communications and processing: the Reservisor airline reservation system built by the Teleregister Corporation. A few parts of the original have been preserved at the Smithsonian Institution, and there are enough records to understand both the basic issues in the airline industry that led to the development of this remarkable device and how the machine helped solve some of the problems of rapidly evolving air-transport technology. This article also discusses the place of the Reservisor in the larger view of the development of information technology.

Modern information technology is historically founded on two deep footings: communications and processing. While both can be traced back beyond the historical record, arguably the greatest change in each occurred when their technologies became electrically driven.

As the first truly "modern" technology, communications led the way into the age of the immediate with the Morse telegraph in the late 1830s. Not long after came the popular miracle of the Atlantic cable, which connected continents. From the effort to carry multiple telegraph signals on a single wire (since erecting telegraph lines was fearfully expensive) came the telephone in the 1870s. The name "wireless" correctly suggests a desire to avoid that enormous economic drawback — wires — which plagued both the telegraph and telephone. Sending signals through the air (or ether) was but one more miracle from a long line of unforeseen leaps into hard-to-believe futures for communications technology in the nineteenth century. The leaps from wireless to radio to television are familiar to most of us. Thus were spawned the "glamour industries" of most periods in the nineteenth and twentieth centuries.

Curiously, electrically driven processing on a large scale lagged communications by nearly a century, perhaps because the *modification* of information inherently requires more steps and internal subsystems than *moving* it. To be sure, the Hollerith machine and its card-based electromechanical descendants were impressive and important, but their impact on the social and commercial world was not on the same scale as the telephone or even the telegraph. Indeed, influences of that scale did not happen until the advent of computers which, of course, have turned out to be the quintessential information engines.*

As we also know, there has been a clear trend to combine processing and communications technologies in various ways and to varying degrees. For example, digital processing technology now plays a central role in television. Beyond the obvious ever more elaborate graphics and animation tricks lies the crucial infrastructure of digital switching. In the last year or so, the media have trumpeted ambitious plans for "information highways" to transmit unimaginable amounts of computer data. For even longer periods, newspaper articles and other media sources have let the public in on the trendy and even useful fun of computer bulletin boards and commercial "on-line" services. Less well known is the fact that, shortly after the beginnings of the computer in the mid-1940s, a machine appeared that was the first in a long line of important commercial systems integrating commercial communications and processing: the Reservisor airline reservation system built by the Teleregister Corporation. As far as we know, all that survives of the system is an agent set, two racks, and a magnetic-drum memory, which are now housed in the Smithsonian Institution.**

The background to the Reservisor system: The reservations problem

Whether an airline flight was short or long, the problem was in sending and receiving immediate and accurate information. An oversold flight meant angry passengers. On the other hand, an unoccupied seat suffered an immediate 100 percent markdown as the plane closed its doors.

* In May 1990, the National Museum of American History opened the most extensive and complex technology exhibition in the Smithsonian's history: "The Information Age." This introductory material is from the original themes of the exhibition.

** The agent's set is now on display in the exhibit "Beyond the Limits" in the National Air and Space Museum. This exhibit covers the history of computers in aerospace technology.

1058-6180/94/$4.00 © 1994 IEEE

Early methods of airline reservations were ingenious make-do systems based on the systems used for slow-moving Pullman accommodations. The basic technology consisted of telephone calls made by agents. Flights were handled from the point of origin. This had a somewhat different meaning in the immediate postwar period. The gains in the range of airplanes developed during World War II would take a few years to come into wide use in commercial aviation. Limited ranges meant that longer flights were broken up into "legs." Each "leg" was treated as an origination. Longer flights meant that a ticket agent had to combine legs by phoning a *series* of origination points.

Flight information was sent and received through a complicated system of manual operations. The booking point had a manual display board (often using chalk) which recorded the number of available seats on a particular flight. Local agents were in sight range of the board; some even used binoculars. Agents or travelers from other locations seeking reservations by phone suffered from time lags involved in getting, using, and modifying the data on availability of flights. Advance sales or cancellations might be initiated by letter, by telephone, or in person. But all ended up as a written record at some point, sent to a central inventory control unit. There was inevitably much guesswork about selling or not selling seats, and many frustrations and difficulties in communicating effectively with agents, as most reservations information exchange was done by phone. Overbooking was reportedly common. If anything, return reservations were even more difficult to do.

A point-of-origin agent could see the board, of course, but the official availability data was that held in the central ticketing office. If there was a question about seat availability, even the local agent had to call this office. As air travel increased, it became clear that the system was on its way to breakdown.[1-4]

Other ideas for automating airline reservations

There are indications of one or two early conversations and proposals to automate reservations in some way or another. Ralph Damon, president of American Airlines, was approached by Sperry in 1945 with an offer to design a system. Damon was obviously not convinced, since the airline selected Teleregister later the same year.

In 1947, well after the Teleregister effort was under way, Engineering Research Associates of St. Paul, Minnesota (later bought out by Sperry) wrote a "Proposal for Automatic Space Reservations System," which featured the use of an electric typewriter as the input and output device. In the same year, the *St. Paul Dispatch* carried an announcement that Northwest Airlines had access to some kind of device that could give a yes or no on requests for airplane seats. There is no evidence that either of these two systems was ever built.

American Airlines takes up the challenge

Just after the war, with a clear vision of the potential problem, the head of American Airlines' Systems and Methods Division, Charles Ammann, researched the various existing methods for handling seat inventories. He concluded that all were as limited as those of his own company. Carefully analyzing the various aspects of American's traditional "request and reply" and "sell and report" systems, Ammann outlined solutions to existing bottlenecks:

There was inevitably much guesswork about selling seats and frustration in communicating with agents, as most reservations information exchange was done by phone.

1. A new system should present the flight information necessary for the customer's decision immediately and clearly.
2. The new system should keep track of ticket sales and cancellations as they occur and keep up an accurate running inventory.
3. The agent's machinery in the new system should retain a record of the most recent transaction until consciously cleared or until another transaction replaced the previous one.
4. The system should automatically let all agents and sellers know immediately when a flight was sold out.
5. The system should perform these tasks economically and be capable of expansion.

Using his training as a radio engineer, Ammann built a limited working model of an electronic inventory-control system. The model assumed three flight legs in three days with three agents connected to the central office. Relays served as storage, and availability was indicated by lights. Simple push-button switches set up availability queries.[5]

Ammann brought this model to the president of American Airlines and sold him on the idea of a flight reservation system.[3] After considering various possibilities for a commercial developer for the project, American Airlines negotiated with the Teleregister Corporation in 1945 for its construction.

The Teleregister Corporation

Teleregister was founded in the 1920s to handle the display of stock market transactions using automated display boards instead of handwritten entries on chalkboards. The founder was Frenchman Philip Dreyfus, who had been in the French signal corps. Dreyfus was familiar with French signal techniques such as Baudot codes, which were more sophisticated than the Morse system. He became a pioneer in the teletypewriter and teleprinter business. It is said that he got the idea of displays during the growth of the stock business in the 1920s. Large Teleregister boards became fixtures at many brokerage offices, and Teleregister became the leader in this technology.

Immediately following the war period, the firm was located in Stamford, Connecticut.[6]

The Reservisor pilot project

The Teleregister information boards used in brokers' offices for stocks were not very different in intent from the manual boards used by the airlines. This may have been why Teleregister was selected for the contract to do a pilot project for the American Airlines office in Boston. The system was installed on February 2, 1946.

The Boston board was but a little more sophisticated than Ammann's electronic model of the desired system. It was local, had no remote capabilities, and was designed to test the *processing* phase of the operation *without* a communications tie-in. Perhaps Teleregister felt confident about the communications, since most of the boards they installed in brokerage houses were sent information over the teletypewriter lines. In any event, there was no overall count of the immediate number of seats available, only whether (or not) the immediate request could be filled.[7,8]

Even though they were in the same location as the central information system, the agents used the machines rather than voice or eye communication. They queried the system by pressing contact button switches and received light signals to indicate availability, just as they would in a remote location. Though there really was little gain in this test situation over the sight method, Teleregister engineers and the airline learned much about the potential of the system. There were more tangible benefits. It was faster to record availability data using plugboards than writing on a chalkboard. The working rooms could be smaller, too, since the large visual display could be eliminated with the use of the agent set.

Each agent was now a relatively independent unit. Since the information reached the agent directly, sales could be closed immediately without the lag necessary to contact the central board or office by telephone and get the information.

Perhaps the most interesting lesson was the surprising reaction of the public to the device. Agents discovered that the reactions of the customers to unavailable flights were less negative. Customers felt that the machine was unbiased and neutral, and would give them accurate information. By contrast, the public sometimes suspected agents of holding out on them or of favoritism.[6]

The Boston office continued in operation through the late 1950s until it was made part of the SABER* system in the early 1960s. The somewhat peculiar triangular agent sets, as well as other parts of the system, were upgraded over the course of the lifetime of the Boston station.

The development of the "Magnetronic" Reservisor

There are tantalizing indications of a transfer of knowledge in reservations technology and procedures from the railroads to the airlines. The railroads had reservation systems for a long time, of course, and early in the development, Teleregister hired a number of railroad people who in fact stayed with the Reservisor division over its lifetime. One witness claims to have seen the same route maps used to schedule the movement of railroad cars being used for planes. A lot of procedures had, according to coworkers formerly from railroads, been moved directly from railroads to airlines, including the communications network.[6,9]

Another important resource for the computer side was Howard Aiken, who had built the Mark I relay calculator at Harvard University and who was a consultant to Teleregister. It was said that much of the logic of the Reservisor system came from Aiken. Aiken was reportedly seen around the Connecticut headquarters for meetings.[6]

Most "teams" that develop a piece of technology experience turnover during the period of the project, and always seem to the members and leaders to be at less than full strength. The group who developed the Reservisor was no exception, but work was started in April 1949 on the LaGuardia location in spite of shortfalls. The first working version of the Reservisor, known rather pompously as the "Magnetronic Reservisor" after its magnetic drums, was working reasonably well by the spring of 1952. It was unveiled and put into full service in June of that year. The next generation came in 1956 with enlargements in the amount of memory, which allowed more flights to be handled. It also handled the network of agent sets better and could reserve more than 10 days ahead.[7,10,11]

The American Airlines system worked so well that eventually there were Teleregister systems at TWA, United, Braniff, National, Northeast, Pan American, and Western. To the disgust of the Reservisor management, Eastern eventually went with Univac.

The technology of Reservisor

The system was binary, which was in keeping with the rather simple yes/no nature of the information on availability. For the time, the design requirements were impressive:

1. Storage capacity for 1,000 flights or flight stops (partial flights).
2. Storage capacity for 10 separate dates for *each* flight stop (10,000 units of "flight memory").
3. Sufficient capacity in each storage record for an inventory count of at least 100 seats.
4. Preservation of stored information in the event of a power failure.
5. "Sufficient checks" to be able to detect incorrect input signals, malfunctioning of electronic circuits, and incorrect inventory quantities.
6. Random access to the memory.[12]

The central computer was to be installed at LaGuardia in an area of 1,000 square feet. It was designed as a mix of tubes and relays, though the version built around 1957 ended up with some 4,500 tubes and 3,000 diodes.[13]

More interesting was the fact that the machine was built in a "fail-safe" configuration. As the block diagram

* American Airline's successor to Reservisor was originally named SABER, an acronym for Semi-Automatic Business Environment Research. The name was changed to SABRE in 1959 for marketing reasons.

(Figure 1) of the Reservisor clearly shows, it was actually two machines, each built around its own magnetic-drum memory, which simultaneously worked on the same input data. They compared signals at every stage and would print error messages for service personnel if there were discrepancies. Most of the time, problems could be located quickly and solved within a few minutes. The duty cycle of the machine was 22 hours, with two hours of scheduled maintenance *each day*.[11,12]

Saturday nights there was a longer downtime for more elaborate scheduled checks. Unscheduled downtime was reported as less than a tenth of one percent. Tube reliability was over five times better than predicted. During the entire first year of operation, it was necessary to change only 129 tubes, or about 10 per month. Further work on maintenance schedules and tube selection got the tube life to the point that the machine went two to four months without tube failure.

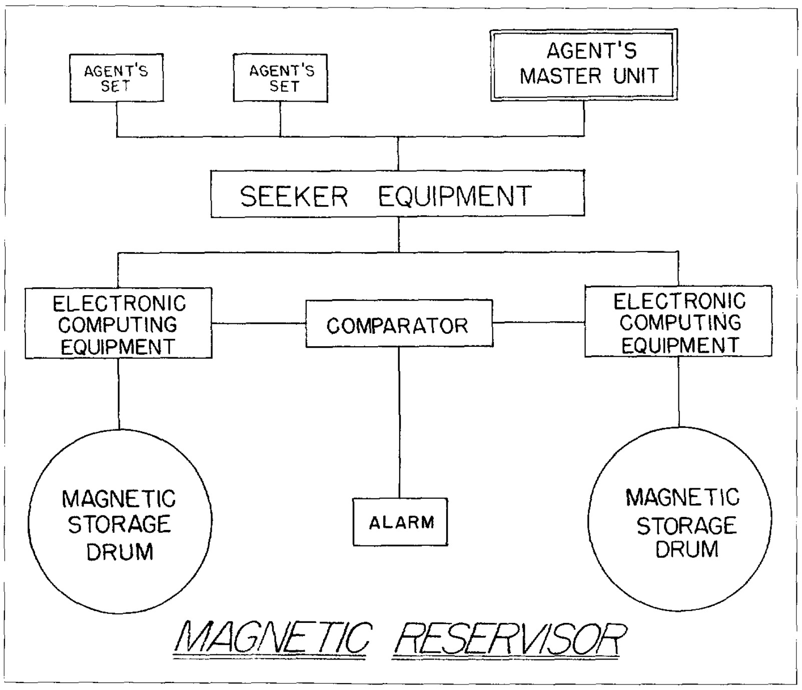


Figure 1. Block diagram of the Reservisor (Charles E. Smith Museum, Dallas).

The Smithsonian has the drum from the first Reservisor. Markings are engraved on the drum. There were 20 to the inch, meaning that the bit density on the drum tracks was 20 to the inch. The drum provided for 1,024 memory locations repeated in 10 circumferential sections. Each date section provided 7 bits, giving a count of 128 per memory "bin." Magnetic storage on the drum protected the inventory data from power failure.

Actually, there were two drums locked together. Technicians could disassemble them and replace one with the other if the first failed. The second drum functioned as a backup. (In the first four years of operation, however, it was necessary only *once* to take one of the two halves of the machine off line.) During the input storage operation, the system wrote to both drums, but read from only one. There was reserve capacity, since doubling the packing factor from 20 to 40 to the inch would allow 2,048 "bins" on the periphery. Figure 2 shows a section of the Reservisor magnetic-drum memory.

Design was very conservative, with an emphasis on reliability rather than speed. The access time was given as 50 ms.[12] The goal was to have a device that was more reliable than any other type of data-handling machine or system of people. Wherever possible (if there was enough time), twin contact relays were used instead of tubes because of their reliability. All components were mounted on plug-in assemblies for easy servicing and minimum downtime. All transactions were introduced into *both* halves and compared for similarity at four key steps. If there was a discrepancy, error signals were generated.[12]

The instructions for the machine were hardwired. There was no intent to build any kind of general-purpose computer.

The public's experience with this technology

If the traveler came to the agent's station, she or he would see the operator involved with two pieces of equipment:

- one of a number of coded destination plates (see Figure 3) and
- an input and output device called an agent set (Figure 4) that looked rather like a slightly oversized version of a calculating machine of the period.

Two additional parts of the system were hidden:

- the telephone lines and
- the computer (Figure 5), located at LaGuardia airport.

The coded plate could fit into the agent set slot in four ways (front top or bottom, and back top or bottom) and thus hold up to four groups of flights. Each group (orientation of the plate) had eight columns of information and thus held up to eight flights over some part of the day (e.g., 6 a.m. to 5 p.m., 3 p.m. to 9 p.m., and so on).[11]

A would-be traveler would enter (or telephone) and ask the sales agent at a ticket office for a particular flight or a general flight time up to 10 days in advance. The agent selected a plate that had the requested destination and time of day, then placed the plate in its slot in the agent set. The agent then punched in the desired date (up to 10 days away)

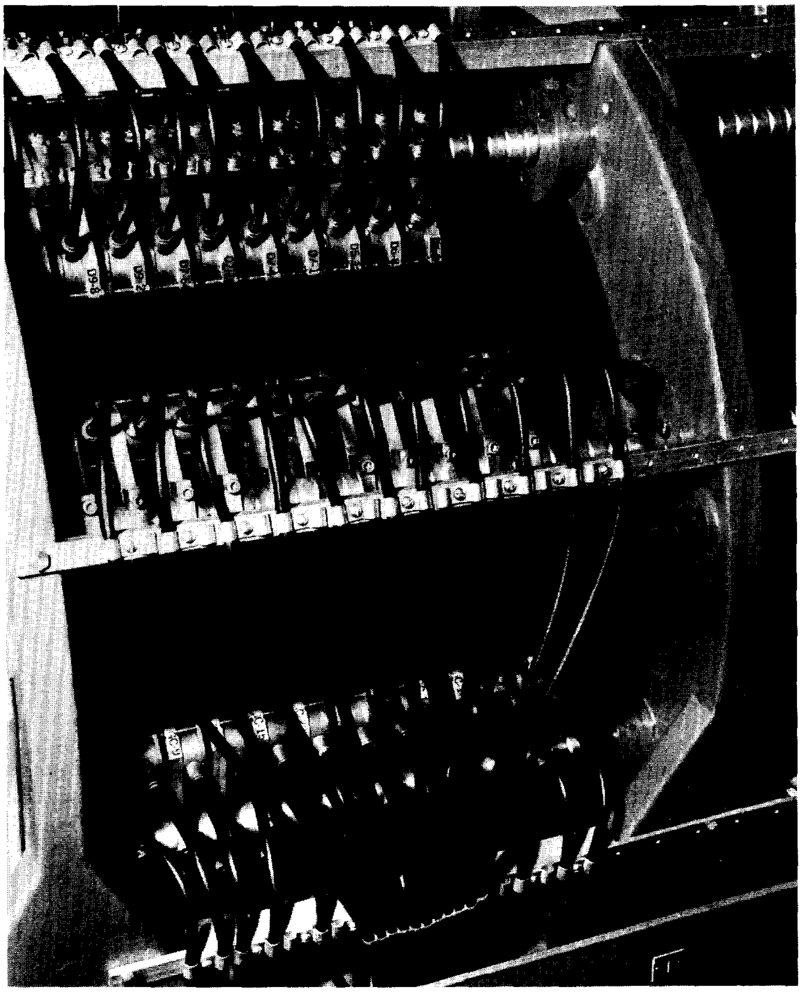


Figure 2. A section of the magnetic-drum memory of the Reservisor (Charles E. Smith Museum, Dallas).

Thus, within a few seconds, the agent could tell the traveler which flights were available for the number of seats wanted. When the traveler made up his or her mind and chose a flight, the agent pushed the switch that accompanied the availability light for that particular scheduled flight, and then pulled the "sell" switch on the lower left of the keyboard area. The agent's set then sent a signal to the central computer requesting another check of the availability of the desired seats. If they were still available, that number was subtracted from the day's seat inventory. The computer then sent a confirmation signal back to the agent's set, and the upper green light on the panel lighted.

If the inventory was depleted while the traveler was deciding and the seats were suddenly no longer available, the lower "reject" light turned on and seats were not subtracted from the inventory.

The technological lessons of Reservisor

There was little question about it. As one observer of the scene summarized Reservisor's performance in 1956:

> It [the Reservisor] shows that information can be processed by a central computer, at the time the transactions occur [real time], with negligible delay, and with inputs scattered over a large geographical area. It shows that an electronic system can provide important by-products, the value of which is hard to estimate... It shows that customer service can be improved, by answering inquiries more rapidly and by reducing the chance for overselling a flight due to human bookkeeping errors. *And it shows that a complex electronic system can provide reliable operation to a degree generally not attainable by manual or punched card methods* [italics mine].[11]

We take all of these for granted now, of course, but at that time these characteristics were not all certain and taken for granted. To many, they were startling.

But technology is more than an assemblage of devices, and nowhere is that illustrated better than in the human limitations in the use of Reservisor. When Julian Reitman was hired in 1955, part of his job was to study the patterns of usage

and the number of seats (up to four). Finally, the agent pulled the right-hand switch ("AVAIL") to start the check for availability.[12]

The next steps were done by the machine. It made the connection via the leased teletypewriter line to the central computer at LaGuardia. The computer accepted the inputs of destination, date, and number of seats. Then it searched for the number of unsold seats on all of the flights (as many as eight) listed on the plate. All flights listed on the plate that had available the requested number of seats got a coded signal back from the computer. On the agent's set, the coded signal was identified and sent to a light below the appropriate column of the destination plate. Travelers who were familiar with the system might wait anxiously for the light to come on under their preferred flight or time of day, or for several lights (if they liked to have choices), or for any lights at all.[6]

and practice, and the traffic that resulted. He discovered that American Airlines seldom, if ever, used the Reservisor system in the way it was designed to be used.

The system was designed to automatically decrement the total number of seats available by the number entered by the agent as sold. What Reitman discovered was actually happening was that the number was not decremented until the sale had been registered manually by a clerk at the machine's installation, and a slip had come down to the operator on a conveyer belt. Somehow when the crunch came the people on the operating end couldn't quite bring themselves to trust the machine, and kept a human in the loop. After the handwritten slip came down to the operator, he would decrement the number manually.[6]

Not all of the lessons were so straightforward. Between 1956 and 1959, Reitman did studies comparing standard communications theories with the actual performance of the Magnetronic Reservisor system. The system was anomalous by comparison with standard telephone networks. Of the agent sets tied to the main office at LaGuardia (a number which varied between 50 and 80), some 75 percent were at the large reservations amphitheater on 42nd street. The rest of the information came in on communication phone and teletypewriter lines from remote locations. These lines worked at the incredibly slow pace of 50 baud (about 5 percent of the speed of the common modem of the late 1980s). In a real sense, the engineers did not understand how the machine actually functioned in practice because the standard communications concepts did not apply to the Reservisor System.[6]

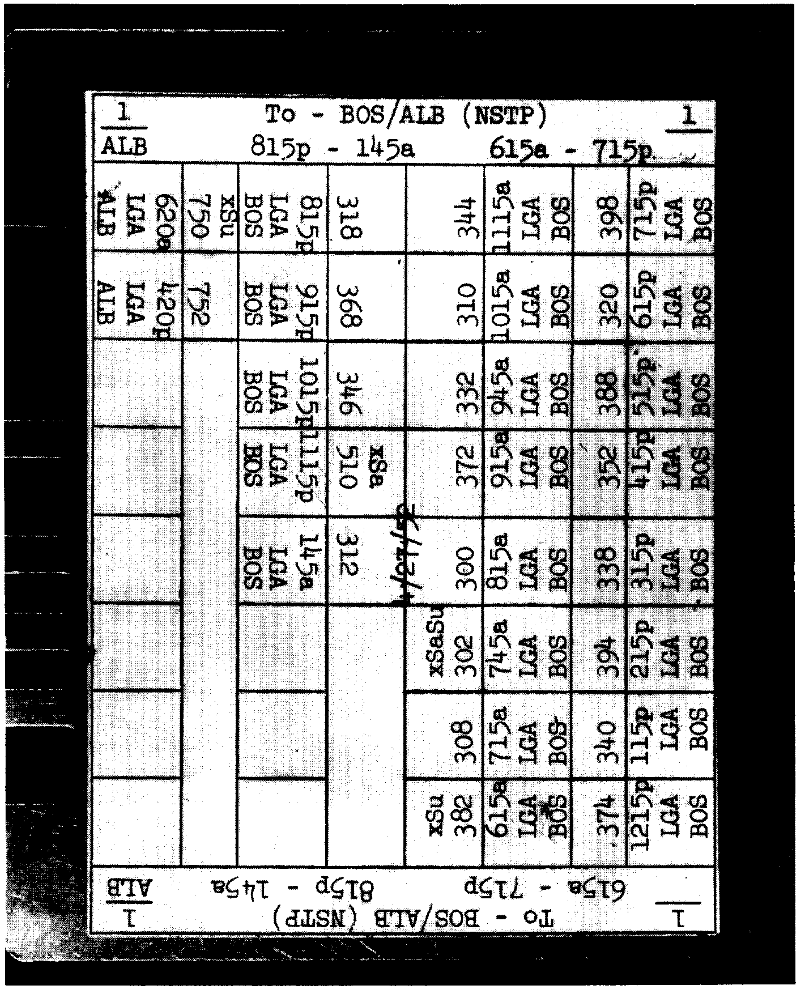


Figure 3. Destination plate for a Reservisor agent set (Charles E. Smith Museum, Dallas).

Reitman and his colleagues (notably a mathematician, Jerry Harrison, who worked with Reitman) tried to understand how the machine worked from a theoretical standpoint. They used "queuing theory," which is a part of classical communications theory. Harrison and Reitman investigated the question of whether these theories really applied to traffic on airline reservation systems using computer terminals. This was a real-time system, with properties like communications response times and peak traffic service characteristics that people at Bell labs were writing and talking about. The Bell theoreticians produced complex and often elegant mathematical equations to describe such systems, but Reitman and Harrison found that Bell's equations did not fit realities of the system, as the Teleregister engineers were measuring them in periods of peak traffic.

Specifically, Reitman noticed that transactions were not autonomous. For example, someone during a peak traffic period would call in from San Francisco for a flight for, say, Monday morning. If the flight was not available, there might well be an immediately repeated call for Tuesday morning. If that was full, for Monday afternoon or Wednesday morning, and so on. Thus there could be *five* communication transactions to accomplish *one* reservation. On this basis, communications theory wasn't adequate, for it expected communication to be an independent event. In Reservisor traffic, however, there was a high probability for two or more linked events — even as many as 10.[6]

Somewhat mischievously, the technical staff wondered if there was a way that they could "jam up the machine" as a

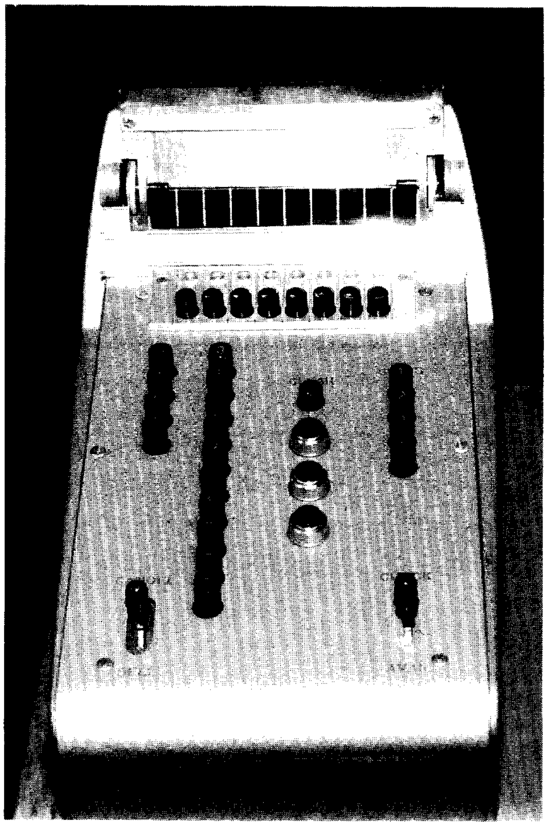


Figure 4. A post-1956 Reservisor agent set (National Museum of American History).

means to measure the actual peak system capacity. Reitman discovered, to his surprise, that he could freeze the entire system by suddenly throwing in the transactions of just three keysets. Of course, this depended on which keysets were selected. It turned out that some had higher priority than others in queries for service by the system. If your keyset was connected to the central node of the switching system, it had permanent priority and you could ensure that *nobody* else got any service. (In practical terms, that meant *no* response when another agent pushed the button on a set that was supposed to query the system for information.)

There was no separate, definitive, *clear* indicator that the system was locked or jammed. Part of the reason for not having a specific "jammed" signal was that Teleregister did not want to give the agent a clear indication that the system was not working. The company was afraid to have any mode of operation that was less than optimistic. By contrast, later systems, when jammed or experiencing some other failure, always sent the agent a message to the effect that he or she had made a mistake and should reenter. The new philosophy was that the agent *had* to have faith in the computer.[6]

Once Reitman had gathered and analyzed the information, he knew that the design concept for the entire system was faulty. The peak passenger traffic periods during the week (Monday morning, Friday afternoon) were understood and recognized. But the seasonal variations were enormous, so the major peaks were much, much larger than the averages. He and others started thinking about how to better interconnect the agent sets to the system for greater efficiency and thus flexibility. From this came Teleregister's new, "unified" system. It was for this system that the agent set shown in the photograph was made. The new set was initially designed for TWA.

Reitman and other engineering staff summarized their studies in a series of publications in 1959. These seem to be aimed at American Airlines in the hope of competing with IBM for the new system. By that time, however, it was too late. IBM had been involved with the successor project since 1953.[6]

Limitations of the Reservisor system

Much as the public might marvel at the Reservisor in action, the airlines wanted more. Lists of passenger names, telephone numbers and addresses at which passengers could be contacted, and other information could not be taken, stored, and manipulated. Nor could Reservisor do the large-scale statistics of traffic on various flights or even the basic arithmetic of gross total receipts at each sales location. Though the technological potential was there, problems between ATT and Teleregister initially prevented the various systems for each airline from talking to each other.[2,4]

As early as 1953, convinced of the usefulness of automated systems by only a year or so of experience with the Magnetronic Reservisor, American Airlines executives were thinking about the next step. The often repeated story about the chance meeting between C.R. Smith, president of American Airlines, and R. Blair Smith, senior IBM salesman, on a transcontinental flight, has an air of inevitability about it. The long conversation led to the creation of task groups at both IBM and American Airlines to develop methods for extending the capabilities of reservation systems beyond the basics of Reservisor.[4,14] The five-year joint study project led to a contract in 1958 for the creation of the SABER (Semi-Automatic Business Environment Research) system.[15]

Reservisor was the first commercial system to combine electronic processing and electronic communications. It demonstrated that the combination was not only feasible but that it could be reliable in the extreme. For easy adaptation into society, a technology must be seen as enduring and robust, or to have the potential for these important attributes.

Reservisor was one of the first *inventory* systems to be controlled by an electronic computer. Because it ran so long and so reliably (the equipment operated 22 hours a day, seven days a week, with a two-hour daily maintenance period), it provided a testbed and standard for large-scale heavy-duty information-technology applications. Reservisor provided data and a testbed for mathematical theories of scheduling databases (for example, queuing theory). Its reliability should be emphasized, for this was an electronic system not far removed in time from the ENIAC, which had proved to be sufficiently reliable but had down and repair times that were not at all negligible. Reservisor demonstrated not only that information could be reliably processed by a central computer, but also that it could be processed at the time the transaction occurred or with negligible delay, and that the system could process information with input stations scattered over a wide geographical area.

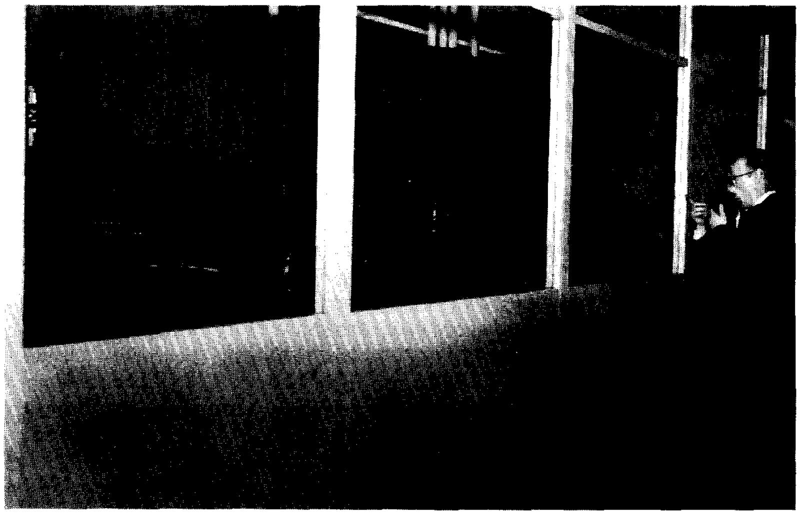
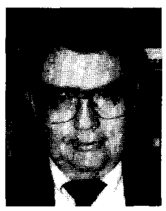


Figure 5. The Reservisor installation (Charles E. Smith Museum, Dallas).

The Reservisor is still remembered with awe and some affection by people in the industry. Surprisingly, it has received rather little notice in the historical literature, despite the fact that it was clearly an important precursor to the large IBM systems which succeeded it. In the end, as one might expect, Teleregister was no match for IBM, and once it lost the American Airlines account to IBM's SABER system it gradually withered until it was bought out in the 1960s by TRW, and disappeared into the conglomerate maw. ■

References

1. R.J. Serling, *Eagle: The Story of American Airlines*, St. Martin's Press, New York, 1985.
2. R.F. Burkhardt, "The SABRE System: A Presentation," Oct. 1, 1964.
3. A.E. Keller, "American Airlines Automates Reservations for the Jet Age," *Management and Business Automation*, Jan. 1959.
4. R.F. Meyer, "American Airlines SABRE (A)," Case EA-C 758, Harvard Business School, Boston, 1967.
5. C.E. Ammann, "Airline Automation: A Major Step," *Computers and Automation*, Vol. 6, No. 8, Aug. 1957.
6. Transcript of Julian Reitman Aural History Interview of Oct. 28, 1987, pp. 2-8, 10-11, 15-19, 22-24, 27-31.
7. American Airlines, "America Long a Leader in Reservation Systems," Press Release, n.d., ca. 1959.
8. American Airlines, "Meet the Televisor," *Flagship World*, Vol. 2, No. 2, 1946, p. 14.
9. *Railway Age*, Vol. 133, No. 3, July 21, 1952, pp. 46-47.
10. *Tele-tech*, Vol. 11, No. 10, Oct. 1952, pp. 108-109.
11. R.G. Canning, *Electronic Data Processing for Business and Industry*, Wiley, New York, 1956, pp. 8-12.
12. C.G. Abbott, "The Magnetronic Reservisor, A Reservation Inventory Control System" (originally presented at the Sixth Southeastern Conference, Inst. of Radio Engineers, Feb. 5, 1954), printed and distributed by Teleregister Corp., pp. 2, 4-6, 10-14, 17-18.
13. M.H. Weik, *A Survey of Domestic Electronic Digital Computing*, Ballistic Research Laboratories, Aberdeen, Md., 1955, p. 101. Updated in second edition, 1957, pp. 224-230, and third edition, 1961, pp. 876-877.
14. C.J. Bashe et al., *IBM's Early Computers*, MIT Press, Cambridge, Mass., 1986.
15. D. Copeland, R.O. Mason, and J.L. McKenney, "SABRE: The Development of Information-Based Competence, Part One, 1950-1970," to be published in *IEEE Annals of the History of Computing*.



Jon Eklund is a curator in the Division of Computers, Information and Society and also a curator in the Division of Physical Sciences at the National Museum of American History of the Smithsonian Institution. Over the past few years, he has been researching the history of various machines in the Smithsonian's computer collections and elsewhere, which are representative of early computer applications.

Eklund has taught at Wesleyan University, Middletown, Conn.; the University of Maryland, College Park; the SUNY program in Museology and Conservation of Art and Artifacts at Cooperstown, N.Y.; and the University of Maryland, Baltimore County. He earned a BS in biophysics at Yale University in 1958, an MA in physics from Wesleyan University in 1966, and a PhD in the history of science and medicine from Yale University in 1971. He is a member of the History of Science Society, the Society for the History of Technology, and Sigma Xi. He serves on the board of directors of the Computer Museum in Boston and the board of the National Plastics Center and Museum of Leominster, Mass.

Eklund can be reached at the National Museum of American History, Smithsonian Institution, Washington, DC 20560.