INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

Applications	Message Switching, Order Processing
Type of Industry	Rubber Products Manufacturer
Name of User	Goodyear Tire and Rubber Co. Akron, Ohio

Equipment Used	IBM 360/50 Computer System
	Teletype Model ASR 28 Terminals
	IBM 2740 Selectric Terminals

Synopsis

Goodyear Tire and Rubber Co. routes administrative messages from its message control center in Akron, Ohio, to plants, offices, distribution points and customers in more than 50 cities across the nation.

The system handles 7,000 messages daily over lines leased from the American Telephone and Telegraph Co. The heart of the system is an IBM System 360 Model 50 computer which polls 60 incoming lines and stores messages on two of eight discs contained in an IBM 2314 direct access unit.

Goodyear uses its communications system for direct order entry and tire and tube inventory records. In addition, inquiries for order and inventory status may be initiated from any of 150 separate terminals.

The Goodyear Tire and Rubber Co. of Akron, Ohio, is the world's largest rubber company. In addition to tires and tubes, Goodyear manufactures such things as rubber industrial products, safety padding for automobiles, flooring products, gaskets, chemicals, aviation products, is deeply involved in the aerospace industry and is backing the development of a planned city in Arizona.

The company employs more than 100,000 persons around the world and annually has sales exceeding $2 billion.

The Goodyear Tire and Rubber Co. is using a nationwide communications network to route administrative messages automatically to and from plants, offices and distribution points in 50 cities through the nation.

The system handles some 7,000 messages daily from 150 separate terminals in 80 different locations. It uses over 13,000 miles of lines leased from the American Telephone and Telegraph Co. and its affiliates. Transmission rates range from 10 to 15 characters per second on the low speed lines and the average time spent for each message is 30 seconds. Separate facilities provide highspeed transmission utilizing wide band lines.

An IBM 360/50 computer with core storage of 524 K controls the switching functions. Interfaced with the computer is an eight-disc IBM 2314 Random Access Unit.

The computer constantly polls the 60 incoming lines at the Akron Center. The incoming message is picked up by the computer, the destination code is checked and, if the corresponding line is available, the message is immediately rerouted. If the receiving terminal is busy, the 360 stores the message momentarily and sends it when the receiver's wire is clear.

Each message is automatically logged on one of the eight 2314 disc drives which queues the message for destination terminals and permits instantaneous retrieval of all messages which have been or, are in, the process of being switched.

In addition to providing a stand alone system for administrative message switching, the computer provides Goodyear with a real time order entry system and maintains tire and tube inventory records. Inquiries for orders and inventory can be initiated from 150 separate terminals -- either in Akron or at remote factories and distribution centers.

Goodyear began looking into a computerized message system in March of 1964, and was on the air with an IBM 7740 Communications Control System in January, the following year. The 7740 replaced a torn-tape system and enabled the company to double the number of messages which could be sent over the same lines in a comparable period of time.

The initial move to computer control, and the steps taken since, have enabled Goodyear to stay ahead of an increasing volume of traffic which is growing at a rate of seven to 10 percent a year.

Two man years were required to analyze, design and program the original 7740 system. The initial installation utilized an IBM "Communications Control Package" (CCP II), 60 percent of which was needed by Goodyear. Company programers and systems analysts wrote the other 40 percent specifically for company needs.

When the 360/50 was installed in August 1967, another 18 man-months were required to design the software.

The decision to go to a third generation computer was based primarily on the company's need for a fast and efficient distribution system. Absorbing the message switching system enabled Goodyear to justify the expense of real time order control and distribution.

GROWTH OF DATA TRANSMISSION AT GOODYEAR

In 1955 Goodyear installed a leased-line Teletype network. At the time it was the least expensive and fastest communications network available for the company's needs. The torn-tape message center was handling 41,000 messages a month at that time. Today, with the computer, Goodyear is handling close to 30,000 a day.

The major problem leading to computer controlled data communications was backlog. Messages could be transmitted in 30 seconds, from Akron to Dallas, but the backlog was so great, Dallas could be contacted only twice a day.

The 360/50 continually polls incoming messages, queues them on two of the eight IBM 2314 discs according to priority. Inquiries and emergency orders have a higher priority than normal orders and other transactions such as shipments, receipts, production or stock transfers -- all handled within the system.

A terminal statistics report is printed daily. The report lists the number of messages sent and received and the number of characters generated. A message intercept count indicates traffic carried over to the next day.

TP STATISTICS –			MESSAGES		CHARACTERS		FCR – 03/06/68
LINE#	TERM#	MNE	SENT	RECVD	SENT	RECVD	INTERCEPT
9	1	GAW	17	105	8,941	41,866	
9	2	GDH		415		295,643	
9	TOT		17	520	8,941	337,509	
10	2	TGO		83		56,614	
10	1	TOD	33	88	22,247	62,914	
10	TOT		33	171	22,247	119,528	
11	1	CIN	38	45	12,815	18,479	
11	4	FAS	38	17	18,031	3,566	
11	5	IND	9	42	4,062	13,503	1
11	6	MAD	5	11	1,382	5,781	
11	2	STM	33	30	18,691	11,218	
11	4	TOL	9	6	4,986	7,980	
11	TOT		132	151	59,967	60,527	1
12	4	PEO		13		9,489	
12	3	PEU	10	10	3,617	3,168	
12	8	HOC		19		15,663	
12	5	HOD	43	80	18,159	31,939	
12	1	HOP	25	12	11,115	4,239	
12	2	SAS	10	30	7,765	14,854	

THE TERMINAL STATISTICS REPORT MONITORS MESSAGES SENT AND RECEIVED BY THE TERMINAL. "LINE #" AND "CONTROL #" REPRESENT THE CONTROL NUMBER AND THE MESSAGE FUNCTION. THE THIRD COLUMN REPRESENTS THE MESSAGE LOCATION: WAREHOUSE, PLANT, SUBSIDIARY.

PLANNING THE NETWORK

Since computer control has been adopted, Goodyear's network has undergone a number of changes.

When the 7740 was installed, the company standardized line and terminal capabilities. Half-duplex lines capable of transmitting 60, 75 and 100 words per minute and Teletype terminals were selected.

With the 360/50 installation, the 60 and 75 words-per-minute lines were eliminated because the capacity of the new system enabled the company to add more terminals at a lower cost.

The torn tape system provided two full duplex lines. Alternatives in this area were to establish full duplex circuit standards or change the lines to half-duplex circuits. The half-duplex approach was chosen because the full-duplex circuits offered little advantage and complicated computer programing.

Another major consideration was interline traffic. There were some locations, in close proximity, communicating with each other for several hours a day. It was originally believed that routing this traffic through Akron and back again would overload the installed circuits. Management, however, felt that these circuits could be upgraded if necessary. The lines were not overloaded because the computer made better use of available line time to offset the double load. This was true of both the 7740 and the 360.

Recommendations and guidelines for various networks were evaluated on a regional basis. Major design considerations were: 1. Volume changes 2. Full or half duplex lines 3. Line speeds.

TYPES OF MESSAGES

An administrative or intercompany message may be addressed to as many as seven destination stations. If more than seven stations are involved the sender may pick from a distribution code number or send multiple messages. The computer stores the distribution lists for pre-determined destination stations.

An abbreviated input header has been adopted to reduce operator errors and transmission time.

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N60AKR
PUBLIC RELATIONS DEPT AKRON
SUBJECT -- INFLATABLE QUONSET HUT
THE PURCHASING DEPT OF THE JOHN JONES CO HAS SEEN
INFLATABLE QUONSET HUT MADE OF RUBBER ADVERTISED IN
SOME OF THE TRADE MAGAZINES THEY ARE INTERESTED IN
ALL THE DETAILS OF THIS QUONSET HUT -- THEY THINK
GOODYEAR MAKES IT -- PLSE SEND ALL NECESSARY
INFORMATION TO PAUL HARRISON C/O -- PURCHASING DEPT
-- ROOM 111 BUILDING 59 RIVER ROAD NEW YORK NY --
PLSE ADVISE OUR STORE MANAGER NY WEST IN GOODYEAR
SERVICE STORE NEW YORK NY WHEN YOU HAVE DONE THIS
-- THANKS FOR YOUR HELP
R A JERNIGAN
   DM3700
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NORMAL ADMINISTRATIVE MESSAGE.

The normal message has an abbreviated header consisting of five characters. The first character "N" indicates that the message being sent is normal. The next two characters a 6 and an O, represent the ascending sequence number assigned by the originating terminal. These numbers start with one each morning. AKR is the code for the destination terminal. The expanded output header for the same message consists of the following:

00061   AKX 00060   02/10/68   1145   1146   AKR

The 360/50 supplies the sequence control number for the destination terminal (00061), the originating terminal code (AKX), the time the message was received by the computer (1145) and the time it was transmitted to the destination terminal (1146).

Editing is done by the computer to ensure that the message conforms to the pattern indicated by the message type code. Goodyear has found that about 10 percent of all originating messages contain header or control character errors. The computer automatically corrects sequence number errors. This is how it's done: When the computer discovers an incorrect or missing type code -- the normal code designation is inserted, the corrected message is transmitted to the destination terminal and the originating terminal is notified of the corrective action taken. The sending station takes no action unless the computer's assumption is incorrect. When the sequence number is invalid, the correct number is inserted, the corrected message is transmitted and the originating terminal notified. If more than seven destinations are shown, or end-of-header or end-of-message characters are misplaced, the message is transmitted to the valid destinations and the sending terminal is notified to resend any destinations not included in the output header as a separate message.

Non-correctable messages generally require correction by the originating terminal and re-transmission. The computer notifies the sending station accordingly.

A retrieval message is a request for repeat transmission initiated by the destination terminal because a message is garbled or the paper has overprinted or jammed. When this occurs, the operator prepares and sends a message which contains the start-of-message codes, type code "R", terminal code of the sending terminal, incoming message sequence number, destination terminal code, and end-of-header and end-of-message codes. The computer then accesses the disc files, obtains the original message and re-transmits.

The on-line system has built in safeguards. When a terminal goes down, all incoming messages are stored on discs and unloaded when a relieval message is keyed.

If the operator suspects that something is wrong with the terminal she goes to a "line test" condition. The computer does not get an answer back when it polls the station and automatically intercepts all messages until the terminal is on-line again. Intercepted messages can be transmitted to the destination or to an alternate terminal which requests relieval because the destination terminal is inoperative.

When the computer detects errors on a line or terminal, it initiates test messages. If the tests are successful, it continues to transmit to the destination terminal. Otherwise, all incoming messages for that terminal are intercepted until the computer can get a valid response to its continuing series of periodic checks. As soon as two test messages are sent down the line successfully, the line is returned to active status. Any station can also send a transmission to the computer to test the line and terminal equipment. The computer compares the test message with an identical one held on file, and informs the operator that the test either was or wasn't successful.

Restart messages are sent to inform an originating terminal that an incoming message has been distorted because of computer failure. The operator is told to check the input sequence number log sheet and compare the last message with the number provided by the computer. The operator sends this and higher number messages again. Checkpoints are made by the minute to eliminate duplicates when the computer goes down.

The good morning message is sent to every terminal. It provides positive control over all incoming and outgoing messages for the previous day, indicating the number of the last message that terminal sent and the number of the last message received by the terminal.

0000	SUP	03/25/5	1138	LIN
	LAST NUMBER YOU SENT		54	
	LAST NUMBER YOU RECEIVED	71		

GOOD MORNING MESSAGE.

Goodyear places maximum emphasis on message assurance as demonstrated by the descriptions of the error, relieval, test, restart and good morning messages. The company has also implemented strict terminal procedures.

A special form has been designed to log in both incoming and outgoing messages. The form's lefthand side has 99 pre-numbered blocks for incoming messages and the righthand side has a like number for outgoing messages. A terminal identification code is recorded opposite the message number as it's assigned to the outgoing message. Source codes are entered in a similar manner for incoming messages. The information is required for relieval and retrieval purposes. Separate sheets are used for each day's communications, and checked against the good morning message. Missing messages from the previous day can be obtained by notifying the network supervisor.

G-259 (11-64)

TELETYPE SEQUENCE CHECK SHEET   DATE _____

MONTH   DAY   YEAR

IN						OUT					
NO.	SOURCE	NO.	SOURCE	NO.	SOURCE	NO.	DESTINATION CODE	NO.	DESTINATION CODE	NO.	DESTINATION CODE
1		34		67		1		34		67	
2		35		68		2		35		68	
3		36		69		3		36		69	
4		37		70		4		37		70	
5		38		71		5		38		71	
6		39		72		6		39		72	
7		40		73		7		40		73	
8		41		74		8		41		74	
9		42		75		9		42		75	
10		43		76		10		43		76	
11		44		77		11		44		77	
12		45		78		12		45		78	
		46									

TELETYPE SEQUENCE CHECK SHEET.

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CUM DWN 00010971
DS #1 AAC 0971  102522502262
CUM UP 00010971
INVLID MSG NHD AKC
INVLID MSG DST 521 AKG
( INVLID MSG SEQ 0002TOL )
EC TOL
( INVLID MSG SEQ 0033 AKC )
SG 015
SF 2015
ATL UP 00050978
TC 015
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SYSTEMS LOG

The computer monitors every message, line and terminal. Each error and potential error condition is noted and recorded on the supervisory terminal. The supervisory terminal operator scans every entry to make certain that the proper corrective measures have been taken. The circled entry on the above systems log indicates that terminal AKC has sent a message without header information. Entry six (also circled) is an invalid incoming message sequence number. Entry nine, SG 015, indicates line interference which caused the computer to switch to an alternate path and continue. Entry 10 indicates that the computer has received 10 line hits in a row and the line has been put on "line test" status.

ORDER ENTRY

Goodyear considers its on-line order entry system to be one of the most advanced anywhere. Each of the company's distribution points is equipped with Teletype terminals, and the main facility in Akron can almost guarantee a four hour turnaround on all orders.

When a dealer needs merchandise he notifies his distribution point which goes on-line to Akron. When an order enters the computer the disc files are searched. If the order is new, the 360/50 determines the availability and location of the stock. A description of the product and shipping weights are added to the order and it is retransmitted to the appropriate warehouse in the form of a packing slip. When the order is shipped a return message is sent to the computer center where the computer automatically updates the corresponding inventory records.

An operation that once took hours is now done in minutes, resulting in a noticeable improvement in delivery times and great reduction in shipping errors.

The system is keeping track of 20,000 orders in process and 50,000 different kinds of tires, tubes and other tire products. It provides centralized inventory planning for 110,000 stock items. One of the system's major advantages is that it offers Goodyear complete knowledge of inventory availability and location.

There are two order processing procedures. One is for customer orders for shipment to dealers, stores and original equipment accounts. These orders flow into Goodyear by the administrative switching system, mail and telephone. The order data line has four vital areas: the document number, partial number, Goodyear billing or receiving point and shipping point with its class of stock. All orders processed through the system carry a complete 14 digit

product code in addition to a 17-digit entry for the order data line. A transaction code classifies each entry as an order, a shipment, production, a receipt or an adjustment.

After an order is prepared and edited it is sent to the merchandise room for processing. There, an operator prepares a punched paper tape along with a single-sheet hard copy on one of several Teletype units. The hard copy is used to check the order against the source document. The edited paper tape is then transmitted to the computer for transmission to the warehouse or plant selected. The shipping order is automatically printed at the selected terminal location.

SHIPPING ORDER FORM ON WHICH THE SHIPPING WAREHOUSE RECEIVES INSTRUCTIONS FROM THE CENTRAL COMPUTER. FORMS ARE FED THROUGH AND IMPRINTED BY TELETYPE TERMINALS LINKED TO THE COMPUTER CENTER BY COMMUNICATIONS LINES.

The second type of order is a replenishment order to replace stock sold at Goodyear locations. These are generated within the 360 which allocates available production equitably among the warehouses. The orders are then forwarded automatically by the computer to other Goodyear points for shipment. By capturing replenishment orders, tire and tube inventories, and that portion of inventory which is in transit at any given time, Goodyear keeps track of its entire inventory.

INQUIRY

Remote locations have quick access to up-to-date order and inventory information stored in the computer's memory. Programs have been written for 10 types of inquiries: including the status of an open order; the status and detailed list of all items on an open order; the available, accountable, in-process-to, in-process-from, in-transit-to balances; order point for a specific product; and open orders for a given customer or product.

Inquiries may be initiated from a terminal on-line to the Akron center. The request is initiated through the introduction of the proper data and data format. Order inquiries are identified by the 17-digit control number. The question is directed toward the disc-stored open order file, which, in turn, produces such information as what quantities and product codes are listed, the dates and entry of shipment. Product inquiries, on the other hand, concern themselves with a particular 14-digit product code. The question is directed toward the inventory file, and the computer obtains the availability and other pertinent information for a given stock location or class of stock.

Answers are returned as administrative messages on the terminal used to initiate the inquiry.

RESULTS AND FUTURE PLANS

Goodyear has been able to increase its ability to handle an ever growing communications network without an appreciable increase in the cost of maintaining that program. At the same time, the company has found it profitable to integrate order entry and communications and within the next two years hopes to add a computerized production control system to its current capabilities. Goodyear is also looking into the possibilities of using data display terminals with the current system. When complete, Goodyear believes the complex will represent the rubber industry's most efficient production/distribution system.