

NO. 4 ELECTRONIC SWITCHING SYSTEM
MACHINE ADMINISTRATOR'S RESPONSIBILITIES AFFECTING
ROLLBACK, ROLLFORWARD, AND REINITIALIZATION

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the event of a rollback. These recent changes must be corrected and resubmitted or resubmitted as soon as the machine normalizes (rollforward).

1.04 The MAC must also be aware of what recent changes would be lost in the event of reinitialization from magnetic tape. Reinitialization from magnetic tape would be required if the recent change data located in both translations (call store) and disk file store were mutilated. Those recent changes, which were submitted after the reinitialization magnetic tape was created, must be identified and resubmitted as soon as the machine normalizes.

2. RECENT CHANGE OVERVIEW

GENERAL

2.01 The recent change system (RCS) is used to add translation data or modify translation data which was originally generated by the office data assembler (ODA). The RCS is coordinated and implemented by the machine administrator through the MAC. The No. 4 ESS Translation Guide (TG-4) provides a complete cross-reference of ODA and recent change forms.

RECENT CHANGE MESSAGES

2.02 There are generally two types of recent change messages which are used to introduce changes to translations data:

- The recent change data message (RCDM) is used to specify the new data which is to be entered into the translation data base.
- The recent change action message (RCAM) is used to specify the actions to be taken on an RCDM.

The No. 4 ESS Translation Guide (TG-4) provides a complete complement of RCDMs and RCAMs.

RECENT CHANGE MESSAGE FLOW

2.03 There are three states a RCDM generally progresses through during the recent change process:

- Buffered state
- Test state

- Activate state

The actions which affect the MAC as a RCDM progresses from the *buffered state* through the *test state* to the *activated state* are shown in Fig. 1.

A. Placing a RCDM in the Buffered State

2.04 To enter a RCDM into the buffered state the MAC will call up the desired display form per TG-4. Data is then inserted into the form. The entire form (message) is then transmitted to the processor via keyboard control (BUF). The system responds that the message is either accepted or rejected. When accepted, the RCDM resides in the recent change disk buffer storage area until it is acted upon by a RCAM (TST). A copy of the RCDM is printed on the MAC and MOC printers. The MAC copy of the RCDM should be retained for the MAC recent change record file described in paragraph 4.01. The buffered RCDM is also recorded on a cassette tape in the MAC magnetic tape transceiver control unit (MTTCU). This cassette tape serves as a permanent record of recent change activity only. This tape could be used to restore the buffered messages if the disk buffer area were cleared; however, no active role has been assigned to this tape in the rollback, rollforward, or reinitialization process.

B. Placing a RCDM in the Test State

2.05 To enter a buffered RCDM into the test state where it can be verified, a RCDM (TST) message is used. The recent change disk buffer storage area, where the message resided in the buffer state, is cleared when entered in the test state. The RCDM is transmitted to the RC4 activate table in core backed by disk. When the message enters the activate table, an area in the disk rollback area is marked with the message activate table address and zeros are entered into the rollback area data field corresponding to the length of the test message in the activate table. (See Fig. 2.) No data is entered into this test area in the rollback area. In the event of rollback, the address information and zeros data field for the test state message will be rolled back and in effect clears the activate table of messages in the test state. This action removes non-activated recent changes from the system in the event of rollback in order to simplify the restoration of service problems.

2.06 When accepted, a copy of the RCDM is printed on the MAC and MOC printers. The MAC copy of this test RCDM should be retained for the MAC recent change record files described in paragraph 4.01. The accepted tested RCDM is also recorded on a cassette tape in the MOC MTTCU. This cassette tape, referred to as the "rollforward" tape, shall be used by MOC personnel during the rollforward process described in section 4. The rollforward tape provides a backup for messages in the test state and those messages which have been activated.

C. Placing a RCDM in the Activate State

2.07 To enter a test state RCDM into the activate state where the processor can act upon the new information, a RCAM (ACT) message is used. When activated, the new data is entered into the translators (call stores) and is made available for call processing. The old translation data is entered into an activate section in the rollback area (Fig. 2). The RC4 activate table, where the message resided in the test state, is cleared. When accepted, a brief acceptance message is printed on the MAC and MOC printers. If a copy of the activated RCDM is desired a separate verification message must be sent. No cassette tapes are made at this time with the exception of the recent change comment message (activate) which is recorded on the rollforward tape.

D. Exceptions to the Recent Change Process

2.08 All RCDMs, with the exception of trunk subgroup characteristics and trunk assignments, are processed through all three states of the recent change system. Trunk related messages progress through the buffered and test states only via the recent change system. Activation of the facilities associated with these recent changes is accomplished through the circuit maintenance system (CMS) via the 51A test board in the trunk operations center (TOC). See Note on Fig. 1.

2.09 In the event of abnormal occurrences, such as rollback, rollforward, or reinitialization, the MAC must be able to quickly provide a status of recent change activity, identify which changes will be lost as a result of rollback or reinitialization, and formulate a schedule for reinserting rolled back changes. The following general procedures should provide sufficient guidance to the MAC to perform these functions.

3. ROLLBACK

GENERAL

3.01 The recent change system is capable of rolling back old translation data. As a recent change data message (RCDM) is placed in the activate state, a "rollback" copy is built in the disk rollback area which contains the old translation data being replaced by the recent change.

TYPES OF ROLLBACK

3.02 Two types of rollback can occur: Type I and Type II. Details of each of these procedures are discussed in the following paragraphs.

A. Type I Rollback

3.03 Type I rollback is applicable only to a recent change that is actively being processed. It provides for automatically rolling back the translation data to its previous state when an interrupt or rollback is triggered while a recent change is being processed. This is necessary to prevent the incomplete (partial) update of a recent change. When Type I occurs, a message will be received in MAC, indicating that the recent change was not accepted. This will require that only the message being processed be corrected and reinserted.

B. Type II Rollback

3.04 Type II rollback is applicable for rolling back messages previously processed by the system and already active in the machine. Type II rollback is manually requested by the MOC via the maintenance control console (MCC), usually in an attempt to restore stable machine service. Normally, the determination of the necessity for Type II rollback is by mutual agreement between the MOC and the MAC. The rolling back of critical recent changes will, in most cases, result in wrong routing and trunking configurations. This effect must be taken into consideration by the MAC prior to a Type II rollback decision.

3.05 During a Type II rollback the following conditions will be observed:

- (a) When rollback occurs the recent changes are rolled back in a reverse order to which they were placed into the test or activate states.

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- (b) When rollback occurs at the activation of a recent change, the recent change is placed back into the test state.
- (c) When rollback occurs as a recent change is moved into the test state, the recent change is completely removed from the system. It is not rolled back into the buffer state.

3.06 Following a successful Type I or Type II rollback, a message will be printed in the MAC and MOC which gives the extent of the rollback and the order number associated with the last recent change rolled back. Utilizing this information the MAC can commence scheduling the sequence of changes to be rolled forward. (Section 4)

3.07 There are several indicators on the recent change portion of the system status section of the MCC in the MOC which indicate rollback related activity:

- (a) A recent change activity lamp is lit when a recent change is in process.
- (b) A recent change rollback lamp is lit when rollback occurs.
- (c) A rollback area capacity warning lamp is lit when the disk rollback area reaches 60 percent of capacity.

ROLLBACK AREA

3.08 The rollback area is a 16,000 word section of disk memory. This area receives rollback data (old translation data which was replaced by a recent change). The maximum rolled back data storage capacity of this memory area will vary with the amount of data being changed by the RCDM. The rollback area's boundaries are related to the dumping of rolled back data onto magnetic tape, (referred to as a "tape dump"). See Fig. 2. These tapes will be used as required for reinitialization when both translation data and the disk store backup are mutilated.

3.09 When a tape dump is made, the disk rollback area is marked indicating the last RCAM incorporated into the system prior to the last tape dump. In the example in Fig. 2 the latest data in the rollback area will be the data in disk area 5A.

3.10 The oldest data in the rollback area will be located in disk area 1T.

3.11 The rollback area will be changed each time a tape dump is made. The part of the rollback area before the previous tape dump will become inaccessible. For example; if tape dump number 3 were made between points C and A, the rollback area's beginning point would be B. Only the last and the previous tape dump markers are retained in the rollback area. The rollback area markers are moved forward by the processor each time a tape dump is made. When tape dump number 3 is made, rollback can be accomplished back to point B only (message 7T Fig. 2).

3.12 If a tape dump is not taken prior to filling up the rollback area, the oldest messages will be overwritten by the newest messages and the oldest rollback data will become lost. For example, the data which was placed in the rollback area by RCDM No. 1 when put into the test state (1T) will be lost (overwritten) if a tape dump (number 3) is not taken before the rollback area becomes filled. When overflow occurs a message will be received in the MAC and MOC indicating that rollback cannot be performed completely to the last tape dump because the overwritten rollback data have been lost. A rollback area capacity warning lamp lights on the MCC when the rollback area approaches its capacity thresholds. Recommended intervals for taking tape dumps of the rollback area are discussed in Section 5.

MAC RESPONSE TO ROLLBACK OPTIONS

3.13 The MOC has four options for rolling back recent changes on a last-in/first-out basis.

- (a) A request can be made via MCC that a specified number "X", of RCAMS be rolled back, but not to exceed the number entered since the last tape dump was made. The "X" RCAMS rolled back must be the last "X" RCAMS written into the rollback area (last-in/first-out basis).

Note: An RCAM, as referred to in the rollback area, consists of the replaced translation data words, the action which caused it to be replaced (activate), the order number of the recent change message, various core and disks addresses, and other control information.

(b) A request can be made via the MCC to roll back all replaced translations data associated with RCAMs through a specific recent change order number. This option will not roll back past the last tape dump. Rollback will be to the last action on the order specified. (It could have two actions existing in the rollback area, ie, test and activate RCAMs.)

(c) A request can be made via the MCC that all replaced translations data associated with RCAMs which were placed into the activate state since the last tape dump be rolled back.

(d) A request can be made via the MCC that all replaced translations data associated with RCAMs within the rollback area including those which were stored in the rollback area prior to the last tape dump be rolled back, up to the next to the last tape dump.

3.14 Since RCDMs are not necessarily activated in the order that they were placed in the test state, rollback may cancel both activated RCDMs and those still resident in the test state. A message will be generated, listing the last RCDM rolled back.

3.15 When Type II rollback is deemed necessary and the option to be used has been determined, the MAC must consider the effect this action will have on traffic.

(a) When an RCDM adding trunks to a trunk subgroup is rolled back, any calls on those trunks during rollback will be interrupted. The rollback program itself may not interfere with established calls, but the audit program will remove connections since the trunks no longer exist.

Note: The trunks which are rolled back to the translations data base are not placed in operational status following rollback. To minimize routing problems associated with trunks affected by rollback, those trunks are placed in a special rollback state associated with the trunk out.

(b) This problem becomes greater when the RCDMs being rolled back include a "unit type" recent change. For example, if a message adding a new *time-slot interchange (TSI)* is rolled back, the severity of the problem is

increased since all calls on that TSI could be disconnected.

(c) When an RCDM which established a new in-chain routing data block is rolled back, the result could be a severe service interruption. On the other hand, the rollback of an RCDM which established an out-of-chain routing data block may have no impact unless an overload condition is experienced.

3.16 The urgency to restore machine service by Type II rollback should not be hampered by the need for the MOC to involve the MAC. The MAC on the other hand cannot wait until this situation occurs before analyzing the effect of rollback. The MAC must maintain a comprehensive knowledge of the effect of rollback on recent change activity.

3.17 As recent changes are placed in the activate state, the "reinitialization file", (See DFMP Division H, Section 9e, Machine Administration Records, Paragraph 2.08) will also be updated with a copy of the recent change. Those recent changes that could have a significant effect on service, or that result in major routing changes, should be identified and tagged with a "special attention tag".

3.18 The MAC will be able to periodically review those recent changes which are designated "special attention". This should allow the MAC to evaluate the effect of Type II rollback within a minimum time period.

3.19 The MAC must be aware of the rollback option to be used, and which messages that option will roll back. In order to do this the MAC must be able to determine the rollback area boundaries.

3.20 The following procedure should allow the MAC to determine rollback boundaries.

(a) The rollforward tape produced in the MOC contains all messages placed in the test state and all recent change comment messages when a message is placed in the activate state. The time and date each message was entered will appear on the message. The rollforward tape is to be marked automatically by the processor at each tape dump.

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(b) The reinitialization file contains all activated messages. The time and date each message was entered will appear on these messages. This file is also marked to indicate tape dumps.

(c) The sequence in which the messages appear in the rollback area can be determined by playing back the MOC rollforward tape. The message sequence information obtained should be identical to the reinitialization file paper record.

3.21 When *option one* is used, rollback "X" number of messages, the number to be rolled back can then be compared to the first "X" number listed in paragraph 3.20.

3.22 When *option two* is used, rollback to a specific change order number, the chronological listing described in paragraph 3.20 may be searched until the most recent RCAM for that order is found. All RCAMs through the order specified, will be rolled back. Rollback will stop at the last tape dump, if the order specified is not found.

Note: If order numbers are reused before they have cleared the rollback area, some confusion could exist. Care should be taken in assigning order numbers to prevent this from happening, after an order number passes the next to the last tape dump (marker "A" in Fig. 2) it should be available for reassignment.

3.23 When *option three* is used, rollback to the last tape dump, all messages listed in paragraph 3.20 will be rolled back to "B" (the last tape dump in Fig. 2).

3.24 *Option four*, rollback all replaced translations data in the rollback area. This will rollback all messages in the rollback area which could include all replaced translation data entered since "A" (the next to last tape dump). This assumes that the rollback area has not overflowed.

3.25 When selecting the option to be used, the MAC should insure that the rollback will not disrupt a "group" of absolute word changes. An absolute word change is usually submitted when a situation cannot be fixed with any existing RCDM. Several absolute word changes may be required to complete the required change. They must be entered as a group, and if they are to be removed, they must be removed as a group.

4. ROLLFORWARD

4.01 To ensure that rolled back RCAMs can be resubmitted (rolled forward), a recent change record system is required. The components of this system are as follows.

(a) A cassette tape of RCDMs placed in the *buffered state*. This tape is produced in MAC on channel RCREC as RCDMs are buffered. This cassette tape serves as a record of recent change activity. No active role has been assigned to this record in the rollforward process.

(b) A cassette tape of RCDMs in the *test state*. This tape is produced in MOC on channel RCMOC when RCDMs are placed in the test state. This tape is referred to as the "rollforward" tape, also includes recent change comment messages corresponding to the activation of the RCDM. This tape will be used to resubmit rolled back changes into the buffered state.

(c) Recent Change Records:

- Recent Change—"Inactive File"
- Recent Change—"Come-up File"
- Recent Change—"Due Data File"
- Recent Change—"Active File"
- Alphabetical and Numerical—"Work Detail File"
- Reinitialization File

These files and their uses are described in the DFMP Division H, Section 9e, Machine Administration Records.

4.02 The MAC should analyze recent changes rolled back before being rolled forward. Some orders will be more critical than others and, therefore, should receive priority in being resubmitted. Those recent changes that establish unit type equipment, for example, should be given a high priority. This analysis should determine the following:

- Unit type recent change order numbers

- Order numbers of recent changes that significantly affect routing
- Dependency orders, ie, order A must be submitted before order B.
- The state of recent changes rolled back.

4.03 After the analysis has been completed, the MAC should specify the order in which messages are to be entered. The rollforward tape will place messages in the buffered state. Those rolled back activated messages should be submitted first. A comparison of the rollforward listing (showing recent change messages put into the test state) with the "Reinitialization File" (showing activated orders only) should be made to determine which messages are to be activated and which ones are to be progressed to the test state only.

4.04 Rollforward tapes will have all test and activated messages in the rollback area recorded when the message was advanced to the test state. Before a test message found on the rollforward tape can be listed as a message to be resubmitted to remain in the test state, a further check is needed. The MAC should insure that the order was not activated. After this check all test messages without an activate message on the same order should be placed in the test state.

5. REINITIALIZATION BY MAGNETIC TAPE

5.01 Translation data in the No. 4 ESS resides in simplex call store memory and is booked up with duplex disk copies. A complete set of backup information is also kept on magnetic tape. If call store is mutilated, the backup information for call store translators is read from disk. If both call store and disk store are mutilated, the backup information must be read from tape.

5.02 The magnetic tape will be created periodically by dumping translation data. The MAC normally schedules tape dumps. In selecting the appropriate time to make a tape dump several factors are considered.

- (a) The machine should be in a stable state. If recent changes have been submitted recently that change routing patterns significantly, time should be allowed for any problems that may exist to surface. An analysis of the machine load and service summary (MLSS) and the machine

service report (MSR) can be used as an indication of the status of machine performance.

- (b) The relationship of the rollback area and the tape dumps should be considered. If tape dumps are not taken frequently enough, the rollback area will "wrap around", ie, the oldest rollback data will be overwritten by the latest rollback data and those that were overwritten become lost. A message will automatically be generated to indicate the percent of rollback area that has been used since the last tape dump. When the rollback area, since the last tape dump, reaches 40 percent of the total rollback area, a message will be sent to MAC. Messages will also be generated at the 60, 80, and 90 percent points. It is recommended that a tape dump be taken when the rollback area is near 50 percent. This will allow a reasonable amount of rollback area to exist in the event Type II rollback is needed and yet allow space for the new rollback section to be expanded.

5.03 Periodic intervals may be established to schedule a tape dump. Although the criteria of paragraph 5.02 may not require a tape dump, extended time intervals between tape dumps may result in significant differences between the reinitialization tape and the actual active translation data in call store. To allow this condition to exist may result in a time consuming effort to resubmit recent changes after reinitialization. Although major changes may not have been lost, the cumulative effect of many changes will have a significant impact on service. The MAC should establish a tape dump schedule based on the knowledge of recent change activity in this machine. When recent change activity is great enough to require frequent tape dumps, recent changes may not get exercised sufficiently before they are removed from the rollback area. If this situation exists, the MAC should hold three or four tapes in case reinitialization with these tapes becomes necessary.

5.04 When reinitialization occurs, the messages residing in the recent change disk buffer storage area may be lost. An RCAM is available to request the RCDM order numbers in the recent change disk buffer storage area (see TG-4). This message should be submitted before reinitialization to ensure reinsertion of these messages.

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6. REFERENCES

6.01 The following listing provides further information concerning recent changes, verification system, and rollback/rollforward.

SECTION	TITLE	SECTION	TITLE
		234-100-010	Interrelationships of Operational Work Centers—MOC, MAC, TOC, TEC, and NMC
966-220-000	No. 4 Electronic Switching System, Description	234-102-000	Machine Administration Center (MAC)—Organization and Function
234-100-004	No. 4 Electronic Switching System, Description	DFMP	Maintenance Operations Center (MOC)—(Div. H, Sec. 9L(2))
234-100-005	No. 4 Electronic Switching System, Theory	DFMP	No. 4 ESS Assignments (Div. H, Sec. 9c)
234-180-155	Recent Change, Verification System, Rollback and Rollforward Programs	DFMP	No. 4 ESS Machine Administration Records (Div. H, Sec. 9e)
		TG-4	Translation Guide 4

<u>RECENT CHANGE DATA FLOW</u>	<u>AREAS AFFECTED</u>	<u>DESCRIPTION OF ACTIONS PERFORMED</u>
RCDM	MAC	Recent Change Input on Dataspeed 40 KSR Keyboard
RCDM Advanced to the BUFFER STATE	MAC MOC RC Disk Buffer Storage Area	Printer Copy of Buffer State Message Received Cassette Tape Recording of Buffered Message Printer Copy of Buffer State Message Received Recent Change Resides Here in the Buffer State
RCDM Advanced to the TEST STATE	MAC MOC RC Disk Buffer Storage Area RC Activate Table Disk Rollback Area	Printer Copy of Test State Message Received Printer Copy of Test State Message Received Cassette Tape Recording of Test Message (Rollforward Tape) Cleared Recent Change Resides Here in Test State Recent Change Address in the Activate Table in Addition to Blank Data (Zeros) From Activate Table Entered
RCDM Advanced to the ACTIVATE STATE	MAC MOC Disk Rollback Area RC Activate Table Translators (Call Stores)	Acceptance Message Received Acceptance Message Received Old Translation Data Replaced By Recent Change Entered Cleared New Data Available For Call Processing

Note: Exceptions for Trunking Changes.

1. No activate state for trunking changes.
2. The translations data is updated while the message is in the test state.
3. Trunking messages do not reside in the RC activate table while in the test state.
4. Trunks are turned up for service through the 15A testboard in the TOC.

Fig. 1—Recent Change Message Flow

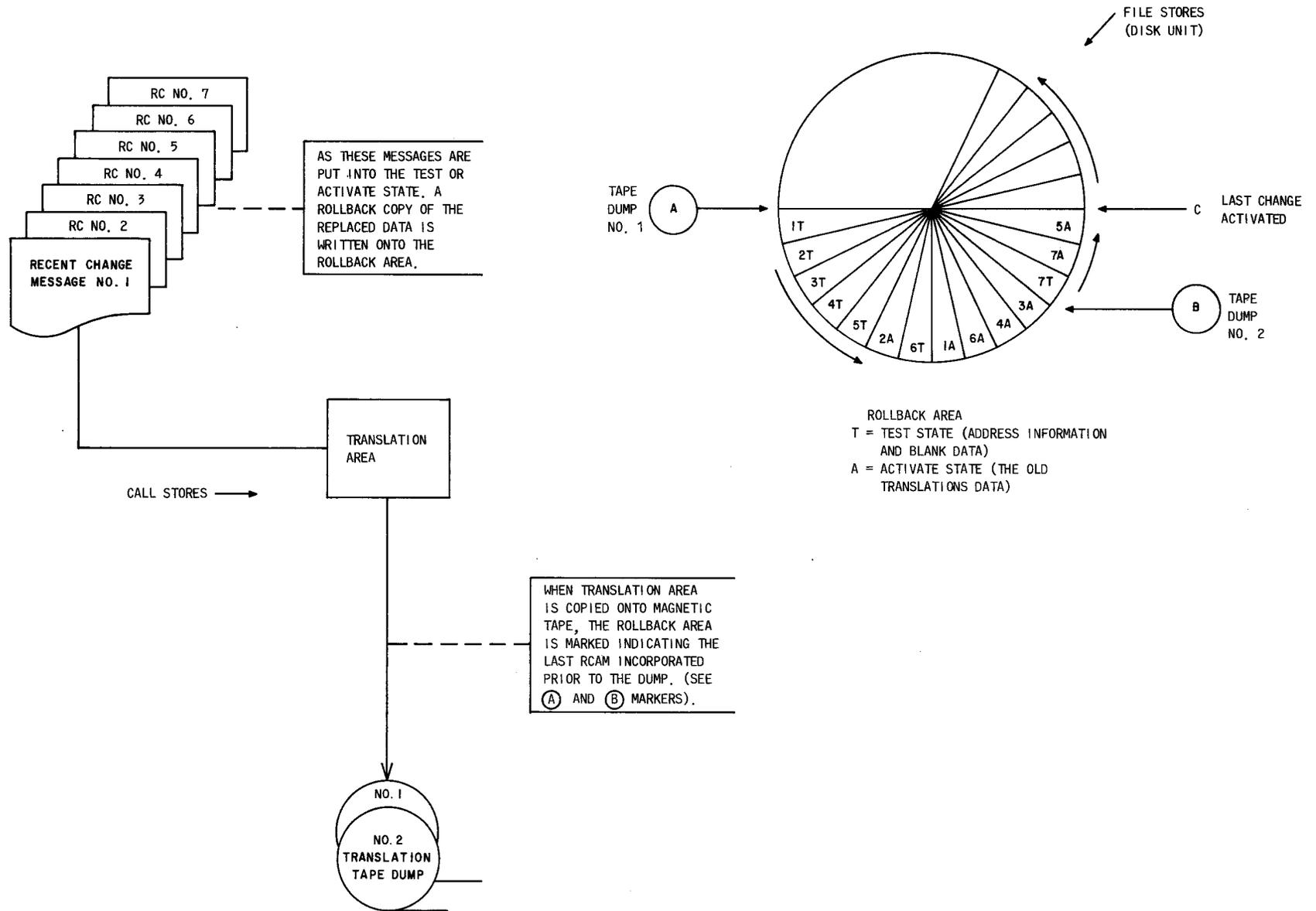


Fig. 2—Rollback Area Example