INTERNATIONAL STANDARD 2628

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Basic mode control procedures — Complements

First edition — 1973-06-01

UDC 681.14

Ref. No. ISO 2628-1973 (E)

Descriptors : data processing, data transmission, control procedures, character sets, codes.

Price based on 8 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2628 was drawn up by Technical Committee ISO/TC 97, *Computers and information processing,* and circulated to the Member Bodies in May 1972.

It has been approved by the Member Bodies of the following countries :

Australia	Ireland	Spain
Belgium	Italy	Sweden
Canada	Japan	Switzerland
Czechoslovakia	Netherlands	Thailand
Egypt, Arab Rep. of	New Zealand	United Kingdom
France	Portugal	U.S.A.
Germany	South Africa, Rep. of	U.S.S.R.

No Member Body expressed disapproval of the document.

Printed in Switzerland

Basic mode control procedures – Complements

0 INTRODUCTION

A data communication system may be considered as the set of the terminal installations and the interconnecting network that permits information to be exchanged.

A data link comprises terminal installations connected to the same network, operating at the same speed, in the same code. Any "store and forward" delay or intermediate data processing separates data links. Any system is constituted of one or several data links.

The information transfer in a data link is monitored by data link control procedures where some characters, selected within a coded character set, are given particular meanings according to the transmission phase and are used for various purposes such as to delineate information, to reverse the direction of transmission, to ask questions, to answer, etc.

This International Standard defines complements to the basic mode and its extensions :

1) Recovery procedures

   – System guidelines are given for the use of timers, counters, etc.;

2) Abort and interrupt procedures

   – Defines abort procedures which are always initiated by the master station, and interrupt procedures which are always initiated by the slave station;

3) Multiple station selection

   – Gives means whereby a master station may select more than one slave station so that all the selected slave stations receive the same transmission at the same time.

1 SCOPE AND FIELD OF APPLICATION

This International Standard extends the digital basic mode control procedures as defined in ISO/R 1745 and ISO 2111, to allow the following features :

1) Recovery procedures;

2) Abort and interrupt procedures;

3) Multiple station selection.

Those systems which conform to ISO/R 1745 do not necessarily have to include the functions described in this International Standard. However, those systems implementing the functions described in this International Standard and conforming to ISO/R 1745 and ISO 2111, must follow these recommendations.

2 REFERENCES

ISO/R 1745, *Basic mode control procedures for data communication systems.* (At present under revision.)

ISO 2111, *Data communication – Basic mode control procedures – Code independent information transfer.*

CCITT Recommendation V24, *Function and electrical characteristics of circuits at the interface between data terminal equipment and data communication equipment.*

3 RECOVERY PROCEDURES

3.1 General

These recovery procedures are system guidelines which should be used by all stations, as applicable. However, it is recognized that the detailed method of station mechanization, absolute value of timers, etc., may vary with applications and communication facilities.

In some cases, these recovery procedures can only detect the error condition and then notify the operator or the processor program, or both. In more sophisticated cases, automatic recovery is partially or completely possible. In other cases, only operators can perform the recovery procedures. Operator recovery procedures are not part of this International Standard. However, the operator may do such things as retry *n* more times, establish voice communication to the distant station in order to determine trouble, etc.

For a good system, the functions of timers A, B, and C defined below, must be utilized. The value of the timer may vary over a wide range depending upon whether they are implemented via hardware, software, or human operator.

It is recognized that in some systems additional timers may be required for such purposes as aiding synchronization procedures, added reliability, etc.

3.2 Timers and counters

Timers are primarily used as aids in recovery procedures when recognition of specific control characters does not occur. The action taken following a time-out is specified in

general terms to provide system protection. The absolute values of the timers are dependent upon such things as manual use, non-manual data entry, speed of transmission, type of data source/sink, etc.

Counting is primarily used as an aid in determining what recovery alternative is applicable in each error condition. The number of consecutive negative or invalid replies and the number of consecutive attempts to recover using one recovery procedure before an alternative is chosen depends upon the network configuration, quality of the channel, and application.

3.2.1 *Timer A* (No-response timer)

Where implemented : control station, master station, or both.

Purpose : protection against an invalid response or no response.

Start : after transmitting any ending character where a reply is expected; for example ENQ, ETB, ETX, DLE ETB, DLE ETX.

Stop : upon receipt of a valid reply from the communication line; for example ACK, NAK, STX, EOT, DLE STX.

When time-out occurs :

1) – retransmit same information (up to *n* times)[1], or

– transmit different information; for example ENQ, different polling/selection sequence;

2) transmit EOT, when station abort procedures are used;

3) notify operator or processor program, or both;

4) return to non-transparent mode, if applicable.

3.2.2 *Timer B* (Receive timer)

Where implemented : slave station.

Purpose : protection against non-recognition of any block terminating character, for example ETB, ETX, ENQ, DLE ETB or DLE ETX received from the communication line.

Start :

1) receipt of SOH, STX (if not preceded by SOH), DLE SOH, DLE STX or other opening characters or sequence as required.

2) this timer may be restarted to permit receipt of variable length blocks.

Stop : upon receipt of a valid terminating character or sequence; for example ETB, ETX, ENQ, DLE ETB, DLE ETX.

When time-out occurs :

1) remain in slave status and initiate search for character synchronization in synchronous systems;

2) prepare to receive another transmission;

3) notify operator or processor program or both, and discard the incomplete block;

4) return to non-transparent mode, if applicable.

NOTE – For maximum system efficiency, the duration of the no-response timer (Timer A) should be short and the receive timer (Timer B) should time-out before the no-response timer.

3.2.3 *Timer C* (No-activity timer for switched lines)

Where implemented : all stations.

Purpose : facilitates disconnection procedures of the communication line if data transmission stops due to not recognizing DLE EOT, or due to remote station or communication facility problems.

Start or restart :

1) upon receipt of indication of circuit connection; for example receipt of ON condition of circuit 107 (data set ready[2]) or circuit 125 (calling indicator[2]) and circuit 108.2 (data terminal ready[2]).

2) upon receipt or transmission of any character in asynchronous systems or the synchronizing sequence in synchronous systems.

Stop :

1) upon receipt or transmission of DLE EOT, or

2) loss of circuit 107 (data set ready[2])

When time-out occurs :

1) disconnect communication circuit;

2) notify operator or processor program, or both;

3) return to control mode, if applicable;

4) return to non-transparent mode, if applicable.

3.2.4 *Timer D* (No-activity timer for non-switched lines)

Where implemented : control station

Purpose : serves as a "no-activity" time-out for all stations in a system.

Start or restart : upon receipt or transmission of any character in asynchronous systems or after the synchronizing sequence in synchronous systems.

Stop : upon receipt or transmission of EOT

1) Retransmission of a data block can result in duplication of a block at the receiving location if a block numbering or other protective scheme is not used.

2) CCITT – V 24 designation.

When time-out occurs :

1) notify operator or processor program, or both;

2) return to control mode, if applicable;

3) return to non-transparent mode, if applicable.

3.3 Recovery procedures

Some recovery procedures are outlined in the following with their linkage to the appropriate phase diagrams in 4.2 of ISO/R 1745 and to the timers A, B and C described in this International Standard.

In all cases, after the appropriate time-out periods, it shall be the final responsibility of either the control station or the master station to take action.

3.3.1 *Recovery procedures by control station*

R1 – In the case of :

1) invalid or absence of termination supervisory sequence detected by time-out of either timer A or timer C, the control station must transmit EOT or DLE EOT whichever is appropriate;

2) invalid or no response to a polling/selection sequence detected by time-out of timer A, the control station may transmit the same or a different polling/selection sequence following the transmission of an EOT and/or notify operator or processor program, or both.

R2 – In the case of :

repeated unsuccessful polling of one, several or all stations, the control station should notify operator or processor program, or both.

3.3.2 *Recovery procedures by master station*

R3 – In the case of :

1) invalid or no response to a selecting supervisory sequence detected by the time-out of timer A, the master station may

a) terminate by transmitting EOT;

b) transmit same or another selecting supervisory sequence (up to *n* times);

c) notify operator or processor program, or both.

2) invalid or no response to information message detected by time-out of timer A the master station may

a) repeat the previous transmission (up to *n* times). This procedure can lead to duplication of blocks;

b) transmit prefix ENQ (up to *n* times) which requests the slave station to repeat its previous response (ACK or NAK). This procedure can lead to loss of blocks unless used in conjunction with a response numbering scheme to ensure that blocks are neither added nor deleted.

R4 – In the case of :

1) repeated negative replies (NAK) or invalid or no responses to a selection supervisory sequence, the master station should notify the operator or processor program, or both;

2) repeated negative replies (NAK) or failure to receive a valid reply for an information block, the master station may transmit an EOT (if master station abort is used) and/or notify the operator or processor program, or both.

3.3.3 *Recovery procedures by a slave station*

Recovery procedures by a slave station are explained by the functions of timer B (see 3.2.2).

4 ABORT AND INTERRUPT PROCEDURES

4.1 General

Abort procedures are always initiated by the master station wishing either

1) to stop transmitting a block of information before its normal end (ETB or ETX) but without returning to control mode or neutral; or

2) to stop transmitting at any time during the information transfer phase and then return to control mode or neutral.

Interrupt procedures are always initiated by the slave station which desires to stop receiving either instantaneously or within a short period of time.

4.2 Abort procedures

4.2.1 *Block abort*

4.2.1.1 DESCRIPTION

The master station decides to terminate a block in an unusual way so that the slave station rejects this block. There is no return to control mode or neutral and the master station resumes transmission to the same slave station.

4.2.1.2 PROCEDURE

When the master station decides to abort a block, it terminates it immediately with ENQ (DLE ENQ if applicable). The slave station replies with NAK which is the only valid acknowledgement in this case. The master station then resumes transmission beginning with STX (or SOH). If the reply from the slave station is invalid, or if there is no reply, the normal recovery procedures may apply (*n* retries, time-out). (See Figure 1.)

NOTE – As examples, block abort may be used in the following cases :

– the master station determines that invalid data have been sent;

for example, errors are detected at the buffer storage level, or when reading data from their media, or by the source (operator).

– with fixed length blocks when, due to transmission, programming or operator errors, the block being transmitted overflows normal length.

– when the master station determines that the block being transmitted will not be accepted by the slave station.

4.2.2 *Station abort*

4.2.2.1 DESCRIPTION

The master station is sending a message and decides, either while a block of information is being sent or between two blocks of information, to stop transmitting and return to control mode or neutral.

4.2.2.2 PROCEDURE

a) While a block is being sent

When the master station decides to abort a transmission, it immediately sends the transmission control character ENQ (DLE ENQ). The slave station detects this unusual termination with ENQ (instead of ETB or ETX) and then replies with NAK which is the only valid reply in this case. After receiving NAK, the master station sends EOT and the communication link returns to control mode or neutral.

When there is no answer or an invalid answer, the normal recovery procedures may apply (*n* retries, time-out). (See Figure 2.)

b) Between two blocks of information

The master station terminates the block being transmitted in the usual way. The usual answer of the slave station is ACK. The master station then sends EOT and the communication link goes back to control mode or neutral.

If the answer is NAK or if there is no answer or an invalid one, the master station may or may not decide to use the normal recovery procedures (*n* retries, time-out) before transmitting EOT with the resulting return to control mode or neutral. (See Figure 3.)

NOTES

1 In switched line applications, DLE EOT may be used in place of EOT.

2 Examples of use : when it is intended to disconnect the line.

Master station abort may be used in the following cases :

– Master station detects its own malfunction, or a malfunction of the transmitting media.

– Master station detects a failure in the slave station or in the link (persisting NAK, or invalid reply, or absence of reply) or the master station detects that the slave station is no longer in a position to receive.

– Master station is notified that the transmission media are urgently required for another purpose.

4.3 Interrupt procedures

4.3.1 *Block interrupt*

4.3.1.1 DESCRIPTION

The slave station, at the end of a message or of an information block, is no longer in a position to receive and wishes the master station to cease transmission immediately.

4.3.1.2 PROCEDURE

The slave station replies EOT instead of its normal reply. EOT indicates a negative acknowledgement of the last received block and the conclusion of the current transmission. The communication link returns to control mode or neutral. (See Figure 4.)

NOTE – The transmission systems fall into one of the following classes :

1 Control station is also master station.

2 Control station is also slave station.

3 Control station is neither master nor slave but is monitoring only the transmissions of the master station.

4 Control station, being neither master nor slave, is monitoring all data exchange within the system.

The block interrupt procedure, as described in 4.3.1.2 above, can only be used in classes 1, 2 and 4. As regards class 3, the control station is not aware of the EOT sent by the slave station and there is no way to return to control mode or neutral other than through recovery procedures (control station time-out, for instance).

For this reason, the use of block interrupt procedure is not recommended for systems falling in class 3 above. Concerning systems falling in classes 1, 2 and 4, block interrupt is not recommended for frequent utilization; its use should be reserved for emergency situations.

4.3.2 *Station interrupt*

4.3.2.1 DESCRIPTION

Station interrupt is the means whereby a slave station can request the master station to stop transmitting as soon as possible.

4.3.2.2 PROCEDURE

Station interrupt is accomplished by the slave transmitting the control sequence DLE < instead of the normal positive acknowledgement. This reply has a double meaning :

1) it includes the positive acknowledgement which would have been normally sent;

2) it means a request from the slave station to have the current transmission terminated at the earliest possible time (by the master station sending EOT). However, the master station may not stop transmitting immediately

and may, for instance, continue to transmit so that its buffers are cleared and readily available for further transmissions. The point where the master station effectively stops is system dependent.

NOTES

1 Example of use. The control station being also the slave station may want to interrupt so as to be able to urgently poll or select another tributary station.

2 Recovery procedures. The possibility of a station interrupt sequence being garbled by line disturbances should be considered. In particular, if backward supervision numbering should be established, this may lead either to use the same numbering scheme for the station interrupt sequence as for the supervisory sequence, or to impose other rules to preserve the correct information blocks sequencing.

For instance, it should not be permitted to continuously send the station interrupt sequence.

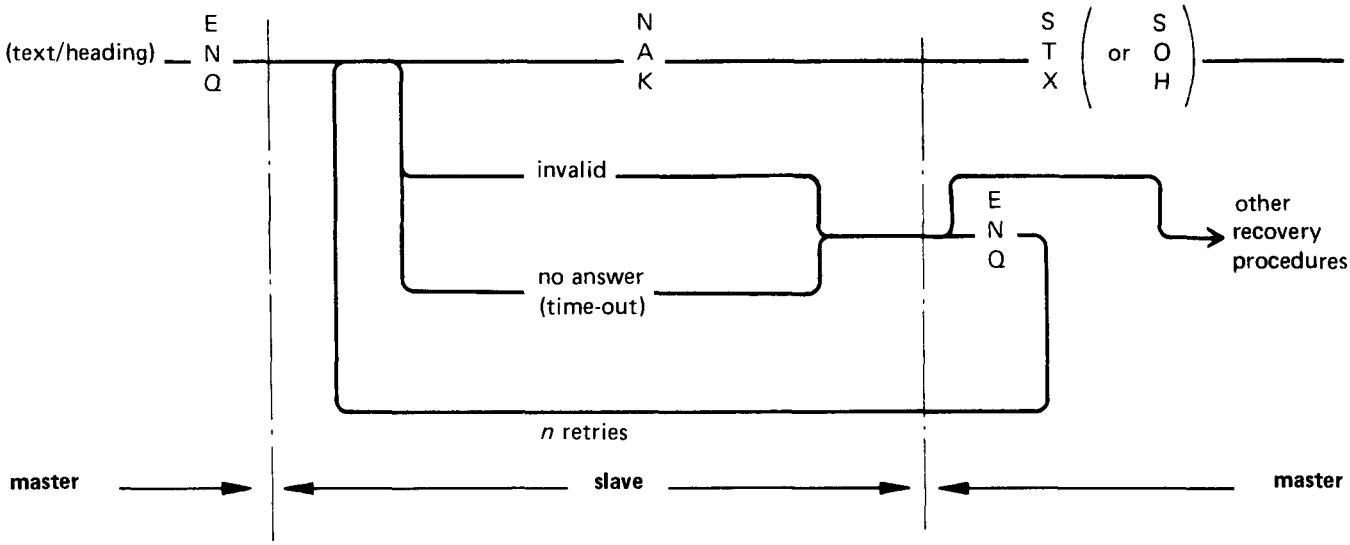


FIGURE 1 – **Block abort**

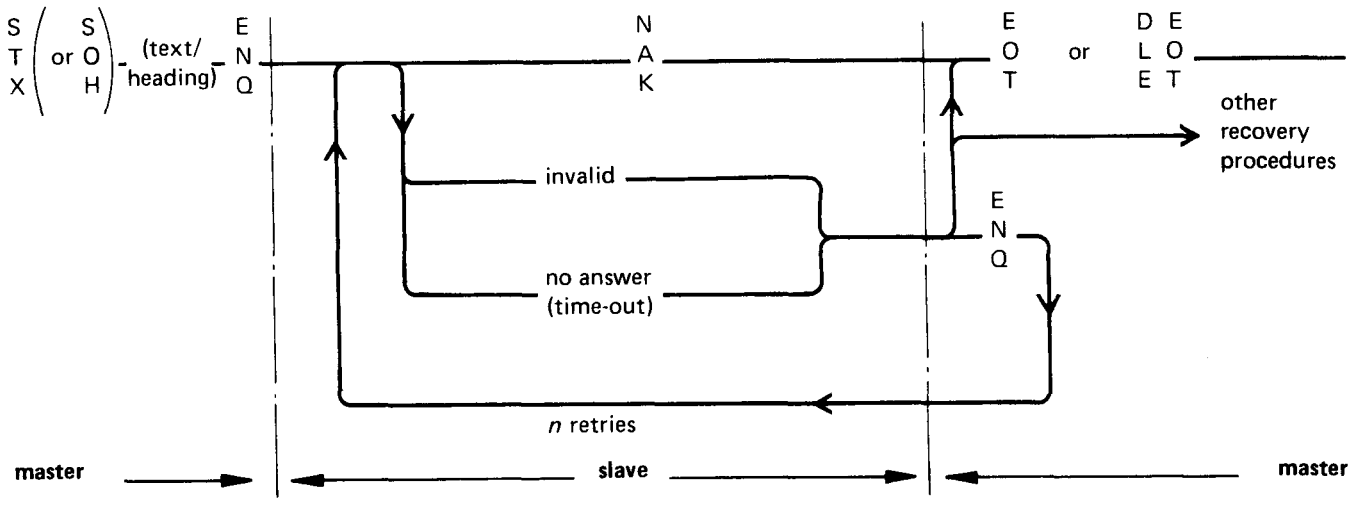


FIGURE 2 – **Station abort (while a block is being sent)**

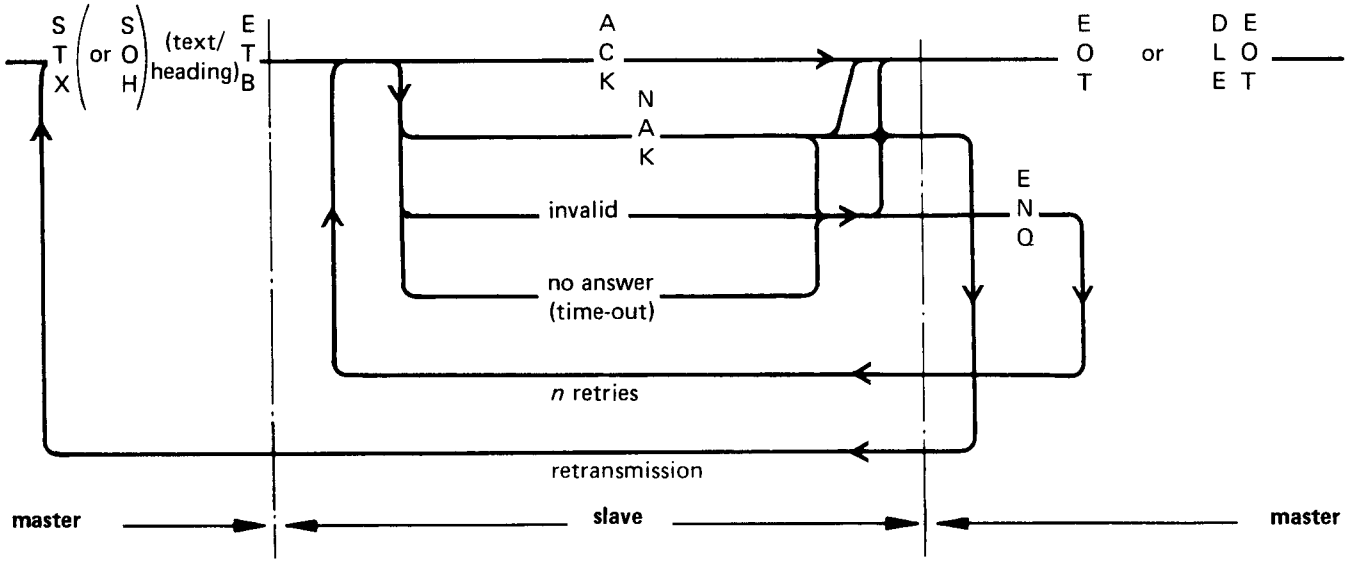


FIGURE 3 – **Master station abort (between two information blocks)**

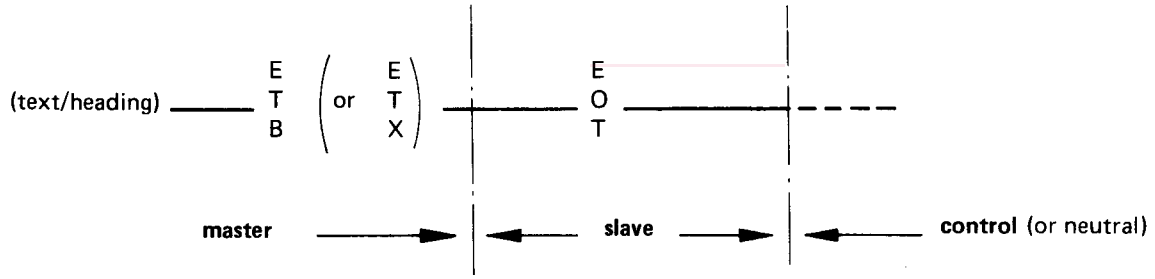


FIGURE 4 – **Block interrupt**

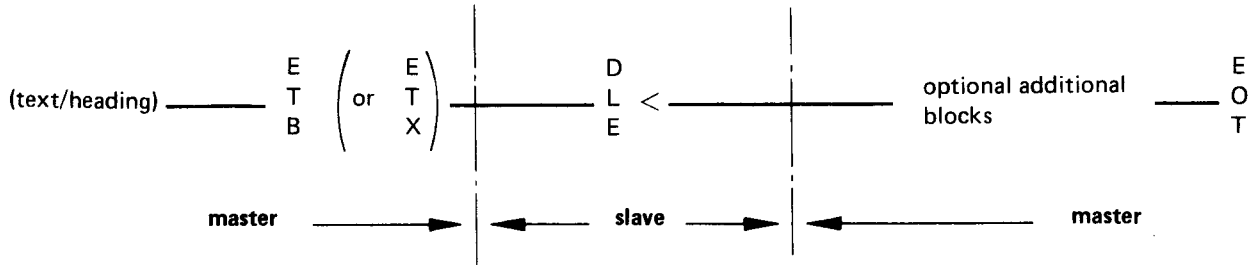


FIGURE 5 – **Station interrupt**

5 MULTIPLE STATION SELECTION

5.1 General

5.1.1 Multiple selection is a means whereby a master station may select more than one slave station so that all the selected slave stations receive the same transmission at the same time.

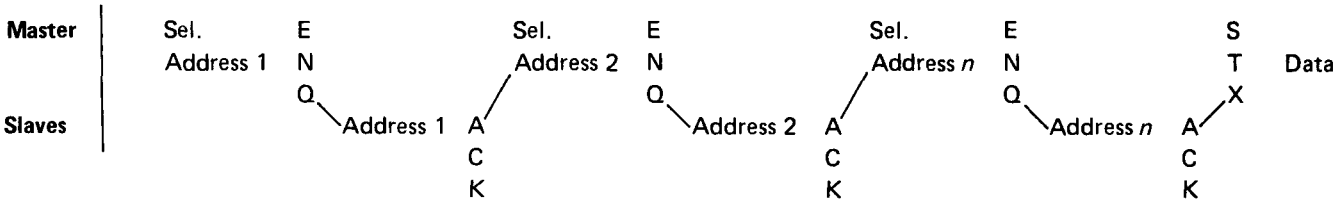
5.1.2 The procedures for multiple selection are not covered by the basic mode control procedures, hence they are considered to be an extension to them.

5.1.3 When a system is designed to work both with and without the multiple selection procedure, some means must be provided for the master station to notify the slave stations which procedure is to be entered. For example, by assigning two different addresses to each station having both facilites.

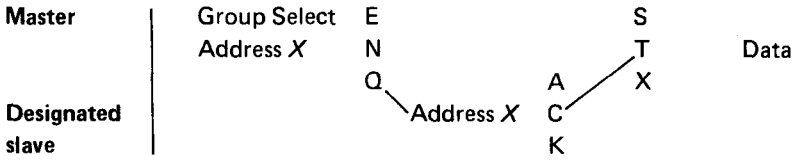
5.2 Selection sub-phase

Three methods providing various degrees of protection are proposed for the selection sub-phase. They are listed in the order of decreasing degree of protection.

5.2.1 *Sequential selection with individual replies from the selected stations.*



5.2.2 *Group selection with reply from one designated station*, for example, the most distant one, or strategically located, or any station indicated within the selection sequence.



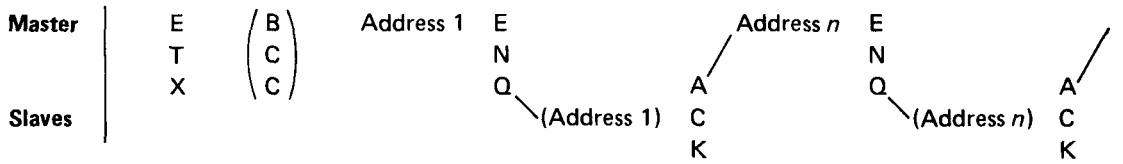
5.2.3 *Group selection with fast select.*

5.3 Information transfer phase

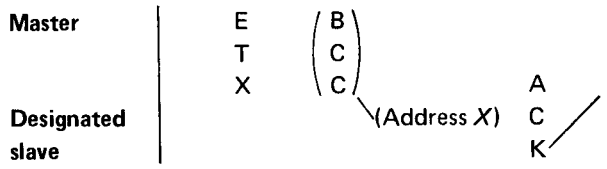
Three methods providing various degrees of protection are proposed for the information transfer phase. They are listed in the order of decreasing degree of protection.

5.3.1 *Information transfer with individual replies from the slave station*

After each transmission block, the master station sends a delivery verification supervisory sequence, consisting of a prefix identifying a single slave station, followed by ENQ. Only tributary stations having slave status should respond to delivery verification supervisory sequences.



5.3.2 *Information transfer with reply from one designated station,* for example the most distant, or strategically located.



X being the address of the designated station.

5.3.3 *No reply*

Although the "no reply" case is not considered by the basic mode, it is recognized that it may conveniently be used for general announcement (for example conference) and the broadcasting of messages of a "clear text" type.

5.4 Relations between selection procedures and information transfer procedures

Although the adoption of one of the three selection procedures does not preclude the adoption of any one of the three procedures for information transfer, it is recognized that some pairings would not be realistic. Straightforward pairings could be, for example, 2.1 with 3.1, 2.2 with 3.2, and 2.3 with 3.3.