7.

Information element 3.6 could also be used after "out-of-service" -information without 3.1, 3.2 and 3.3.

Note 5 - Information elements 3.1, 3.2, 3.3 and 3.6 are a set of elements that should only be used together.

Notes to Table 4/Q.50

For indication of termination (not interruption) of a call, select/seizure and release may be necessary on a per call basis.

Note 5 - The request for speech service may be implicit, that means, that a discrete information flow may not be required.

For common channel signalling it must be ensured that the circuit establishment process between the CME is finished before signalling for this circuit has finished.

Note 4 - Dependent on the realization of the CME there could be a longer or shorter delay for 64 kbit/s channel acknowledgement.

A 64 kbit/s select/seizure information element between CME and ISC is mandatory for Type 2 CME equipment, if 64 kbit/s channels are used on a demand basis. Also preassigned 64 kbit/s channels (digital non-interpolated (DNI) channels) could be used (e.g. for common channel signalling).

Note 3 - Preassigned (DNI) 64 kbit/s channels do not need this information element.

Notes to Table 3/Q.50

Note 2 - If a defined portion of the bearer capacity is used for special call types (definition of minimum and/or maximum number of channels per call type, e.g. for 3.1 kHz audio or 64 kbit/s), a special load control information is needed for each of these call types.

Note 1 - This information may be implicit in information element 1.1 (e.g. because 3.1 kHz audio data and speech may be supported by the same LRE algorithm or 3.1 kHz audio data is detected by the CME using inband signals (2 100 Hz) from the data terminal).

Notes to Table 2/Q.50

+———————————+————————————————+———————————+

_ service" _ _ _

_o of "Back-in- _basis _ _

_3.7 Acknowledgement _Used on a per circuit _ ISC-->CME _

_ _CME basis _ _

_ _on a per circuit or per _ _

_ _longer necessary - used _ _

_m Note 5 _from service is no _ _

_3.6 Back-in-service _Sent after the removal _ CME-->ISC _

_ _on a per circuit basis _ _

_o acknowledgement _of-service signal" used _ _

_3.5 Out-of-service _Sent to acknowledge "Out-_ ISC-->CME _

+------------------------+----------------------------+--------------+

_ _on a per circuit basis _ _

_m _unavailable signal used _ _

_3.4 Out-of-service _General CME trunk _ CME-->ISC _

+————————————+————————————+————————+

_ Note 5 _ _ _

_ release signal) _(this) trunk(s). _ _

_ maintenance _new seizures on these _ _

_ (released after _idle. The ISC prevents _ _ _o traffic signal _(this) trunk(s) are (is) _ _

3.3 CME clear of	Signal sent when all	ISC-->CME

```
+--------------------------+-------------------------------+----------------+
```

_ _trunk _ _

_ Note 5 _for the release of the _ _

_ Acknowledgement _Release, ISC is waiting _ _ _o Release _reception of Maintenance _ _

_3.2 Maintenance _Sent to acknowledge _ ISC-->CME _

+--------------------------+--------------------------------+---------------+

_ Note 5 _service _ _

_o Release Signal _planned removal from _ _

_3.1 Maintenance _Sent for manual control, _ CME-->ISC _

+————————————+——————————————+———————+

_ _ _ element _

_ _ _information _

_ elements _ _ the _

_Type of information _ Notes _Direction of_

```
+----------------------+---------------------------+--------------+
```

Information elements for maintenance (CME/ISC) Type 2

TABLE 4/Q.50

+----------------------------+------------------------------------+-----------------+----------------------
-+

_ Acknowledgement_of Release _ _ _

_m 64 kbit/s pos. _successful completion _ _ _

_2.14 Release _Sent to indicate _ CME-->ISC _ _

```
+--------------------------+---------------------------------+----------------+--------------------
-+
```

_ _required any longer _ _ Note 5 _

_o _speech circuit is not _ _ _

_2.13 Release speech _Sent to indicate that the_ ISC-->CME _ _

```
+----------------------+----------------------------+--------------+-----------------
-+
```

_o _cannot be satisfied _ _ _

2.12 Speech NACK	Sent if speech request	CME-->ISC		

+--------------------------+----------------------------------+----------------+--------------------

–

_o Acknowledgement_can be satisfied _ _ _

_2.11 Speech, pos.   _Sent if speech request   _ CME-->ISC _   _

+——————————————+——————————————————+—————————+———————————
—+

_o select/seizure _service request _ _ _

_2.10 Speech service _Sent to indicate speech _ ISC-->CME _ _

+————————————+——————————————+———————+—————————
—+

_ _ _ element _ elements _

_ _ _information _ information _

_ elements _ _ the _ of the _

_Type of information _ Notes _Direction of_ Procedures; use _

+————————————————+————————————————————+——————————+————————————
—+

+————————————————————+——————————————————————————+—————————————+————————————————
—+

_ service _ _ _ _

_o 3.1 kHz _termination of the call _ _ _

_2.9 Release   _Sent to indicate   _ ISC-->CME _   _

+------------------------+------------------------------+---------------+-------------------
-+

_ _satisfied _ _ _

_o service/NACK _request cannot be _ _ _

_2.8 3.1 kHz _Sent if 3.1 kHz service _ CME-->ISC _ _

```
+----------------------+----------------------------+--------------+------------------
-+
```

_ Acknowledgement_ _ _ _

_o service, pos. _request can be satisfied _ _ _

_2.7 3.1 kHz   _Sent if 3.1 kHz service _ CME-->ISC _   _

+——————————————+——————————————————+—————————+———————————
—+

_ seizure _ _ _ _

_o service/select _optimized facilities _ _ _

_2.6 3.1 kHz _Request to allocate data _ ISC-->CME _ _

+------------------------+--------------------------------+---------------+-------------------
-+

_ _required any longer _ _ _

_ _64 kbit/s circuit is not _ _ _

_m 64 kbit/s _ISC to indicate that a _ _ _

_2.5 Release   _Sent by the originating _ ISC-->CME _   _

```
+----------------------+-----------------------------+-------------+-----------------
-+
```

_ _satisfied _ _ _

_m _request cannot be _ _ _

_2.4 64 kbit/s NACK _Sent if a 64 kbit/s   _ CME-->ISC _   _

+—————————+———————————+—————+———————
—+

_ _(Note 4) _ _ _

_m Acknowlegement _can be satisfied _ _ _

_2.3 64 kbit/s pos. _Sent if 64 kbit/s request_ CME-->ISC _   _

+------------------------------+-------------------------------------+-------------------+-----------------------
-+

_ _specific trunk _ _ _

_ _information element to a _ _ _

_m identity _information to assign an _ _ _

_2.2 Trunk _Explicit or implicit _ ISC-->CME _ _

+——————————————+——————————————————+—————————+———————————
—+

_ seizure _the DCME (Note 3) _ _ _

_m select/ _circuit is required via _ _ _

_2.1 64 kbit/s _Sent when 64 kbit/s _ ISC-->CME _ _

```
+————————————————+————————————————————+——————————+————————————
—+
```

_ _ _ element _ elements _

_ _ _information _ information _

_ elements _ _ the _ of the _

_Type of information _	Notes	_Direction of_ Procedures; use _

```
+----------------------------+-----------------------------------+-----------------+---------------------
-+
```

Information elements for seizure/release (CME/ISC (Type 2))

TABLE 3/Q.50

o = optional for this type of CME

m = mandatory for this type of CME

Note a - Each information element may be sent as a message or may be implicit by the lack of a signal (e.g. the CME may send a signal for no capacity for speech available and remove the same signal to indicate trunks available for speech).

```
+----------------------+------------------------------+--------------+------------------
-+
```

_	64 kbit/s	_	_	_	_

_ available for _ _ _ _

_o of trunk(s) _ _ _ _

1.8 Acknowledgement _ ISC-->CME _ _

+--------------------------+-----------------------------------+-----------------+---------------------
-+

_ _ condition _ _ _

_ _ available" overload _ _ _

_ 64 kbit/s _ of "No 64 kbit/s capacity_ _ _ _m available for _ is sent to notify the end_ _ _

_1.7 Trunk(s) _ This information element _ CME-->ISC _ _

+——————————+——————————————+——————+————————
—+

_ available" _ _ _ _

_ kbit/s capacity_ _ _ _

_o of "No 64 _ _ _ _

1.6 Acknowledgement _ ISC-->CME _ _

+——————————————————+—————————————————————————+————————————+———————————————
—+

_ Note 2 _ _ _ _

_ available _ trunk(s) available _ _ _

_m capacity _ additional 64 kbit/s _ _ _

_1.5 No 64 kbit/s _ No bearer capacity for _ CME-->ISC _ _

```
+--------------------+---------------------------+-------------+----------------
-+
```

_ _ audio" condition _ _ _

_ Note 1	_ available for 3.1 kHz	_	_	_	

_ 3.1 kHz _ end of "No trunk _ _ _

_o available for _ is sent to notify the _ _ _

_1.4 Trunk(s) _ This information element _ CME-->ISC _ _

+------------------------+---------------------------------+----------------+--------------------
-+

_ Note 1 _ _ _ _

_ 3.1 kHz audio _ trunk(s) available _ _ _ _o available for _ additional 3.1 kHz audio _ _ _

_1.3 No trunk(s) _ No bearer capacity for _ CME-->ISC _ _

+——————————+——————————————+—————————+——————————
—+

_ _ condition _ _ _

_ _ speech available" _ _ _

_ speech _ end of "No capacity for _ _ _ _m available for _ is sent to notify the _ _ _

_1.2 Channel(s) _ This information element _ CME-->ISC _ _

+——————————————————+————————————————————————+————————————+———————————————
—+

_ available _ available _ _ _

_m for speech _ for additional trunk(s) _ _ _

_1.1 No capacity _ No bearer capacity _ CME-->ISC _ _

+------------------------+--------------------------------+----------------+--------------------
-+

_ _ _ element _ elements _

_ _ _information _ information _

_ element (Note a) _ _ the _ of the _

Type of information Notes _Direction of_ Procedures; Use _

+——————————+——————————————+——————+————————
–+

(load control) CME/ISC (Type 2)

Information elements for transmission resource management

TABLE 2/Q.50

Note a - Speech includes 3.1 kHz audio.

_4. Back-in-service _ (o) _

_3. Out-of-service _ (o) _

_2. Channel(s) available for speech _ (m) Note a _

_1. No capacity for speech available _   (m) Note a   _

Type of information elements	Used (m) or (o)

Type 1 CME only should use the following information elements (m = mandatory; o = optional).

6.1 Information elements for Type 1 CME

The amount of control information elements utilized between the exchange and the CME depends on the capabilities of the CME and the exchange. Two categories of CME signalling capabilities are recognized. The first category of CME (Type 1) is capable of only transmitting signals from the CME to the exchange (e.g. DLC see Table 3/Q.50). The second category of CME (Type 2) is able to transmit and receive signals to/from the exchange. Tables 2/Q.50, 3/Q.50 and 4/Q.50 give a set of information elements and their flow on the control link between the exchange and the CME for the second category of CME.

6. Control information elements between exchange and CME

To allow a standard method of interworking with inter-exchange signalling systems it is important to adopt the functional interdependency between TRM and CSM as described above.

5.3 Inter-dependency between dynamic load control and call set-up process

Typical ISC/CME information flows

FIGURE 5/Q.50

The information elements and procedures necessary to support the alternate 64 kbit/s speech bearer services are for further study.

Under a 64 kbit/s unrestricted dual seizure situation, the non-controlling ISC will initiate a release of the DCME connection using procedures defined in the appropriate inter ISC signalling system protocol. If the DCME is unable to re-establish a remotely released 64 kbit/s duplex connection, it shall indicate this abnormal situation to the appropriate ISC by out-of- service.

The released 64 kbit/s message from the ISC will be positively acknowledged after proper completion of the DCME circuit disestablishment process. Failure to complete this process shall be notified to the ISC using an out-of-service message and the DCME will put the circuit in a blocked condition. After the failure condition is removed, this circuit will be in idle condition and a back-in-service message shall be sent to the ISC.

The out-of-service message is considered by the ISC to be equivalent to the alarm signal defined in Recommendation Q.33. The ISC will take release actions (if appropriate) as specified in Recommendation Q.33, § 4.

The positive acknowledgement will be used by the ISC to initiate the interexchange signalling to the next ISC (e.g. transmission of the IAM of Signalling System No. 7). A failure to establish a 64 kbit/s circuit between CMEs must be reported to the DSG as soon as the condition has been identified by the CME to the ISG by using an out-of-service message.

For the 64 kbit/s unrestricted bearer service, a circuit is selected if "unrestricted capacity available" is indicated, and a CSM in the form of Seizure/Select request is forwarded to the DCME. An acknowledgement (positive or negative) is set as soon as possible even if capacity is available, to account for possible call set-up rejects other than due to capacity limitations on the DCME link.

According to Table 1/Q.50, the contemporary digital circuit multiplication equipment, having the capability to support on-demand all four identified bearer services, in addition to providing TRM to the exchange, requires call set-up messages (CSM) (from the exchange) for selecting bearer services.

5.2 Call set-up process

The circuit selection in the exchange is a check whether or not a free unseized circuit is suitable for a certain bearer service type, for which a new call is to be accommodated. For example, the exchange would select a free circuit for a speech call if "speech capacity available" is indicated, irrespective of the indications for other bearer service types. If the DCME link is unable to accommodate additional new 64 kbit/s calls, all free unseized circuits within the exchange will be marked accordingly. Even though the generation of bearer service related TRM information with DCMEs may be in part mutually dependent (i.e., no capacity for speech implies no capacity for any other bearer service types but not necessarily vice-versa), separate signalling and processing for each bearer service type are necessary to allow different future CMEs to develop independently.

This DLC information is therefore directly influencing the circuit selection process in the exchange during call set-up for each bearer service separately.

When a CME encounters a "not available" state for a bearer service (either locally or remotely), it presents this indication to the exchange so it will stop routing new calls to the CME for that bearer service even if there are free, unseized circuits available. The exchange will continue to prohibit calls to the CME until it receives an "available" indication for the bearer service which will be sent by the CME when both, locally and remotely, there is no overload.

A universal arrangement is proposed for handling transmission resource management (TRM) information between CME and an exchange. The TRM information is dynamically presented to the exchange in one of two states for each bearer service. The states are called "available" and "not available". Logic within the CME is used to determine which of the two states should be indicated to the exchange regardless of any condition at the exchange.

TRM information is based on traffic load measurements at the local and distant CMEs. Therefore in the multi-destination and multi-clique mode of operation, TRM information is provided for each destination/clique separately.

5.1 CME dynamic load control process

5.<u>Division of functionality between the exchange and the CME</u>

The signalling function requirements are categorized on the basis of bearer services supported by the different CME techniques. For speech bearer services, only transmission resource management (TRM) information alone is adequate especially for CMEs employing speech interpolation. The objective of this provision is to maintain the reduction of transmission quality within tolerable limits. In addition to TRM information, external call set-up message (CSM) exchange is needed for bearer services involving on-demand 64 kbit/s unrestricted service in contemporary digital circuit multiplication equipment (32 kbit/s LRE and DSI).

Table 1/Q.50 gives the relationship between CME techniques and the four bearer services identified in § 3.3.2 with regard to their supportability and the need for CME-exchange message transfer.

4. Bearer services and CME techniques in the context of signalling

Bearer services supported in CMEs in relation to CME-exchange signalling

TABLE 1/Q.50

-alternate speech/64 kbit/s unrestricted bearer service (full duplex);

-64 kbit/s unrestricted bearer service (full duplex);

-3.1 kHz audio bearer service (full duplex);

-speech bearer service (full duplex, analogue or digital);

Up to four basic bearer service types are supported or will likely be supported by CMEs in the international network:

3.3.2 Bearer services supported on CME links

When the CME is remote from the ISC, the link between the ISC and CME could be composed of digital or analogue transmission path. Both conditions have different equipment configurations and different signalling requirements (see section 7).

The location of certain types of CME relative to the exchange determines the choice of signalling interface. These CMEs can be located at the ISC or remote from the ISC (e.g., at an earth station). Certain types of signalling interfaces may be more practical when these CMEs are co-located with the ISC, and others may be more practical when they are remote from the ISC. Therefore, the location of the CME needs to be considered when choosing the signalling between ISC and CME.

e)16 kbit/s LRE.

d)combined 32 kbit/s LRE and DSI

c)digital speech interpolation (DSI) with 64 kbit/s PCM;

b)analogue speech interpolation equipment;

a)32 kbit/s low rate encoding (LRE);

There are different types of CME which are being used or will most likely be used in the international telephone network, each with its own capabilities and limitations:

3.3.1 Circuit multiplication equipment and physical location

Requirements and actions for control of ECD are described in CCITT Recommendation Q.115.

The remote control of echo control devices and A/u-law converters, if they are integrated into the CME, is accomplished either by the terminal or test equipment or directly from the ISC (based on call set up information/signalling information).

The functional requirements for signalling between CMEs and exchanges are determined by the type of CME with its capabilities and limitations, and by the types of bearer services it supports.

3.3 Factors for signalling functions determination

(and for 3.1 kHz audio, if appropriate) through DSI systems (i.e., not through internal pre-assignment), the establishment and disestablishment of connections between the CMEs have to be initiated from the outgoing exchange.

Normally, when an exchange needs an outgoing circuit, the only question is whether or not a circuit is available. In this example, the call may be blocked if all of the circuits are unavailable through traffic or maintenance. If the same call encounters a CME, the possible outcomes are more complex.

3.2 Integration of CMEs into the telephone network

Circuit multiplication equipments are used in order to reduce the

3.1 Reasons for use of circuit multiplication equipments (CME)

3.Requirements for control

Multi-destination mode (only one direction shown)

FIGURE 4/Q.50

Figure 4/Q.50 shows a unidirectional system block diagram for a multi-destination mode with two transmit and two receive DCME units.

A DCME operational mode where input trunk channel traffic is interpolated over a pool of available transmission channels for all destinations having traffic in the pool. The transmit trunk channels are designated to receive trunk channels at corresponding locations.

2.11.3 Multi-destination mode

Multi-clique mode (only one direction shown)

FIGURE 3/Q.50

Multi-clique mode - in this mode the pool of transmission channels is sub-divided into several independent pools (cliques) or fixed capactiy, each being for an individual destination. If a part of the cliques capacity is not used, it cannot be used for another destination.

2.11.2 Multi-clique mode (see Figure 3/Q.50)

For transmission of alarms it has also to be considered, that different exchanges may be connected to one CME.

The example in Figure 2b/Q.50 also shows a point-to-point mode. From the switching point of view there could be a difference between the configurations in Figures 2a/Q.50 and 2b/Q.50.

Multi-clique for two origins and two destinations unidirectional

FIGURE 2/Q.50

Point-to-point two origins unidirectional

FIGURE 2b/Q.50

Point-to-point unidirectional

FIGURE 2a/Q.50

At the receive side, the receiving CME simply reconstitutes the N trunks from the N/G transmission channels.

Point-to-point - Using Figure 2a/Q.50 for reference, the transmit side CME concentrates N trunks into N/G transmission channels, where G is the CME gain.

2.11.1 Point-to-point mode (see Figures 2a/Q.50 and 2b/Q.50)

2.11 Operating modes

The condition when the freeze-out fraction or average bits per sample goes beyond the value set in accordance with speech quality requirements.

2.10 Transmission overload

The ratio of the sum of the individual channel freeze-outs to the sum of the active signals and their corresponding hangover times and front end delays, for all trunk channels over a fixed interval of time, e.g. one minute.

2.9 Freeze-out fraction

The condition when a trunk channel becomes active and cannot immediately be assigned to a transmission channel, due to lack of available transmission capacity.

2.8 Freeze-out

One channel of the connection between the transmit unit and receive unit of corresponding CME.

2.7 Transmission channel - bearer channel

A bidirectional connection consisting of a forward channel and a backward channel between the ISC and CME not subject to LRE or DSI operation.

2.6 Trunk

Note - For a complete discription of bearer channels, see Recommendation G.dcme.

CME gain

FIGURE 1/Q.50

The trunk channel to transmission channel multiplication ratio, which is achieved through application of CME, including LRE and/or speech interpolation (DSI).

2.5 <u>CME gain</u>

The ratio of the time speech and corresponding hangover occupies the trunk to the total measuring time, averaged over the total number of trunks carrying speech.

2.4 Speech activity

Speech coding methods with bit rates less than 64 kbit/s, e.g. the 32 kbit/s transcoding process defined in G.721 applied to speech coded according to G.711.

2.3 Low rate encoding (LRE)

A method of profiting from the time instants when a speaker is not active, which is indicated by a speech detector. The channel is then used by another speaker. The signals carried by a transmission channel therefore represent interleaved bursts of speech signals derived from a number of different trunks.

2.2 Speech interpolation; digital speech interpolation (DSI)

DCME and CME constitute a general class of equipment which permits concentration of a number of trunks on a reduced number of transmission channels. DCME in particular permits concentration of a number of 64 kbit/s PCM encoded trunks on a reduced number of digital transmission channels.

2.1 Digital circuit multiplication equipment (DCME) and CME

2. Definitions relating to CME

The information in this Recommendation is compatible with the control procedures for such devices.

Circuit multiplication equipments may have integral echo control and A/u law converter functions.

This Recommendation contains principles and examples of signalling between ISC (exchanges) and their associated circuit multiplication equipments. (In call modification is for further study.)

1. Introduction

INTERNATIONAL SWITCHING CENTRES (ISC)

SIGNALLING BETWEEN CIRCUIT MULTIPLICATION EQUIPMENTS (CME) AND

1.1.2 Draft Recommendation Q.50