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CCITT

THE INTERNATIONAL
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(10/92)

TELEPHONE NETWORK AND ISDN

OPERATION, NUMBERING, ROUTING AND MOBILE SERVICE

INTERCONNECTION OF PUBLIC LAND MOBILE NETWORKS (PLMN)

Recommendation E.220

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation E.220 was prepared by Study Group II and was approved under the Resolution No. 2 procedure on the 30th October 1992.

CCITT NOTES

1) In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized private operating agency.

2) A list of abbreviations used in this Recommendation can be found in Annex A.

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Recommendation E.220

INTERCONNECTION OF PUBLIC LAND MOBILE NETWORKS (PLMN)

(1992)

1 Introduction

1.1 The rapid advances in cellular radio technology have meant that public land mobile networks (PLMN) now have a significant role in the provision of telecommunication services. The rapid growth of land mobile related traffic, and the proliferation of dedicated mobile networks has generated the need for guidelines to be established for interconnecting such networks to the fixed PSTN/ISDN.

1.2 This Recommendation identifies the principles to be adopted for interconnection of PLMNs with fixed networks. Various interconnection scenarios are developed and some issues relevant to mobile networks, and their impact on the fixed networks are addressed.

2 Scope

2.1 This Recommendation is applicable to those cases where the PLMN is a separate entity from the fixed PSTN/ISDN. It does not cover the case where the mobile network switches are integrated within the fixed network. The mobile network and fixed network may be operated by separate companies (or administrations) or by the same company.

2.2 This Recommendation does not cover the case of interconnection of PLMNs with the fixed network across an international boundary. Such interconnections are expected to allow for the connection of international calls to and from the PLMN.

2.3 PLMNs may be based on cellular, cordless or satellite systems. However, in this Recommendation, the emphasis is on cellular systems, although the scope may be widened in the future. Interconnection of satellite mobile systems is for further study.

3 Related Recommendations

3.1 The following Recommendations are directly related to Recommendation E.220:

E.173 Routing plan for interconnection between public land mobile networks and fixed terminal networks.

E.770 Terrestrial mobile and fixed network interworking traffic Grade of Service concept.

E.771 Network Grade of Service parameters and target values for circuit switched terrestrial mobile services.

F.111 Principles of service for mobile systems.

3.2 A complete list of mobile related Recommendations can be found in Recommendation E.201: Reference Recommendation for mobile services.

4 General principles of interconnection

4.1 In general, the interconnection of a PLMN to the existing PSTN/ISDN, should not impose any requirement for additional functionality in the fixed network, nor any restriction in the normal operation of the fixed network. Any additional functionality should be provided in the mobile network, unless otherwise agreed between the operators of the mobile and fixed networks. The fixed network should not have to be specially engineered to compensate for possible performance degradation of services supported by the PLMN interconnected to it in order to match the performance of similar services fully supported by the fixed network (see Recommendation E.770).

4.2 The interconnection should not result in any impairment to the Quality of Service provided on calls routed across the interconnection.

4.3 In cases where more than one network operator is involved, a technical agreement could be drawn up by the operators of the two networks to formalize the interconnection arrangements. This agreement could cover the following areas:

- network topology;
- interface specifications, including signalling systems;
- provisioning procedures;
- operations and maintenance procedures;
- performance monitoring (QOS, GOS, traffic measurement, etc.);
- growth management (forecasts, network planning, etc.);
- charging and accounting arrangements.

5 Network interconnection scenarios

5.1 The following network scenarios are for guidance only. In principle, the interconnection between the PLMN and the fixed network can be at any level in the fixed network hierarchy, e.g. local exchange, transit exchange, international exchange, or a combination of these.

5.2 For interconnection of digital PLMNs (within national boundaries), the interconnection should ideally be provided via digital facilities. Typically, this would be via digital transmission and common channel signalling.

6 Echo control

6.1 *General*

6.1.1 In digital PLMNs electrical echo is eliminated through the use of 4-wire terminal sets. A PLMN can be regarded as having an echo control device connected. Therefore, echo control devices need not be activated for calls within and between PLMNs with such terminal sets.

6.1.2 In a digital PLMN, a long propagation time can be caused by the speech processing devices at the radio access. For calls between such accesses and terminal sets which generate echo, half-echo control devices (preferably echo cancellers) must be activated. Fixed networks, particularly on long international connections, also add propagation delay which may require echo control.

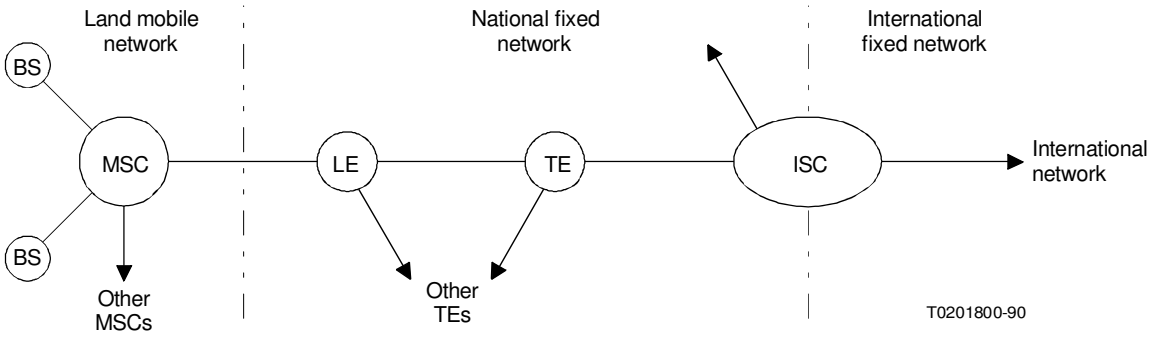


FIGURE 1/E.220

All mobile traffic via interconnect at local exchange

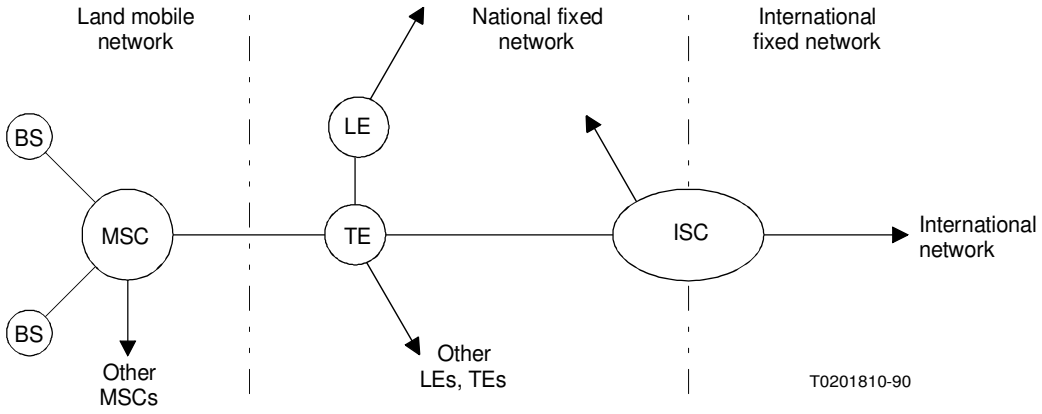
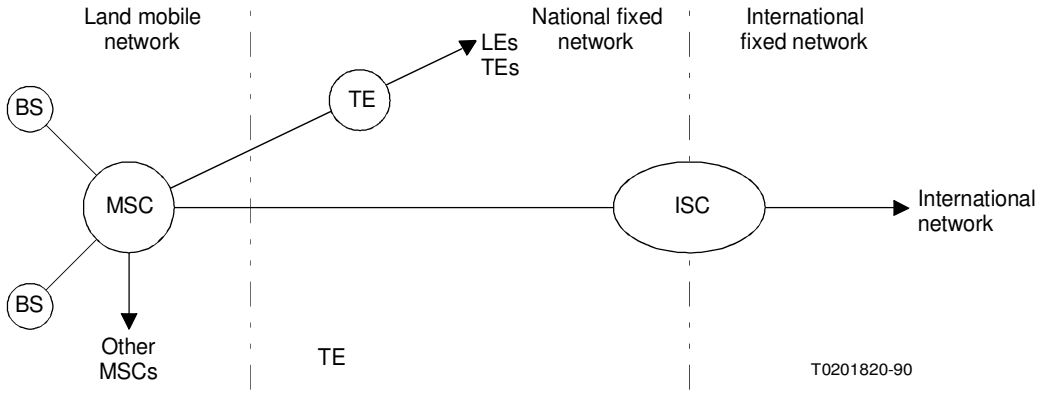


FIGURE 2/E.220

All mobile traffic via interconnect at transit exchange



Key to abbreviations used in Figures 1/E.220 to 3/E.220:

BS Base station
MSC Mobile switching centre
LE Local exchange
TE Transit exchange
ISC International switching centre

FIGURE 3/E.220

Mixed: Interconnect national mobile access via transit exchange; international traffic via international switching centre

6.2 *Location of echo control devices*

6.2.1 In principle, echo control devices should be connected as close to the echo generating source as possible, in order to be able to recognize and control the echo. Figure 4/E.220 shows the possible location of the echo control devices for calls between PLMN and fixed networks.

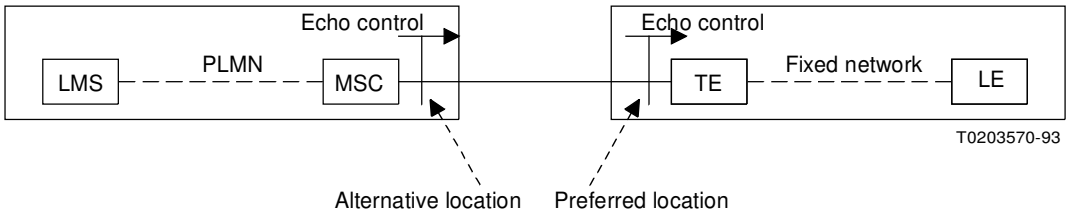


FIGURE 4/E.220

Location of echo control devices

6.2.2 The echo control devices may be located at the trunks between PLMN and the fixed network, either on the PLMN side or in the fixed network. In fixed networks, incoming half-echo control devices are normally associated at the incoming side of the exchange and outgoing half-echo control devices are associated at the outgoing side of the exchange. If the echo control devices are located in the PLMN, the distance to the echo generating point is longer and the control of the echo may be more difficult.

6.2.3 Echo control devices may be connected in pool in either the PLMN or the fixed network. The advantage of this method is that the devices may only be connected when needed and closer to the echo generating point, not only for PLMN interworking but also for long distance national and international calls, e.g. call forwarding in the fixed network.

6.2.4 The final decision on the location of echo control devices will depend on commercial arrangements between the PLMN and fixed network operators and geographical considerations.

6.3 *Network control*

6.3.1 The following paragraphs identify the ideal control procedures for elimination of echo. It is recognized however that these procedures cannot easily be implemented in existing networks. Section 6.4 provides guidance on implementation.

6.3.2 Table 1/E.220 summarizes the call connection cases and identifies those cases that may require activation of a half-echo control device due to interconnection between a fixed network and PLMN.

TABLE 1/E.220

Activation of half-echo control device due to interconnection between a fixed network and PLMN

Originating network	Transit network	Terminating network	Half-echo control device activated
PLMN	Fixed network	Fixed network	Yes
PLMN	Fixed network	PLMN	No
Fixed network	Fixed network	PLMN	Yes

6.3.3 To connect the incoming half-echo control device the relevant networks must be able to decide if the call is originating in the PLMN and terminating in the PSTN where echo may be generated.

6.3.4 To connect the outgoing half-echo control device the relevant networks must be able to decide if the call is terminating in the PLMN and originating in the PSTN where echo may be generated.

6.3.5 The routing must be performed in such a way that sufficient signalling and analyzing capability is achieved for proper echo control.

6.4 *Implementation considerations*

6.4.1 In principle it is desirable that the originating exchange which can identify the originating terminal set type and call destination, should determine on a per call basis whether echo control should be included. However it is recognized that this will not always be possible and therefore an assumption must be made on whether to include echo control, either at the originating exchange or interconnection point. This decision may be changed later on in the network when more knowledge about the routing and terminating equipment is achieved, such that echo control devices are properly connected when they are needed. This will require enhanced signalling capabilities in the network.

6.4.2 As network modernization proceeds consideration should be given to providing functionality to enable adequate control of echo through enhanced signalling capabilities.

6.4.3 Conditions for echo control may be changed as the call set up proceeds due to unknown network destination type, mobility, call forwarding, roaming, redirection, rerouting, etc.

6.4.4 Echo control devices connected nearest to the subscriber in the fixed network, e.g. on international, national and satellite trunks will be activated. On these trunks the echo control device associated to the radio access should ideally be disabled.

6.4.5 There may be cases where calls in the PLMN do not incur long propagation time.

6.4.6 Electrical echo is not always generated in the fixed network.

6.4.7 The evolution towards non-echo generating terminal equipment will contribute to a reduction in echo control problems.

7 Roaming

7.1 Automatic roaming allows a mobile subscriber to move from one service area to another area while still retaining the service. Roaming could be implemented automatically or manually (e.g. via an operator).

7.2 Two kinds of roaming may impact on the interconnection of fixed networks with PLMNs:

a) intra-network roaming, i.e. roaming from one location area to another within the same network; and

b) inter-network roaming, i.e. roaming from one PLMN to another, possibly in different countries.

7.3 The interconnection arrangements may provide for:

– circuit interconnection to facilitate the routing of calls to roamed mobile stations (see also Recommendation E.173).

– signalling interconnection, to facilitate the routing of signalling messages between PLMNs, for location updating, etc. (e.g. using S.S. No. 7 SCCP).

7.4 In all situations, consideration should be given to unsuccessful roaming due to fixed network blocking, and the unavailability of circuits in the target network.

7.5 In order to route calls to roamed mobile stations, the PLMN may translate the dialled number into a mobile station roaming number (MSRN) as defined in Recommendation E.213. It is desirable for a call to the roaming number originating from an ordinary subscriber, to be rejected by the network (either the fixed network or the PLMN). The method of achieving this would be by bilateral agreement.

7.6 In order to avoid trombone routing of calls to roamed mobile stations it may be desirable for the fixed network to have the capability to interrogate the location registers in the PLMN. This will depend on the volume of calls requiring this facility, and the commercial arrangements between the fixed network operators and the PLMNs.

7.7 Provision should also be made to avoid loss of location information for roamers in a visiting location area, for example, due to signalling failures and consequent loss of location registration information.

7.8. Provision of limited roaming ability based upon lower rental and call charges will be subject to commercial arrangements between the fixed network and PLMN operators.

8 Handover

8.1 In a cellular system, handover occurs when, for a call in progress, the current channel cannot maintain the target quality of the connection and another channel takes over, whether in the same or in a different base station. In some cases, handover is required between base stations connected to different Mobile Switching Centres (MSC), which means that a new connection has to be established from the original (controlling) MSC to another. Where this connection between the MSCs is provided via the fixed network, consideration must be given to the overall number of links, particularly where more than one such handover occurs during the same call.

Consideration should also be given to the engineered fixed network blocking loss, and the possibility that a handover will be unsuccessful, due to non-availability of the fixed network circuits. “Grade of Service standards for the probability of unsucessful handover are given in Recommendation E.771.”

9 History

First published in 1993.

ANNEX A

(to Recomendation E.220)

Alphabetical list of abbreviations used in this Recommendation

BS Base station

ISC International switching centre

ISDN Integrated services digital network

LE Local exchange

MSC Mobile switching centre

MSRN Mobile station roaming number

PLMN Public land mobile network

PSTN Public switched telephone network

SCCP Signalling connection control part

TE Transit exchange