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Foreword

This ETSI Technical Report (ETR) has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI).

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or the application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or an I-ETS.

This ETR describes Universal Personal Telecommunication (UPT) call routing in the user plane for incoming and outgoing calls, calls from a UPT user to a UPT user, and service profile management calls.

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1 Scope

This ETSI Technical Report (ETR) covers Universal Personal Telecommunication (UPT) call routing in the user plane for incoming and outgoing calls, calls from a UPT user to a UPT user, and service profile management calls. Procedures for each type of calls, although they are not addressed in this ETR, are outlined in order to provide an understanding on the call phases required in routing.

Although post phase 1 UPT routing is discussed, the focus is in the UPT phase 1 solutions. Optimal solutions are identified, as well as potential applications leading to the Quality of Service (QoS) degradation.

This ETR covers UPT call routing in the user plane in the Public Switched Telephone Network (PSTN) and Integrated Services Digital Network (ISDN). Further study is needed for Public Land Mobile Networks (PLMNs) (e.g. Global System for Mobile communications (GSM), Universal Mobile Telecommunication System (UMTS)), Public Data Networks (PDNs) and Broadband ISDNs (B-ISDNs).

This ETR follows the principles in the ITU-T Recommendation E.174 [5] and is complementary to the ITU-T Recommendation.

2 References

For the purposes of this ETR, the following references apply:

- [1] CCITT Recommendation E.170: "Traffic routing".
- [2] CCITT Recommendation E.171: "International telephone routing plan".
- [3] CCITT Recommendation E.172: "ISDN routing plan".
- [4] CCITT Recommendation E.173: "Routing plan for interconnection between public land mobile networks and fixed terminal networks".
- [5] ITU-T Recommendation E.174: "Routing principles and guidance for Universal Personal Telecommunications (UPT)".
- [6] ETS 300 334: "Integrated Services Digital Network (ISDN); Signalling System No.7; Routing in support of ISDN User Part (ISUP) version 2 services".

3 Abbreviations and legend of figures

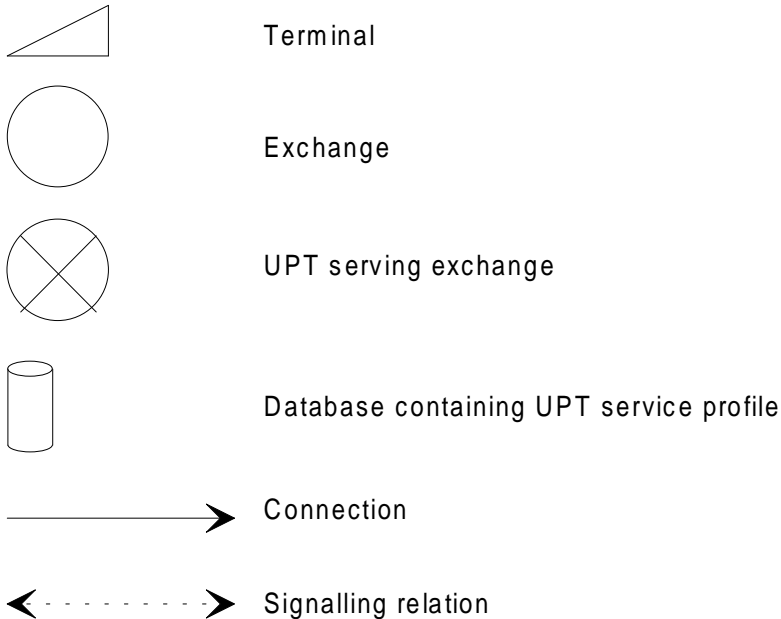
3.1 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

B-ISDN	Broadband Integrated Services Digital Network
DTN	Destination Terminal Number
IN	Intelligent Network
ISDN	Integrated Services Digital Network
PLMN	Public Land Mobile Network
QoS	Quality of Service
UPT	Universal Personal Telecommunication
UPTAC	UPT Access Code
UPTAN	UPT Access Number
UPT InCall	UPT Incoming Call
UPT OutCall	UPT Outgoing Call
UPTN	UPT Number

3.2 Legend of figures

The following symbols are used in the figures of this ETR:



4 Definitions

UPT serving exchange: The UPT serving exchange is an exchange that has Intelligent Network (IN) capabilities to access a UPT service profile and the functions for the authentication, registration, charging, control of the service options and restrictions.

UPT service profile: The UPT service profile is a record containing all the information related to the UPT user in order to provide the UPT user with the UPT service. Each UPT service profile is associated with a single UPT Number (UPTN). The UPT user's service profile is located in the user's home network and it may be accessed from a UPT serving exchange located in the home, originating, assisting or terminating network.

assisting network: The assisting network provides UPT capabilities that allow queries to other UPT capable networks, for example to the home network of the UPT user. An assisting network can be used for calls originating from a non-UPT capable network. An assisting network may also be used in calls from a UPT capable network when capabilities of the originating network are not used.

5 UPT call types and basic UPT routing model

Four UPT call types can be identified:

- UPT Incoming Call (UPT InCall; see clause 6);
- UPT Outgoing Call (UPT OutCall; see clause 7);
- Call from a UPT user to a UPT user (UPT OutCall/InCall; see clause 8);
- UPT service profile management call (see clause 9).

The basic UPT routing model is presented in figure 1.

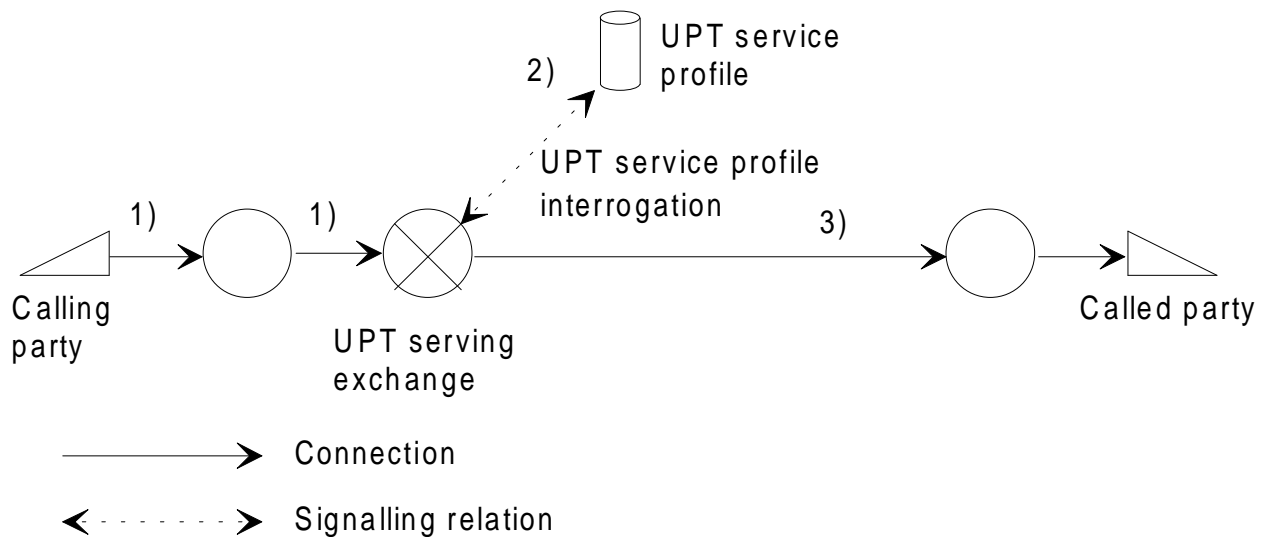


Figure 1: Basic UPT routeing model

In the basic UPT routeing model, the call phases are following (see figure 1):

- 1) the call is routed to the UPT serving exchange. The call may be identified as UPT by means of a UPTN or UPT Access Code (UPTAC) or UPT Access Number (UPTAN);
- 2) the UPT serving exchange interrogates with the UPT service profile. The information transferred depends on the UPT Call Type;
- 3) the UPT serving exchange routes the call onwards. This phase is not relevant in the UPT service profile Management Call.

Applications and enhancements of the basic UPT routeing model are presented in the subsequent chapters.

6 UPT InCall routeing

Applications of the UPT InCall routeing are shown below. The main distinction between the applications is to which UPT serving exchange the call is routed first to access the called users UPT service profile.

CCITT Recommendations E.170 [1], E.171 [2], E.172 [3] and E.173 [4] and ETS 300 334 [6] should be followed. Where technical limitations prohibit conformance with these recommendations, it will be stated.

6.1 Isolated IN based InCall routeing

The UPT isolated IN based application of the basic UPT routeing model for InCalls is depicted in figure 2. In this application, the call to a UPT user is always routed to a UPT serving exchange in the home network of the called user. The UPT serving exchange interrogates the service profile of the called UPT user to determine the Destination Terminal Number (DTN). After receiving the DTN, the call is routed from this UPT serving exchange onwards.

This method needs to be used if the call can not be identified as UPT outside the home UPT serving exchange of the called user, or if it is not possible to provide the DTN through signalling to other UPT serving exchanges (e.g. IN capabilities of the called user's home and the originating network are isolated from each other). Besides these obligatory cases there may exist other situations where this routeing method is applied.

NOTE: The UPT serving exchange can be the originating exchange.

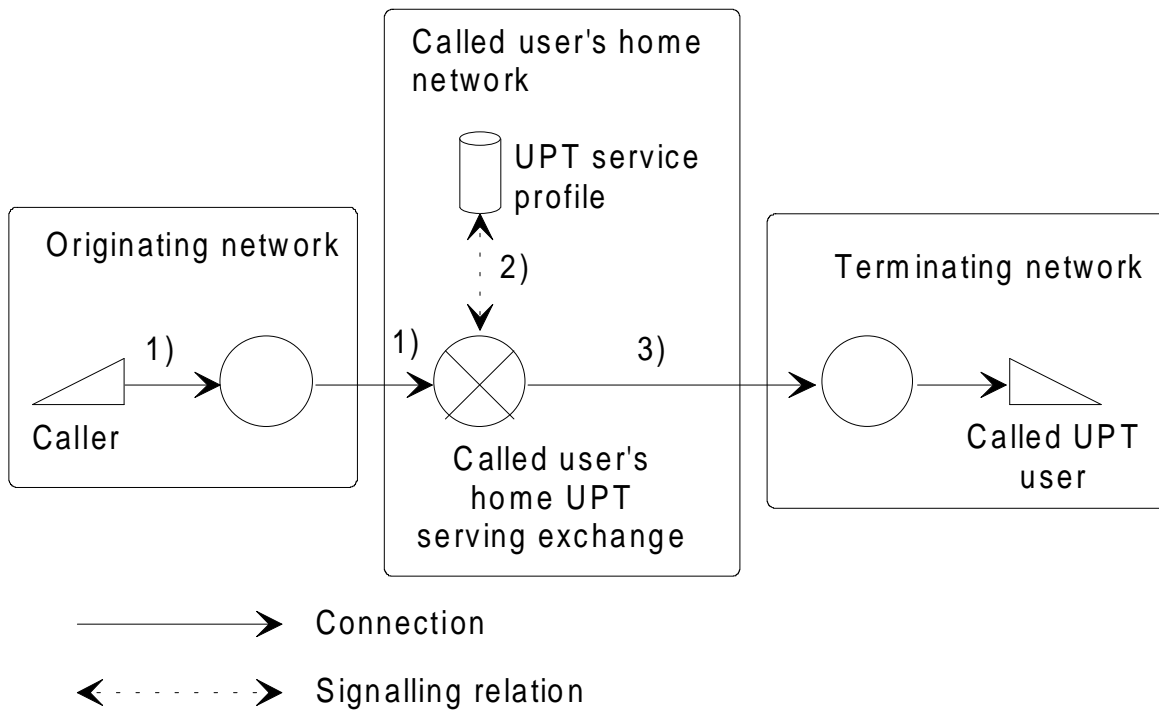


Figure 2: UPT isolated IN-based InCall routing

The call phases in figure 2 are following:

- 1) call is routed to the UPT serving exchange using the UPTN;
- 2) UPT serving exchange sends the UPTN to the UPT service profile that returns the DTN and possibly other routing information;
- 3) call is routed to the DTN.

This InCall routing method may lead to an increase of the number of links so that the limit defined in CCITT Recommendations E.171 [2], E.172 [3] and E.173 [4] may be exceeded. Consequently, the QoS may be affected. Examples are given in annex A.

This method can be applied in UPT Phase 1.

6.2 IN based InCall routing

An application of the basic UPT routing model using IN capabilities is shown for InCalls in figure 3. In this application, the call is routed to an appropriate (e.g. the nearest) UPT serving exchange that initiates an interrogation to the UPT user's service profile using means provided by the IN, in order to obtain the current DTN of the called UPT user. The service profile returns the DTN to the UPT serving exchange that initiated the interrogation. The UPT serving exchange then routes the call to the destination.

The UPT user's service profile may be located in the originating network or in the UPT user's home network.

NOTE: The UPT serving exchange can be the originating exchange.

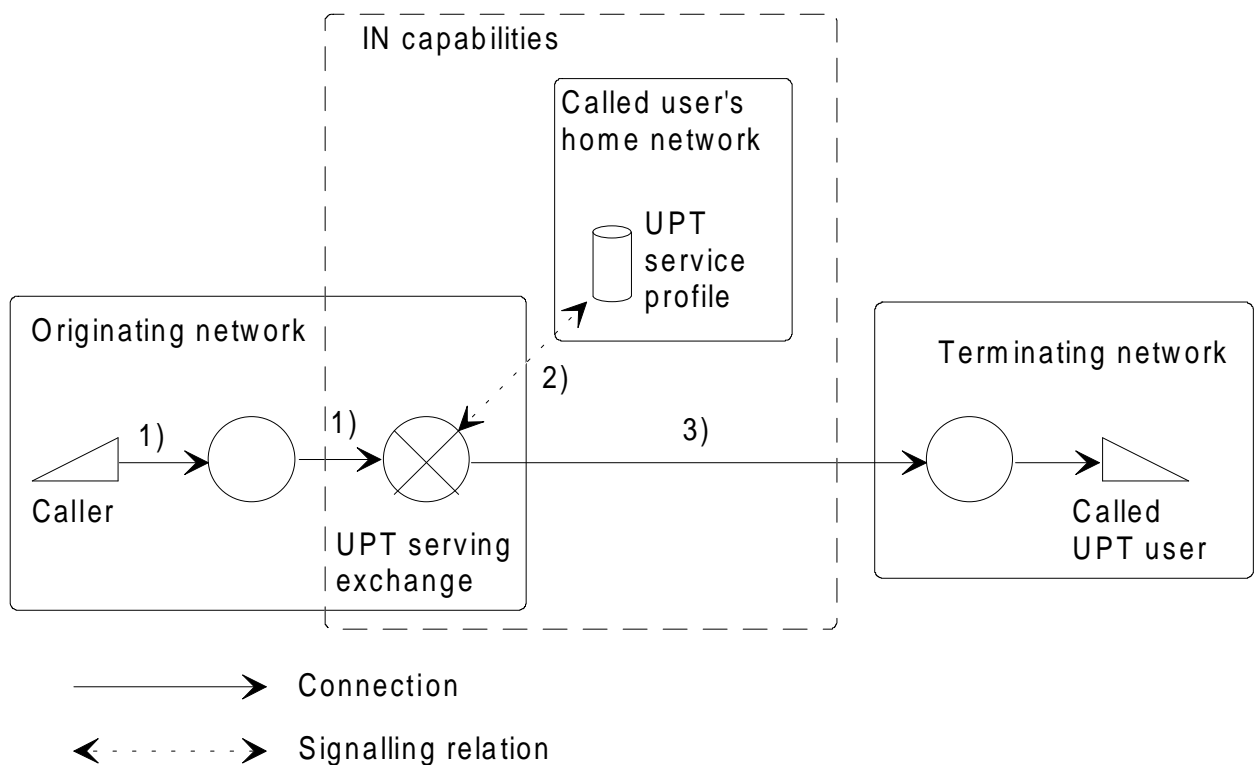


Figure 3: UPT IN-based InCall routing

In figure 3, the call phases are same as described in figure 2.

UPT InCall routing using IN capabilities as described above, offers best solutions to achieve optimal routes - especially if used with redirection (see subclause 6.4). See also annex A.

This method might not be applied in UPT Phase 1.

6.3 InCall routing through an assisting network

A special case in UPT InCall routing is the use of an assisting network (figure 4). In this case, the call is routed from the originating network to an assisting network having IN capabilities to interrogate called user's UPT service profile located in another network (i.e. called user's home network). The call phases are identical with those in the isolated IN-based routing. One may also consider the isolated IN-based routing as a special case of the use of an assisting network, i.e. the assisting and home network coincide.

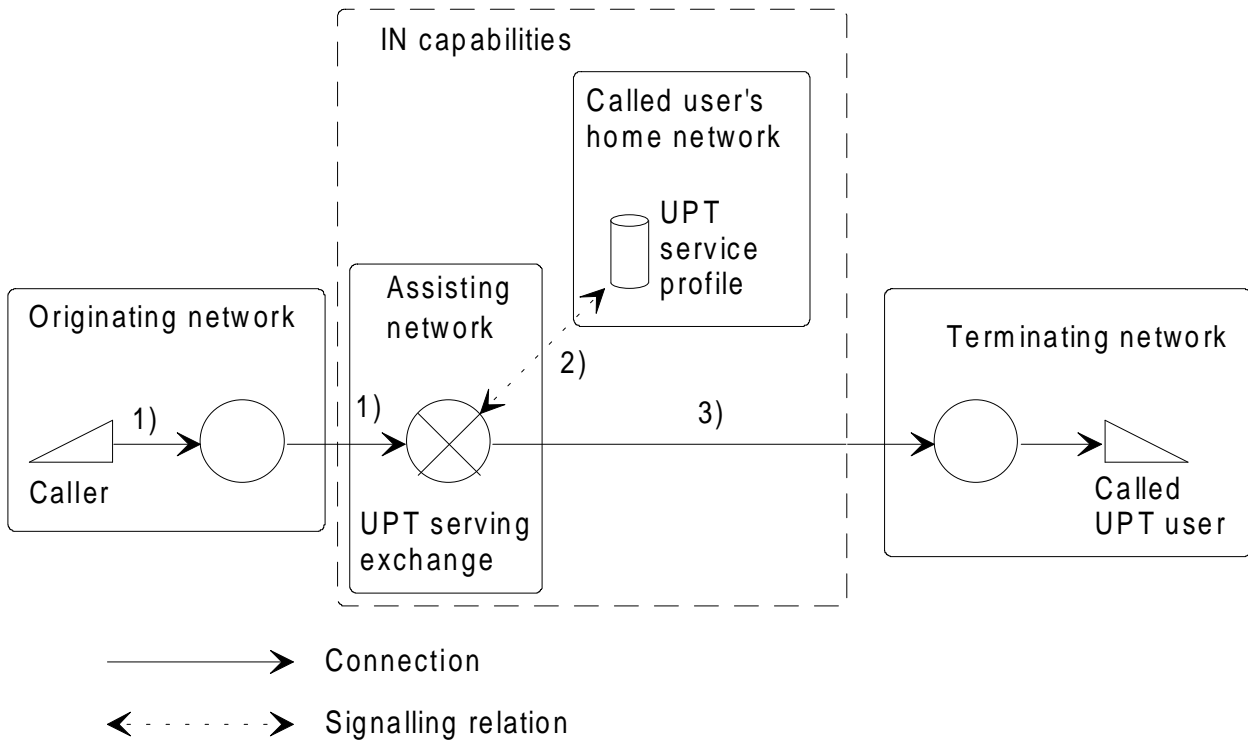


Figure 4: UPT InCall routing through an assisting network

In figure 4, the call phases are same as described in figure 2.

This InCall routing method may lead to an increase of the number of links so that the limit defined in CCITT Recommendations E.171 [2], E.172 [3] and E.173 [4] may be exceeded. Consequently, the QoS may be affected. Examples are given in annex A.

This method may not be used in UPT Phase 1. It may offer a solution, e.g. during a transition period from UPT Phase 1 to post-Phase 1.

6.4 Enhancement of the Basic UPT routing model for InCalls

The basic UPT routing model can be enhanced for InCalls using call redirection as shown in figure 5. In this application, the call to a UPT user is progressed to the UPT serving exchange, that interrogates the UPT service profile to determine the current DTN of the called UPT user. However, instead of progressing the call onwards to the destination or launching a new call to the destination, the call is released backwards to the originating exchange, where the call is routed directly to the number specified by the called UPT user.

The use of redirection requires that the UPT serving exchange provides the current destination number as described in subclause 6.1 or 6.2. Examples of applications according to these chapters are, however, not presented.

This method may require changes in existing signalling and charging capabilities. It is not applicable in UPT Phase 1.

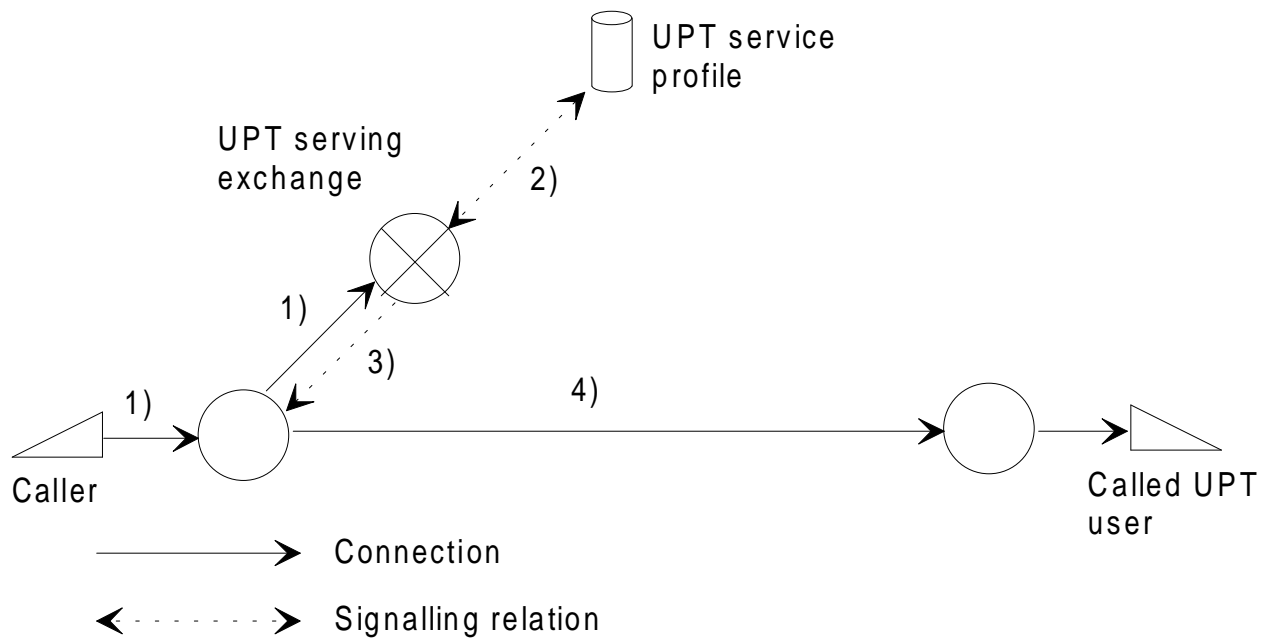


Figure 5: InCall routing with redirection

The call phases in figure 5 are following:

- 1) call is routed to the UPT serving exchange using the UPTN;
- 2) UPT serving exchange sends the UPTN to the UPT service profile that returns the DTN and possibly other routing information;
- 3) UPT serving exchange returns the DTN to an exchange capable for redirection and the connection with UPT serving exchange is released;
- 4) call is routed (redirected) to the DTN.

UPT InCall routing using redirection as described above, used with IN-based applications, offers the best solutions to achieve optimal routes. Using redirection with the Isolated IN -based application, the number of links can be decreased.

7 UPT OutCall routing

As UPT InCalls, UPT OutCall can be modelled according to the basic UPT routing model. Applications found are described below. The main distinction between the applications is to which UPT serving exchange the call is routed first to access the calling user's UPT service profile.

CCITT Recommendations E.170 [1], E.171 [2], E.172 [3] and E.173 [4] and ETS 300 334 [6] should be followed. Where technical limitations prohibit conformance with these recommendations, it will be stated.

7.1 Isolated IN based OutCall routing

The Isolated IN based OutCall routing is depicted in figure 6. In this application, the call from a UPT user is always routed to a UPT serving exchange in the home network of the calling user.

NOTE: The UPT serving exchange can be the originating exchange.

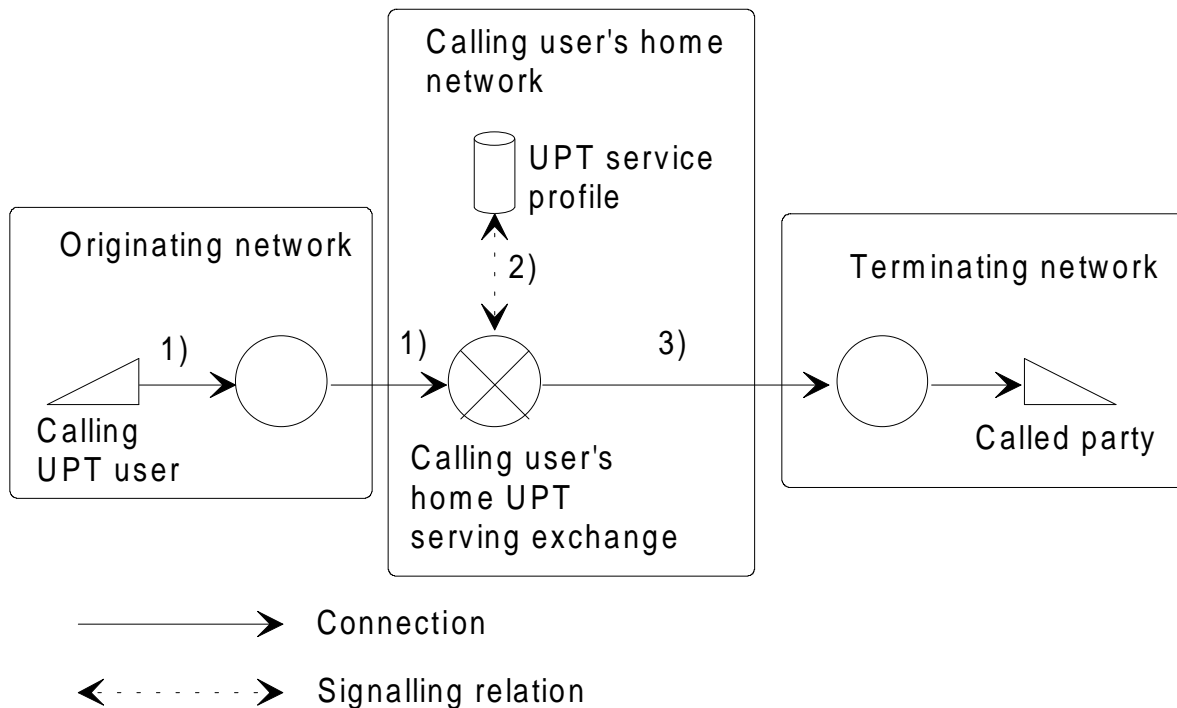


Figure 6: UPT Isolated IN -based OutCall routing

The call phases in figure 6 are following:

- 1) call is routed to the UPT serving exchange using UPTAN;
- 2) before the call set-up: Authentication, service request, service options; during and/or after the call: Charging and control of the service;
- 3) call is routed to the called party number dialled by the caller.

This OutCall routing method may lead to an increase of the number of links so that the limit defined in CCITT Recommendations E.171 [2], E.172 [3] and E.173 [4] may be exceeded. Consequently, the QoS may be affected. Examples are given in annex A.

This method is applicable in UPT Phase 1.

7.2 IN based OutCall routing

An application of the basic UPT routing model using IN capabilities is shown for OutCalls in figure 7. In this application, using UPTAC or UPTAN, the call is routed to an appropriate (e.g. the nearest) UPT serving exchange that initiates an interrogation to the UPT user's service profile using means provided by the IN. This interrogation includes, e.g. calling UPT user's identification and authentication, the service request for OutCall and verification of the user's service options. After these phases, the call is routed from the UPT serving exchange to the number dialled by the caller. During or after the call, the UPT serving exchange controls the service and performs charging, co-operating with the UPT service profile. Note, that this description only gives an outline of the interrogation - the procedures, protocols and their contents are outside the scope of this ETR. However, it is essential to note, that UPT OutCalls, because of tasks outlined above, must be routed through a UPT serving exchange. It is a requirement also for UPT OutCall session, i.e. when calls are made after a separate registration for OutCalls, because no other exchange is able to perform, e.g. charging of the call or control of the service.

NOTE: The UPT serving exchange can be the originating exchange.

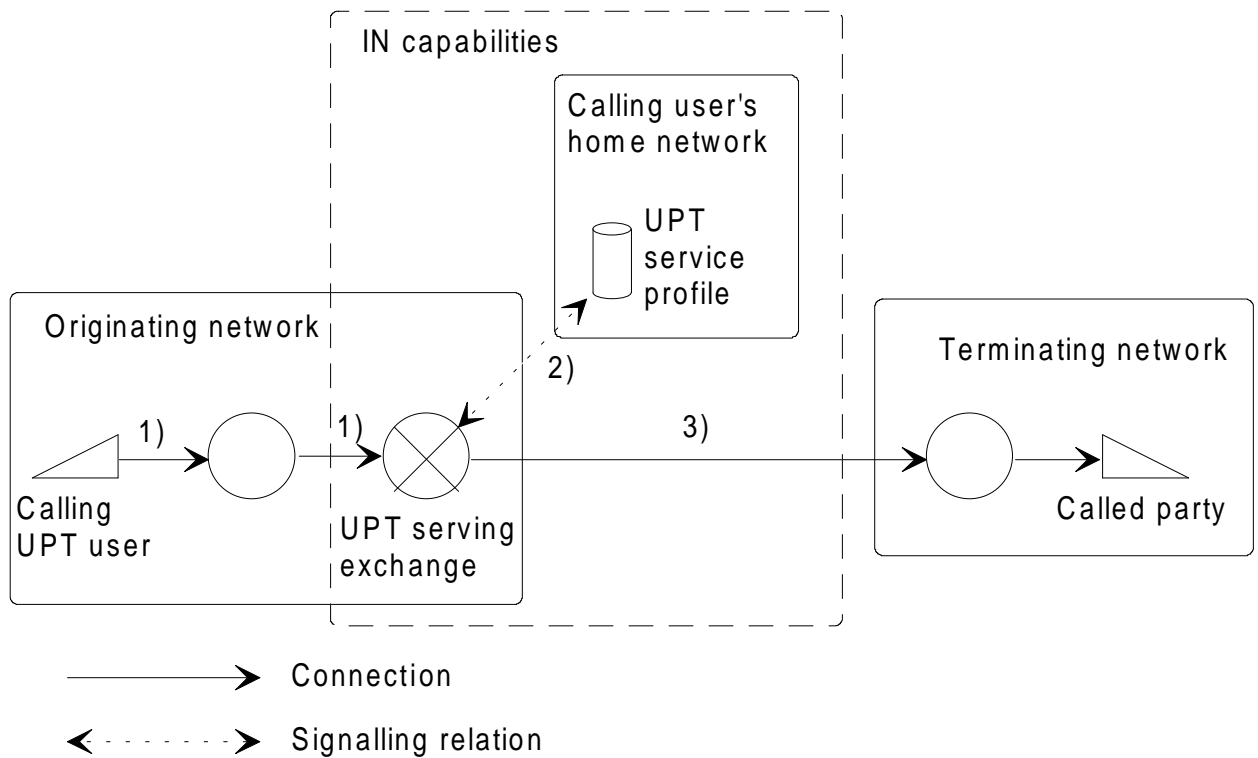


Figure 7: UPT OutCall routing using IN capabilities

In figure 7, the call phases are same as described in figure 6, with the addition that also UPTAC can be used in call phase 1.

UPT OutCall routing using IN capabilities as described above, offers best solutions to achieve optimal routes (see also annex A).

This method might not be applied in UPT Phase 1.

7.3 OutCall routing through an assisting network

As with the InCall routing, a special case in UPT OutCall routing is the use of an assisting network (figure 8). In this case, the call is routed from the originating network to an assisting network having IN capabilities to interrogate caller's UPT service profile located in another network (i.e. caller's home network). The call phases are identical with those in Isolated IN -based OutCall routing with the addition that also UPTAC can be used in call phase 1 (see figure 6). One may also consider the Isolated IN -based routing as a special case of the use of an assisting network, i.e. the assisting and home network coincide.

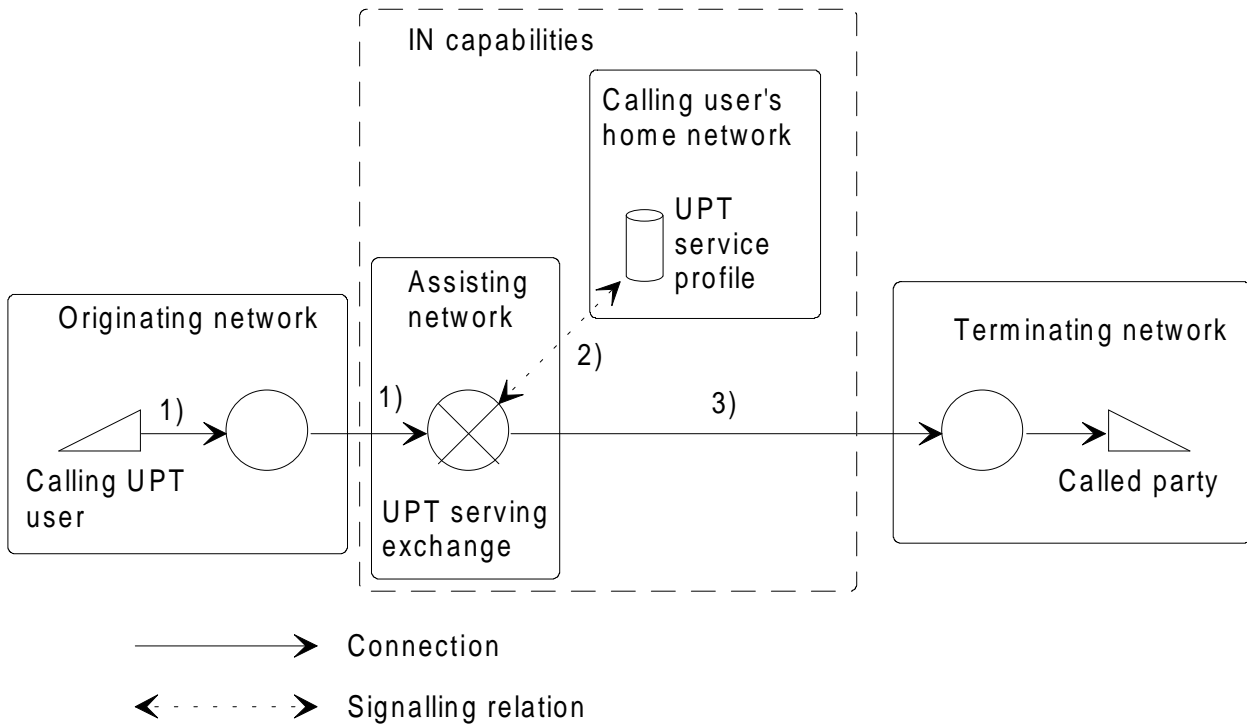


Figure 8: UPT OutCall routing through an assisting network

This OutCall routing method may lead to an increase of the number of links so that the limit defined in CCITT Recommendations E.171 [2], E.172 [3] and E.173 [4] may be exceeded. Consequently, the QoS may be affected. Examples are given in annex A.

This method may not be used in UPT Phase 1. It may offer a solution, e.g. during a transition period from UPT Phase 1 to post-Phase 1.

8 UPT OutCall/InCall routing

The general UPT to UPT routing model is shown in figure 9.

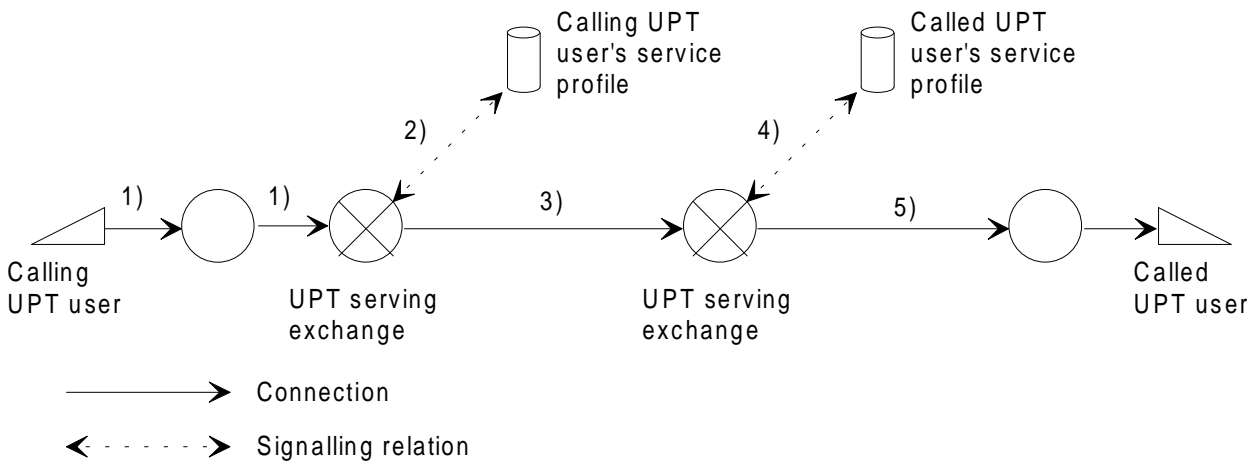


Figure 9: General UPT OutCall/InCall routing model

The call phases in figure 9 are following:

- 1) call is routed to a UPT serving exchange using UPTAC or UPTAN;
- 2) before the call set-up: Authentication of the calling UPT user, service request, service options;
during/after the call: Charging and control of service;
- 3) call is routed to a UPT serving exchange identified through the called UPTN;
- 4) the UPTN is sent to the called user's UPT service profile that returns the DTN and possibly other routing information;
- 5) call is routed to the DTN.

NOTE: In this model both UPT OutCall and InCall functions are performed in a sequence: Phases (1) to (3) are the same as described in subclauses 7.1 to 7.3 for UPT OutCalls; phases (3) to (5) correspond phases (1) to (3) in subclauses 6.1 to 6.3. In principle, any UPT OutCall case of subclauses 7.1 to 7.3 can appear with any InCall case of subclauses 6.1 to 6.4.

CCITT Recommendations E.170 [1], E.171 [2], E.172 [3] and E.173 [4] and ETS 300 334 [6] should be followed.

According to this model, two UPT serving exchanges are involved in the route. This can very easy lead to an increase of the number of links so that the limit defined in CCITT Recommendations E.171 [2], E.172 [3] and E.173 [4] may be exceeded. Consequently, the QoS may be affected. Examples are given in annex A.

This model is applicable in UPT Phase 1, taking into an account the reservations in subclauses 6.1 to 6.4 and 7.1 to 7.3.

In the long term, the first UPT serving exchange may be able to perform both UPT OutCall and InCall functions through the use of (international) IN, because it may be possible to obtain information without routing between the serving exchanges. This may also be possible in UPT Phase 1, if both UPT service profiles are in the same location.

9 UPT service profile management call

UPT service profile management allows the UPT user to access, interrogate and change the UPT user's service profile.

UPT service profile management calls can be routed to the UPT serving exchange as UPT OutCalls (see subclauses 7.1 to 7.3). However, only interrogation according to the service profile management procedures required is necessary, and no routing from the UPT serving exchange takes place.

CCITT Recommendations E.170 [1], E.171 [2], E.172 [3] and E.173 [4] and ETS 300 334 [6] should be followed.

10 Conclusion

A number of possible UPT routing solutions are described above. From the routing point of view, IN-based applications presented in subclauses 6.2 and 7.2 and clause 8 (long term) provide best methods of complying with the recommendations concerning the number of links. However, despite of the support of standards and recommendations, internationally interworking IN may not be implemented for various reasons in the immediate future. To accelerate the implementation of the UPT service, less optimal UPT routing applications have to be accepted. In this situation, the effects of QoS degradation should be considered, and efforts for IN-based solutions should be promoted as soon as practicable.

Annex A: Examples on international UPT routeing

A.1 Introduction

In this annex, some examples are given on international routeing with different UPT routeing applications. The examples are not exhaustive and other possible options exist.

In all examples it assumed, that the maximum of 4 links in the national networks (originating and terminating) need to be allowed. The location of the UPT serving exchange in the originating or terminating network is not relevant.

If the call is routed through an assisting and/or home network in the international part, the UPT serving exchange is located immediately after the ISC in the assisting/home network; in practice, this may not always be true. Note, that Recommendations E.171 [2], E.172 [3] and E.173 [4] allow a maximum of 4 links in the international part of the route.

A.2 IN based routeing

Example in figure A.1 is applicable with IN-based InCall, OutCall and OutCall/InCall UPT routeing, as described in subclauses 6.2, and 7.2 and clause 8 (long term). This example is also applicable for the Isolated IN based UPT routeing (see subclauses 6.1 and 7.1), if the originating and home country of the user coincide.

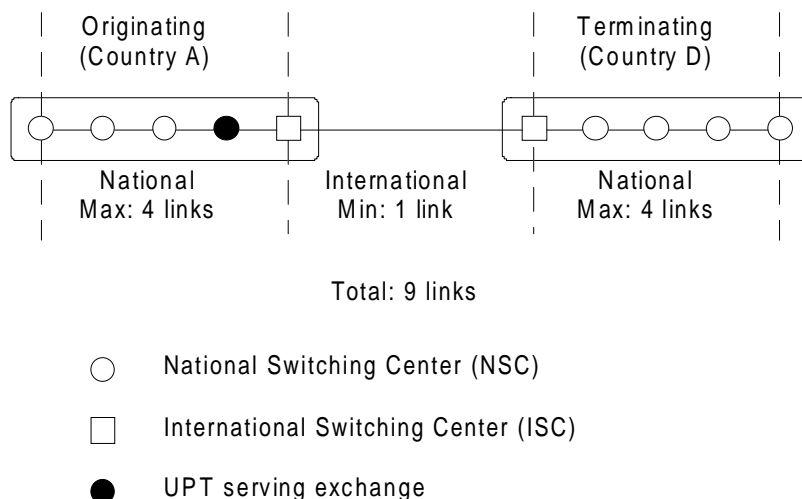


Figure A.1: Example on IN-based routeing

In this case, there are no unusual routeing issues, and so it is easy to limit the number of international links to 4 allowed in CCITT Recommendation E.172 [3].

A.3 Isolated IN based routeing or use of assisting network

Example in figure A.2 is applicable with Isolated IN based UPT routeing or when using an assisting network for InCall, OutCall and OutCall/InCall, as described in subclauses 6.1, 6.3, 7.1 and 7.3 and clause 8 (general).

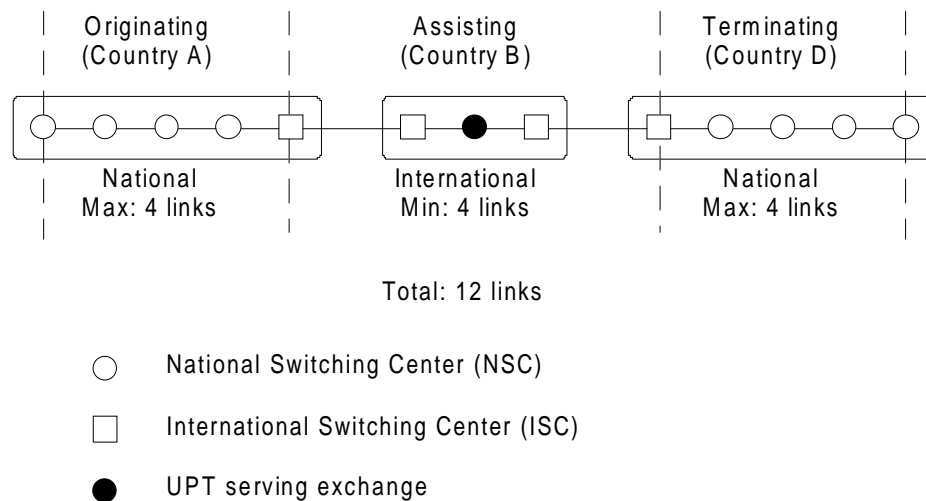


Figure A.2: Example on UPT routing through an assisting network

This example shows, that requirements of CCITT Recommendation E.172 [3] for the maximum number of international links can be met, if there are direct links between the UPT serving exchange and ISCs in the assisting country. Additional transit ISCs between the originating and assisting or assisting and terminating country would increase the number of higher than allowed in E.172 [3]. This example is equally applicable for the UPT Isolated IN -based routing.

Providing the ISC in the assisting country with UPT capabilities would improve the situation as would also do, with InCalls, the application of redirection (see subclause 6.4).

If the home country of the called user and the terminating country coincide, then the number of international links would decrease to 1, and requirements of CCITT Recommendation E.172 [3] could be easily met.

A.4 Routing through two UPT serving exchanges

Example in figure A.3 is applicable for calls from a UPT user to a UPT user when two UPT serving exchanges must be used (see clause 8).

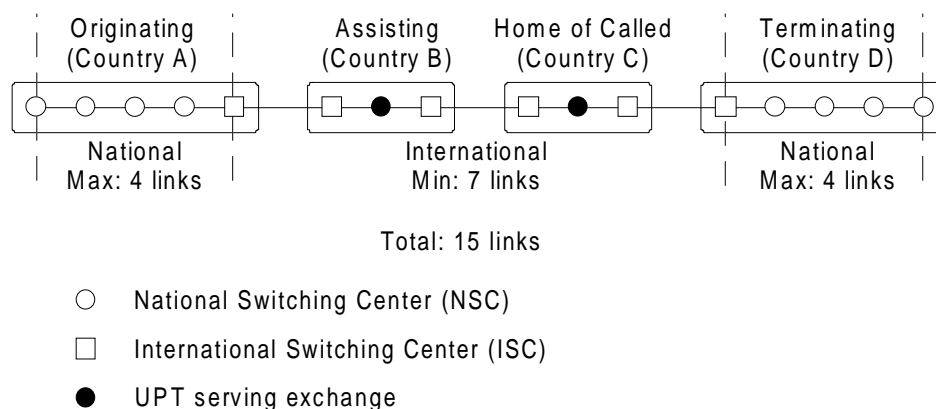


Figure A.3: Example on routing through two UPT serving exchanges

In this example, requirements on the number of international links according to the CCITT Recommendation E.172 [3] are not met.

Providing ISCs in the assisting and home countries with UPT capabilities could improve the situation. Also, use of redirection in the called user's home country could be a help.

If the home country of the called user and the terminating country coincide, then the number of international links would decrease to 3, and requirements of CCITT Recommendation E.172 [3] could be met.

Annex B: UPT routing with PLMNs

B.1 Introduction

No ETSS or ETRs for UPT Phase 1 are planned for UPT service in PLMNs. In principle, however, it is possible for the UPT user to make UPT OutCalls from a PLMN, or the UPT user may register for InCalls to a PLMN terminal. This can easily imply severe consequences in the UPT routing.

One example, where a UPT OutCall/Incall from a PLMN to a PLMN is supposed, is presented in figure B.1. Although other examples are not shown, their number could clearly be numerous. The case in figure B.1 is "ideal" because it is assumed that the assisting network has full IN capabilities according to the long term scenario of clause 8 (however, it is not ideal if the called PLMN is a GSM, see note 2). This is not expected to be common in the UPT phase 1. Consequently, in the UPT OutCall/InCall two UPT serving exchanges can be engaged.

The UPT routing from and/or to a PLMN can very easily lead to an increase of the number of links so that the limit defined in CCITT Recommendations E.171 [2], E.172 [3] and E.173 [4] may be exceeded. Consequently, the QoS may be affected.

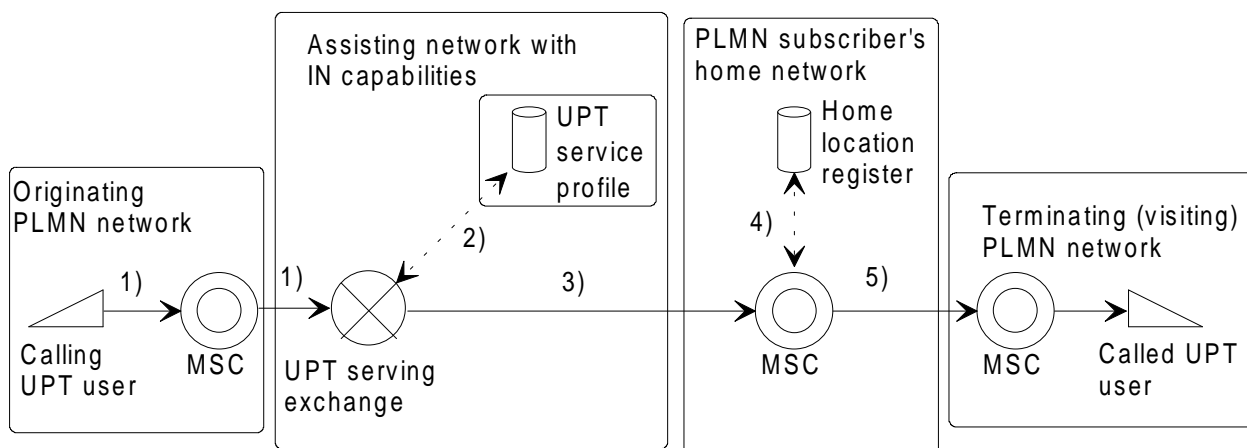


Figure B.1: Example of UPT OutCall/InCall routing from a PLMN to another PLMN

The call phases in figure B.1 are the following:

- 1) call is routed to the UPT serving exchange using UPTAC or UPTAN;
 - 2) before the call set-up: Authentication, service request, service options. The called UPTN is sent to the UPT service profile that returns the PLMN terminal number designated by the called UPT user to the UPT serving exchange;
- during and/or after the call: Charging and control of the service;

NOTE 1: In this example the same UPT serving exchange has an access to the calling and called user's UPT service profiles, and both service profiles are shown with a single symbol.

- 3) call is routed to the Home PLMN network of the PLMN terminal designated by the called UPT user (see note 2);
- 4) mobile Switching Center (MSC) interrogates its Home Location Register (HLR) to determine the called terminal's location (see note 2);
- 5) call is routed to the destination terminal in a visiting network.

NOTE 2: If the called user is registered in a GSM, the called number may be identified as a GSM number by an exchange (e.g. ISC, MSC, transit exchange, even UPT serving exchange) in the assisting network. This exchange may be able to interrogate the HLR of the called number to have the number in the visiting network.. Then the call can be routed directly from the assisting to the terminating network by-passing the home network of the GSM subscriber. By this way, in particular international routeing could be improved.

With routing to a digital PLMN, the choice of route or possible requirement to disable DCMEs should be performed on basis of number analysis, i.e. the terminating network should be identified as a digital PLMN requiring special actions at the beginning end of the route (see ETS 300 334 [6]). Because the UPTN is used for routing to the serving exchange, the originating network may not have desired knowledge on the nature of the terminating network.

B.2 Examples on International UPT routeing to PLMNs

Some examples are given here on international routeing with different UPT routeing applications to PLMNs. The examples are not exhaustive, i.e. it is easy to present other cases.

Figure B.2 gives an example on routeing to a PLMN for UPT InCalls, OutCalls and OutCalls/Incalls. UPT routeing applications according to subclauses 6.1, 6.2, 7.1, 7.2 and clause 8 (long term) are supposed (the home country of the calling/called user and the originating country coincide if applications of subclauses 6.1 and 7.1 are applied).

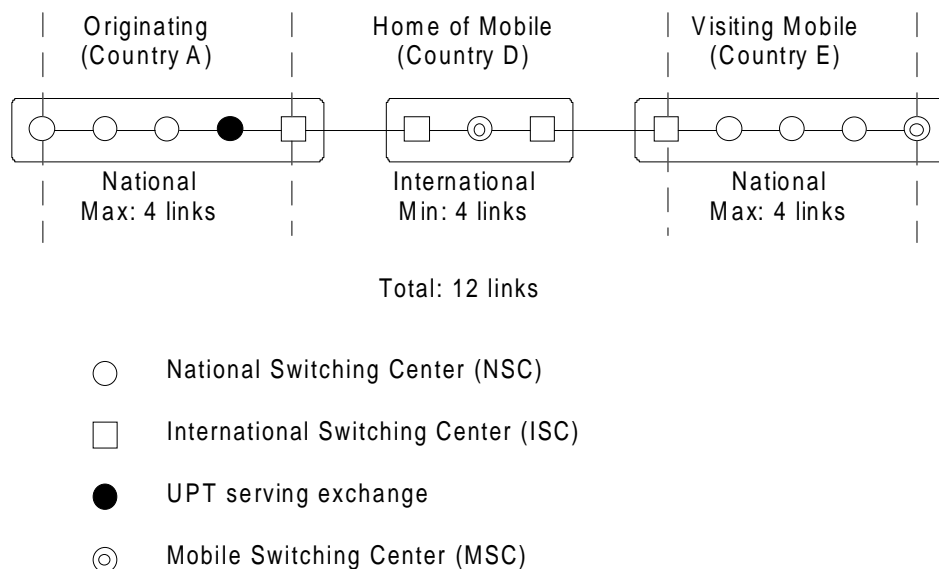


Figure B.2: Example 1 on UPT routeing to a PLMN

In this example, requirements of CCITT Recommendation E.172 [3] are met. However, this requires that there are direct links between the MSC and ISCs in the home country of the mobile user.

If the mobile user is not roaming outside the mobile user's home country, the requirements of CCITT Recommendation E.172 [3] are easily met.

Figure B.3 gives an extreme case on the UPT routing to a PLMN, although this need not be the worst one. Here, two UPT serving exchanges are used for routing a call from a UPT user to a UPT user who has registered for InCalls at a PLMN terminal. The home country of the called UPT user and mobile subscriber do not coincide. The user is roaming outside the mobile subscriber's home country.

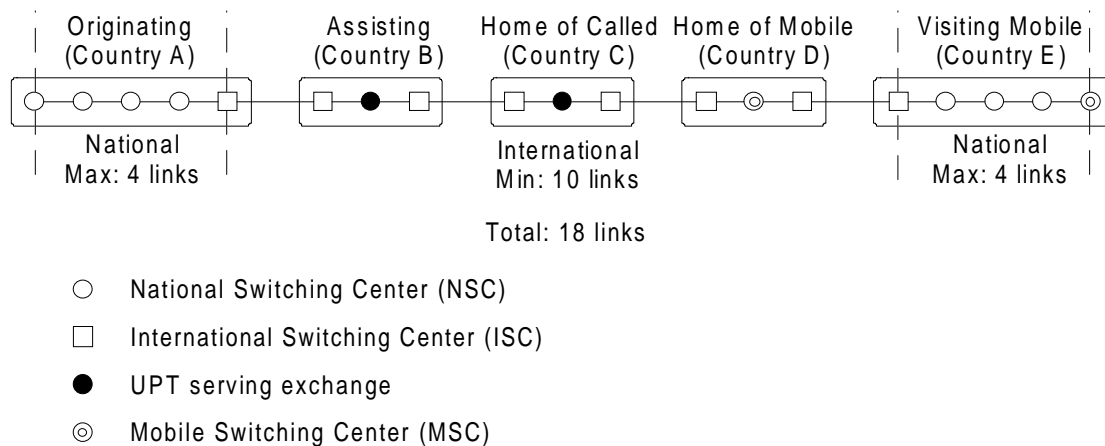


Figure B.3: Example on UPT routing from a UPT user to a UPT user through two UPT serving exchanges to a PLMN

In this example, the number of links is far beyond the requirements in CCITT Recommendation E.172 [3]. The situation would, of course, be better if some of the networks involved coincide.

History

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