TSG-SA Working Group 1 (Services) meeting #1
Sophia Antipolis 1st - 5th February 1999

TSGS1#1(99)047

Agenda Item: 4.4

Source: Marconi Communications Limited, Graham Crisp

Title: 1. Standardization Scenarios for UMTS TDD And Private Systems
2. UMTS Fixed and Cordless Applications Presentation

Document for: Information, Discussion

The first document considers the implications for standardization and specification that arise from the scenarios identified in the UK TAG Report on “Requirements for UMTS TDD and Private Systems”, UK TAG doc 65/98 (attached as Annex A). The document starts from an understanding of the current standardization work, identifies additional items that need to be addressed and identifies bodies may carry out the work. However, given the reorganization that is taking place with respect to UMTS standardization, this information can only be provisional.

The second document is a powerpoint presentation from Graham Crisp on UMTS Fixed and Cordless Applications.

Standardization Scenarios for UMTS TDD And Private Systems

Final draft for approval by UK TAG

UK TAG doc 73/98

22nd January 1999

1 Introduction

This document considers the implications for standardization and specification that arise from the scenarios identified in the UK TAG Report on "Requirements for UMTS TDD and Private Systems", UK TAG doc 65/98 (attached as Annex A). The document starts from an understanding of the current standardization work, identifies additional items that need to be addressed and identifies bodies may carry out the work. However, given the reorganization that is taking place with respect to UMTS standardization, this information can only be provisional.

2 Current UTRA TDD work

The UMTS Terrestrial Radio Access Network (UTRAN) standardization work was carried out within ETSI SMG2 but is now being transferred to the Third Generation Partnership Project (3GPP). This work is based on the current SMG UMTS Model shown in Figure 1 and the Service requirements identified by SMG1. The major part of this work to date has concentrated on public cellular access.

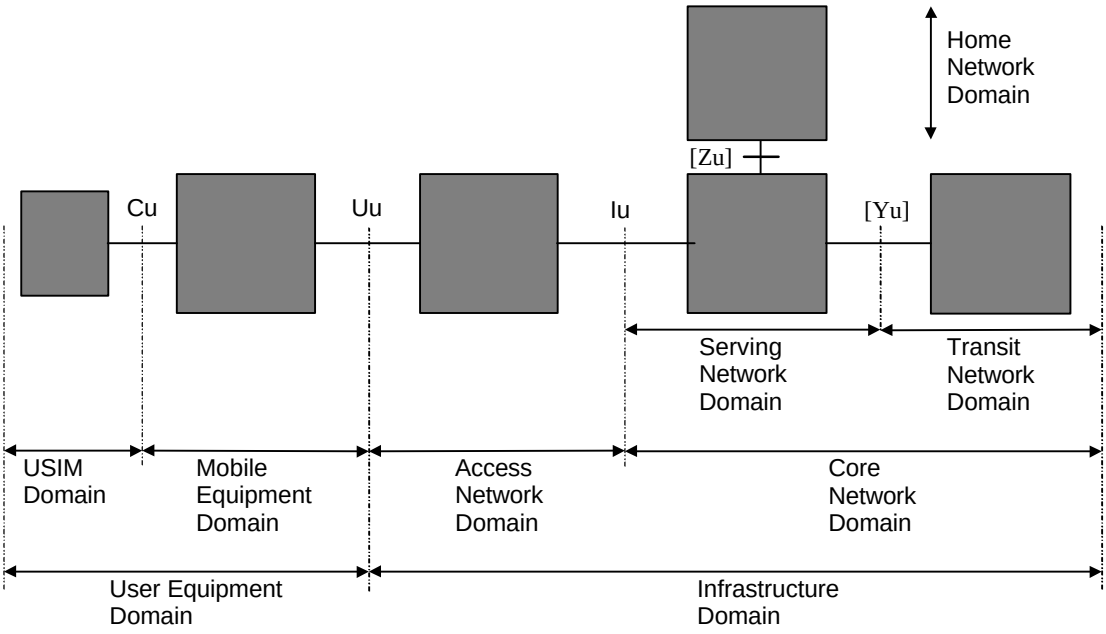

Figure 1 - The SMG UMTS Model.

In order to describe the UTRAN work in more detail it is necessary to expand the Access Network Domain (see Figure 1) to show the next level of detail that is being refined by SMG2. This is illustrated in Figure 2.

Figure 2 shows how the access network domain for a single UMTS Network consists of a single UTRAN which is made up of a number of Radio Network Systems (RNS). The RNSs are in turn made up of a number of Base Stations (BS) which serve the Uu Interface and are connected to and controlled by a Radio Network controller (RNC) which provides the connection to the Core Network (CN) via the Iu interface. Adjacent RNCs are directly inter-connected via the Iur interface to facilitate soft handover between FDD BSs connected to those RNCs.

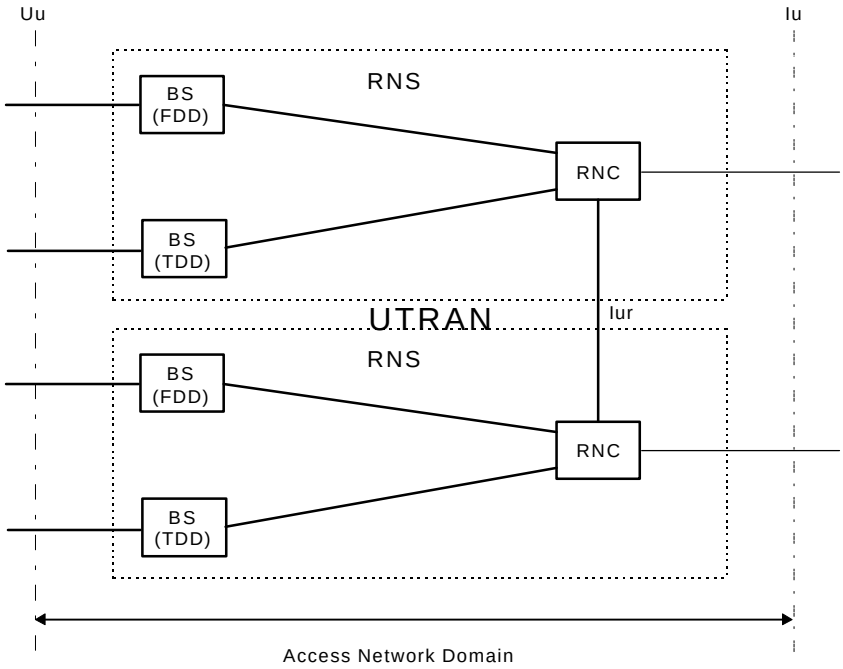

Figure 2 - The UMTS Access Domain.

The main focus of the work within SMG2 has been on the FDD radio interface. Consideration has also been given to the use of the TDD mode for public access and it is expected that the above architecture will apply in this case. In addition, some consideration has been given to the application of the TDD mode in private systems (both business and residential). It is understood that the UTRAN work to date has been based on the following working assumptions:

- In the case of FDD, inter-operator soft handover is not required;
- In the case of the TDD mode, soft handover will not apply;
- The Iu Interface is expected to be common to both the TDD and FDD modes;
- Handover between the TDD and FDD modes is assumed to be supported both within the UTRAN and via the CN.

3 The implications of the different TDD Uses

This section considers the four scenarios identified in the UK TAG document, “Requirements for UMTS TDD and Private Systems”, and identifies the main areas that do not appear to have been addressed by the current standardization work. For clarity, a brief description of each scenario is given below. A discussion of the corresponding service requirements may be found in the above UK TAG document. The four scenarios are:

- Public Access Systems in licensed UMTS spectrum;
- Private Access Systems in licence exempt UMTS spectrum;
- Private Networks in licence exempt UMTS spectrum;
- Public Access Systems in licence exempt UMTS spectrum.

It should be noted that each scenario is likely to be subject to local market and regulatory requirements but such considerations are outside the scope of this paper.

3.1 Public Access Systems in licensed UMTS spectrum

This scenario involves the use of TDD in an operator's licensed spectrum in the unpaired bands, as a complement to FDD in the paired bands. It will be used to increase radio coverage and/or capacity in public places. TDD, and possibly FDD, systems will also be deployed in private indoor/on-site locations to provide improved radio coverage or to support particular business services. In all cases, the operator maintains ownership and responsibility for all parts of the network. These systems will utilise the Access Network Domain architecture already described for public cellular access (Figure 2).

From the above description of the work to date within SMG2, it can be seen that progress is being made on the use of the TDD mode for public access systems. No major areas requiring new work have been identified although the TDD work does appear to be somewhat behind FDD.

3.2 Private Access Systems in licence exempt UMTS spectrum

This scenario involves customers owning and operating their own UMTS radio access network within their premises. These systems will operate in licence exempt spectrum and will be connected to a public UMTS core network. Functions of the core network include authentication, support of service profiles, network interconnect and traffic routing. Applications will range from residential use to private organisations such as universities and conference centres.

Private Access Systems involve the implementation of the TDD radio aspects of a UTRAN within Customer Premises Equipment (CPE). This requires an extension of the SMG UMTS Model to include an additional interface between the access network of the public network and the private access system. This is included in the current NA6 UMTS Task Force extension of the SMG UMTS Model as the Wu Interface between the Access Network Domain and the Private Access Domain, see Figure 3. Note that the model in Figure 3 has been developed on the assumption that individual domains may be owned and/or operated by different entities (such as network operators, service providers, end users, etc.).

In order to understand the standards implications of Private Access Systems, it is necessary to consider the next level of detail of the Private Access Domain, see Figure 4. This figure shows how the Private Access System is made up of a number of TDD BSs which serve the Uu Interface and are connected to and controlled by an RNC which provides the connection to the Access Network via the Wu Interface. (Note that the RNC here may not need the full functionality required in public access systems.)

Note that, in order to interconnect with public networks, Private Access Systems may need to share the same public Network Termination Point with other terminal equipment/services (the TE in Figure 4). This will be particularly important for residential and small business installations where a single connection to the public network may need to be shared with other non UMTS services. The simplest Private Access System will include the functionality of the TDD BS and RNC within a single physical entity.

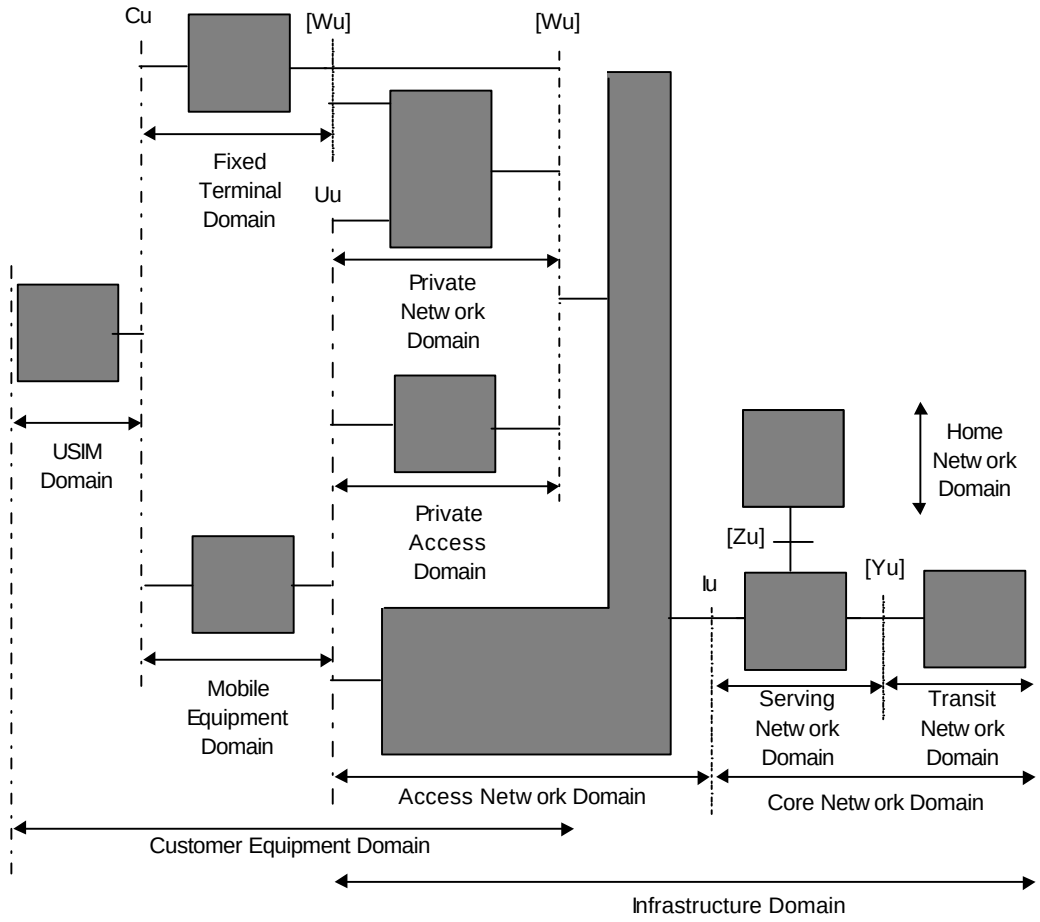

Figure 3 - The NA6 UMTS TF extension of the UMTS Model.

The irregular shape of the access network is used to indicate that the part of the access network supporting the Uu Interface includes the UMTS radio functions whereas the part supporting fixed terminals, private access and private networks does not. As a consequence, the Customer Equipment and Infrastructure Domains appear to overlap. It should be clear, however, that the Private Access and Private Network Domains belong to the Customer Equipment Domain. Note also that the Private Access Domain is referred to as the Cordless Base Station Domain in the original NA6 model.

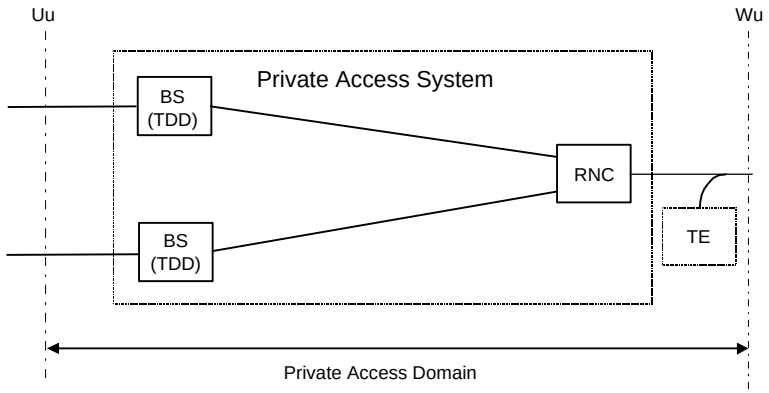

Figure 4 - The Private Access Domain.

We are not aware of any work on the network aspects of UMTS Private Access Systems. However, much of what has already been done within ETSI, ECMA TC32, and ISO IEC JTC1 on Private Fixed

Terminations (CT2, DECT and PHS) for Wireless/Cordless Terminal Mobility may apply. In addition, the current work on radio aspects will need to ensure that the TDD mode supports carrier sharing between uncoordinated systems and high levels of possibly asymmetric traffic.

3.3 Private Networks in licence exempt UMTS spectrum

This is a variant of the Private Access Systems scenario in which the customer additionally owns and operates their own UMTS core network. These self-contained systems will interwork with other private and public UMTS core networks, and will operate in licence exempt spectrum. These systems should provide a home network capability for internal users across multiple, possibly isolated, sites to enable users to access the same services when roaming within the private network. Such networks will be used typically by organisations with large industrial sites or office complexes.

Private Networks involve the implementation of UMTS Core Network (CN) functionality and the TDD radio aspects of a UTRAN within CPE. This allows customers to own and operate their own UMTS core and radio access network within their own premises.

Private Networks require an extension of the SMG UMTS Model to include an additional interface between the access network of the public network and the private network. This is included in the NA6 UMTS Task Force extension of the SMG UMTS Model as another use of the Wu Interface, this time between the Access Network Domain and the Private Network Domain. However, the use of this interface is quite different from that of the Private Access System.

In order to understand the standards implications of the Private Networks, it is necessary to consider the next level of detail of the Private Network Domain. This is illustrated in Figure 5 which shows how a Private Network is made up of a number of TDD BSs which serve the Uu Interface and are connected to and controlled by an RNC. The RNCs are connected to the CN which provides the connection to the Access Network via the Wu Interface. The simplest Private Network may include the functionality of the TDD BS, RNC and CN within a single physical entity. It is not clear whether or not interfaces within the Private network (i.e. between the BS and RNC and between the RNC and CN) should be specified.

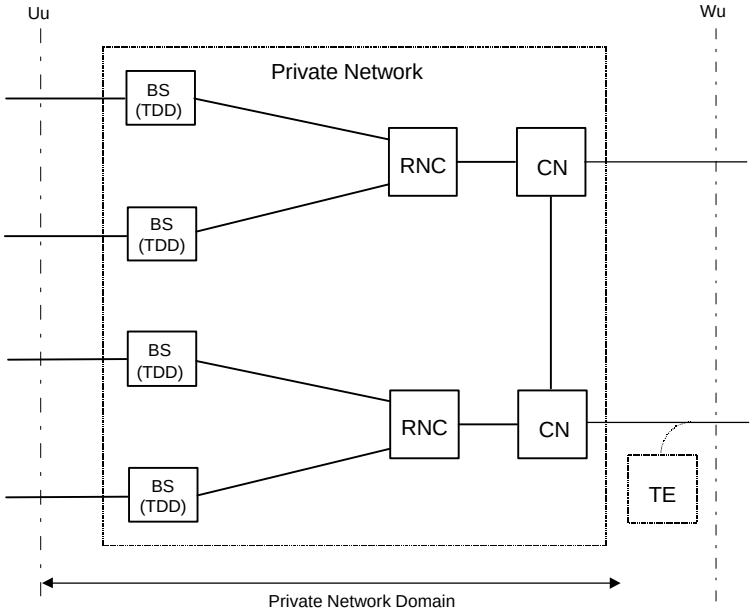

Figure 5 - The Private Network Domain.

As with Private Access Systems, we are not aware of any work on the network aspects of UMTS Private Networks. However, much of what has been done for Wireless/Cordless Terminal Mobility in

Private Networks (CT2, DECT and PHS) in ETSI, ECMA TC32, and ISO IEC JTC1 may apply. Again, the current work on radio aspects will need to ensure that the TDD mode supports carrier sharing between uncoordinated systems and high levels of possibly asymmetric traffic.

In general, Private Networks will have their own service provision capability for their internal users. Private networks may also provide access for visiting users from other private or public networks. Private Network registered users could also roam into other private or public networks. Therefore, the interworking over the Wu Interface between the Core Network Domain and the Private Network Domain will be similar to that between different UMTS Public CNs.

To interconnect with public networks, Private Networks may need to share the same public Network Termination Point with other terminal equipment/services (the TE in Figure 5). This will be particularly important for small business installations where a single connection to the public network may need to be shared with other non UMTS services.

3.4 Public Access Systems in licence exempt UMTS spectrum

Where permissible, public UMTS access may also be provided by a telecommunications operator using a UMTS radio access network operating in licence exempt spectrum. Such an operator could use the wireless network to offer services to users in both public places and private business premises but would be unlikely to offer contiguous wide area coverage.

Public Access Systems using the licence exempt spectrum may be based on the UMTS Access Network Domain (see Figure 2), the Private Access Domain (Figure 4) or on the Private Network Domain (Figure 5) using the Iu or Wu interfaces. The standardization work required is therefore covered by that already identified in the previous sections.

4 Responsible Standardization Bodies

This section considers where the standardization work related to the above scenarios is likely to be carried out. However, these expectations can only be considered tentative due to the current reorganization of the UMTS work in ETSI between SMG, ETSI Project UMTS (EP-UMTS) and the 3GPP.

As decided at the ETSI Extraordinary General Assembly meeting 29th September 1998, the 3GPP will develop specifications for the initial phase of a complete third Generation Mobile System based on UTRAN and evolved GSM core network (a “G-UMTS” system).

The following table indicates those areas of work that 3GPP is understood to be currently undertaking (indicated by a ✓). Although “Cordless Applications” are understood to be within the scope of 3GPP, the extent to which this work will cover the TDD and Private Systems scenarios identified in this document is not yet clear (indicated by a “?”).

Scenario	Service Aspects	System Aspects	Radio Aspects	Protocol Aspects
Public Access - licensed spectrum	✓	✓	✓	✓
Private Access licence exempt spectrum	?	?	✓	?
Private Network licence exempt spectrum	?	?	✓	?
Public Access - licence exempt spectrum	?	?	✓	?

As also decided at the ETSI Extraordinary General Assembly meeting 29th September 1998, the new ETSI Project UMTS will collect current and future ETSI activities relevant to UMTS outside those G-UMTS areas to be handled in the 3GPP.

This may, therefore, include certain aspects of UMTS TDD and Private Systems where these are not addressed by 3GPP.

5 Conclusion

This document has presented an understanding of the current standardization work and identified additional items that need to be addressed for UMTS TDD and Private Systems. It has also identified what bodies may carry out the work, however, given the reorganization that is taking place with respect to UMTS standardization, this information can only be provisional.

Annex A (to UK TAG doc 73/98)

Requirements for UMTS TDD

And Private Systems

UK TAG doc 65/98

27th November 1998

1 Introduction

The radio spectrum that has been designated by CEPT/ERC for UMTS includes 35 MHz of unpaired bands. It is also expected that any additional radio spectrum, that may be allocated to UMTS in the future, will include further unpaired bands. Therefore, public operators typically will use both the paired and unpaired spectrum. In addition, a significant application of the unpaired bands will be for private systems operating in licence exempt spectrum. Indeed, private systems are an integral part of the UMTS vision to provide universal personalised mobile communications. Any consideration of the unpaired spectrum must therefore take into account access to both public and private systems.

The utilisation of the unpaired bands, and the UTRA TDD mode selected by ETSI for use in these bands, are therefore very important to the overall development of UMTS. The intent of this report, prepared by the UK Third Generation Advisory Group (UK TAG), is to stimulate further debate and work on public and private applications of the UTRA TDD mode. To this end, the report considers the ways in which the unpaired spectrum is most likely to be used, and identifies some of the key requirements that will have to be met to ensure that this spectrum is exploited to its full potential. It is recognised that much further work will be necessary to identify the full compliment of requirements and to elaborate on related commercial, standardisation and regulatory issues.

2 General Considerations

Before considering the requirements that arise from individual scenarios, it is worth reviewing some general features of UMTS relevant to both public and private networks.

The UMTS Vision is to offer personalised mobile communications to the mass market regardless of location, network or terminal used. As the scenarios considered later in this paper make clear, this will be achieved through a multiplicity of UMTS networks. These will differ in their service and coverage capabilities, and will range from public networks with national coverage to local private networks providing, for example, coverage in a hotel or conference centre for use by visitors and staff.

The provision of services through multiple inter-connected networks leads to three general requirements:

- Wherever practical and appropriate, the end user should have access to a consistent and coherent set of services and features across the different networks. To this end it should be possible for a user to have a single set of identities with which to access the same services from different networks.

- Inter-system roaming will be required to allow the users of terminals to use the services of different public and private systems without the need to have a separate subscription with each network. For roaming to take place between the different systems, features required include the availability of appropriate FDD and/or TDD mode terminals and secure location registration, authentication, encryption and charging mechanisms. For calls in progress intra-system, and possibly inter-system, handover will be required.

- The means of network selection, and the presentation of options to the user, will need careful consideration and design. Whilst automatic selection may be appropriate in many situations, adequate and clear information will have to be provided to enable the user to select the network most appropriate to the user's specific current circumstances.

Multimedia services, particularly IP based services, are expected to be an important feature of UMTS and many of these services are expected to result in asymmetric traffic flows. This asymmetry is expected to be even more pronounced in pico cells where higher bandwidth services will often be in use. The degree of asymmetry and its variation with time or location, however, is not clearly identifiable as yet and the ability to handle it in as flexible a manner as possible will be important.

3 Scenarios

The UTRA TDD mode is well suited to small cells and is expected to be deployed mainly in the micro and pico cell environments. In addition, it has the potential to handle asymmetric traffic in a flexible and efficient manner. It should be noted that indoor traffic densities are expected to be both very variable with location and to be very high in localised areas.

The following four scenarios have been identified as representative of the range of TDD applications for the purposes of this document.

- Public Access Systems in licensed UMTS spectrum,
- Public Access Systems in licence exempt UMTS spectrum,
- Private Access Systems in licence exempt UMTS spectrum,
- Private Networks in licence exempt UMTS spectrum.

3.1 Public Access Systems in licensed UMTS spectrum

This scenario involves the use of TDD in an operator's licensed spectrum in the unpaired bands, as a complement to FDD in the paired bands. It will be used to increase radio coverage and/or capacity in public places. TDD systems will also be deployed in private indoor/on-site locations to provide improved radio coverage or to support particular business services. In all cases, the operator maintains ownership and responsibility for all parts of the network.

3.2 Public Access Systems in licence exempt UMTS spectrum

Public UMTS access may also be provided by any telecommunications operator using a UMTS radio access network operating in licence exempt spectrum. Such an operator would use the wireless network to offer services to users in both public places and private business premises but would be unlikely to offer contiguous wide area coverage.

3.3 Private Access Systems in licence exempt UMTS spectrum

This scenario involves customers owning and operating their own UMTS radio access network within their premises. These systems will operate in licence exempt spectrum and will be connected to a public UMTS core network. Functions of the core network include authentication, support of service profiles, network interconnect and traffic routing. Applications will range from residential use to private organisations such as universities and conference centres.

3.4 Private Networks in licence exempt UMTS spectrum

This is a variant of the Private Access Systems scenario (clause 3.3) in which the customer additionally owns and operates their own UMTS core network. These self-contained systems (i.e. complete systems in their own right) will interwork with other private and public UMTS core networks, and will operate in licence exempt spectrum. These systems should provide a home network capability for internal users across multiple, possibly isolated, sites to enable users to access the same services when roaming within the private network. Such networks will be used typically by organisations with large industrial sites or office complexes.

3.5 Key requirements

The key requirements resulting from the four scenarios are summarised below. Those which are common to all scenarios are listed immediately below. Those that relate to a subset of the scenarios are given in the following table.

- Within the limitations of the physical air interface, all features supported by the FDD mode should be supported by the TDD mode.
- Handover between TDD and TDD within the same UTRAN should be supported.
- The TDD mode will need to be capable of supporting high traffic densities. It will need to handle asymmetric traffic in an efficient and flexible manner whilst minimising any constraints on the use of adjacent carriers.
- There should be no technical restriction on the ability of a terminal to roam between both public and private networks (subject to suitable commercial arrangements and any regulatory constraints).

Requirement	**Scenario**			
	3.1	**3.2**	**3.3**	**3.4**
The TDD mode must be capable of efficient operation without co-ordination between different overlapping systems using the same carriers. Note, whatever form of Dynamic Channel Allocation scheme is utilised to achieve carrier sharing between uncoordinated systems, it will need to support high traffic densities including asymmetric traffic and to be capable of providing a commercial grade of service.	-	✓	✓	✓
Handover between TDD and FDD within the same UTRAN should be supported. (*In this case handover between TDD of the private access system and the FDD UTRAN of the supporting core network would be desirable.)	✓	✓	D*	-
Inter-network handover is desirable or important.	D	D	D+	D+
It should be possible for operators of private access systems to restrict access to registered members of the business (or household) or to enable access to any authenticated UMTS user.	-	-	✓	✓
Priority mechanisms should be available on private systems to give preference to home registered users over visitors.	-	-	✓	✓
It should be possible for users roaming onto private systems to receive the same services that they would expect to receive when roamed on to a public UMTS network, but the extent to which services and features are available should be an implementation option.	-	-	✓	✓
Where a call originates and terminates on base stations served by a common RNC it should be possible to avoid tromboning of the traffic through the core network (although the core network would still control the call).	D	D	✓	D
Legends ✓ required, should be provided D+ important, should be provided if possible D desirable - not required, or not applicable				

Table 1. Key requirements which do not apply to all the scenarios considered.

4 Conclusion

The four scenarios make it clear that the UMTS Vision to offer personalised mobile communications to the mass market regardless of location, network or terminal used will be achieved through multiple inter-connected public and private UMTS systems. Furthermore, the UTRA TDD mode will be integral to this vision and will need to support essentially the same features and capabilities as the FDD mode.

In particular, the key requirements for the UTRA TDD mode are:

- The TDD mode will need to be capable of supporting high traffic densities. It will need to handle asymmetric traffic in an efficient and flexible manner whilst minimising any constraints on the use of adjacent carriers.

- The TDD mode must be capable of efficient operation in high density traffic situations without co-ordination between different overlapping systems using the same carriers.

In addition, the scenarios show the importance of private UMTS systems to the overall UMTS vision and lead to the following key UMTS requirements:

- It should be possible for both public and private UMTS systems to provide the full range of UMTS facilities and service capabilities, and this should not be limited by inter-connection between networks.

- There should be no technical restriction on the ability of a terminal to roam between both public and private networks.

- Wherever practical and appropriate, the end user should have access to a consistent and coherent set of services and features across the different networks. To this end it should be possible for a user to have a single set of identities with which to access the same services from different networks.

- The means of network selection, and the presentation of options to the user, will need careful consideration and design.

UMTS Fixed and Cordless Applications

Graham Crisp

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Background 1

- 3GPP includes:
  - UTRA TDD Mode Radio,
  - Fixed and Cordless Applications
- But, no agreement what that involves
- This contribution is provided to help to develop a common understanding

Background 2

- Much of this presentation draws on information from “Standardization Scenarios for UMTS TDD and Private Systems” a report produced by the UK Third generation Advisory Group (UKTAG). For further information, a copy of that report is provided to the meeting.

Introduction

- UMTS includes 35 MHz of unpaired radio spectrum
- Some will be reserved for licence exempt use
- Including cordless & private network applications
- Private systems are an integral part of the UMTS Vision
- Potential requirements for standardization of the Fixed and Cordless Applications of UMTS are presented

Scenarios

- Systems using Licensed UMTS Spectrum
  - Public Access Systems
- Systems using Licence Exempt UMTS Spectrum
  - Public Access Systems
  - Private Access Systems
  - Private Networks

Public Access Systems using Licensed Spectrum

- Includes the use of TDD mode in the licenced operators unpaired bands
- Complements FDD in the licenced operators paired bands
- Increases radio coverage and/or capacity in public places
- TDD, and possibly FDD, systems may also be deployed in private indoor/on-site locations
  - to provide improved radio coverage or to support particular business services
  - the network operator maintains ownership and responsibility for all parts of the network

Public Access Systems using Licensed Exempt Spectrum

- Public UMTS access using a UMTS radio access network operating in licence exempt spectrum
- to offer services to users in both public places and private premises
- unlikely to offer contiguous wide area coverage

Private Access Systems using Licensed Exempt Spectrum

- Involves customers owning and operating their own UMTS radio access network within their premises
- Systems operate in the licence exempt spectrum
- Connected to a public UMTS core network
- Functions of the core network include
  - mobility management, including authentication, etc.
  - access to service profiles
  - network interconnect and traffic routing
- Applications range from residential to organisations such as universities and conference centres

Private Networks using Licensed Exempt Spectrum

- Private Access Systems where the customer additionally owns and operates their own UMTS core network
- Provide home network capability for internal users to enable users to access the same services when roaming within the private network
- Interwork with other private and public UMTS core networks
- Operate in the licence exempt spectrum
- typically used by organisations with large industrial sites or office complexes

Key Features 1
Apply to all scenarios

- Wherever possible, the TDD mode should support all features supported by FDD mode
- Handover between TDD and TDD within the same UTRAN should be supported.
- TDD mode will need to be capable of supporting high traffic densities and asymmetric traffic
- Should be no technical restriction on the ability of terminals to roam between public and private networks

Key Features 2
Apply to optional scenarios

Requirement	**Scenario**			
	Lic Sp	**Licence Exempt Spectrum**		
	Pu Ac	**Pu Ac**	**Pr Ac**	**Pr Nwk**
TDD mode must be capable of efficient operation without co-ordination between different overlapping systems using the same carriers.	-	✓	✓	✓
Handover between TDD and FDD within the same UTRAN should be supported. (*handover between TDD of the private access system and the FDD UTRAN of the supporting core network desirable.)	✓	✓	D*	-
Inter-network handover is desirable or important.	D	D	D+	D+
It should be possible for operators of private access systems to restrict access to registered members of the business (or household) or to enable access to any authenticated UMTS user.	-	-	✓	✓

Legends

✓	required, should be provided	D+	important, should be provided if possible
D	desirable	-	not required, or not applicable

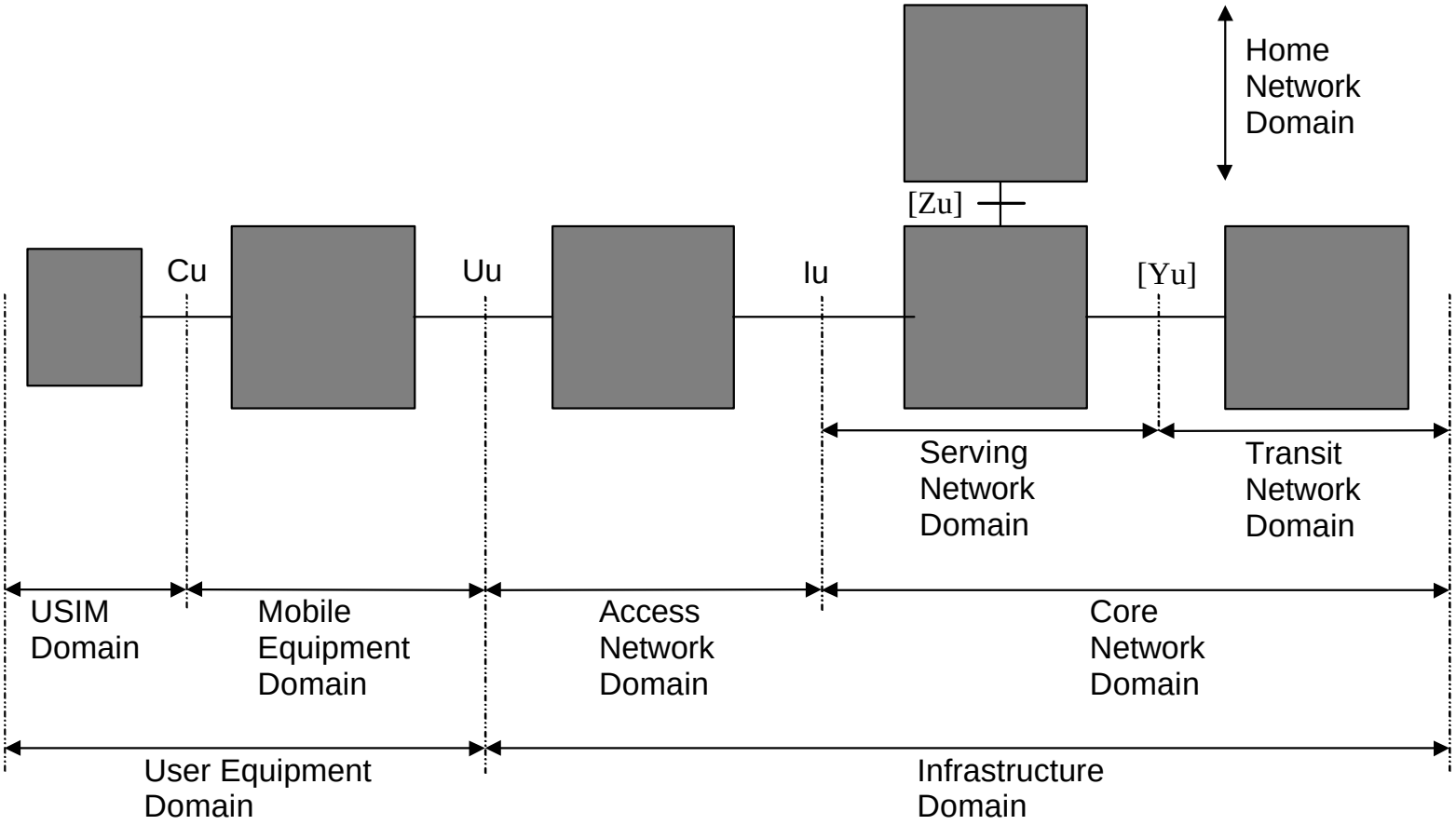
Key Features 3
Apply to optional scenarios

Requirement	**Scenario**			
	Lic Sp	**Licence Exempt Spectrum**		
	Pu Ac	**Pu Ac**	**Pr Ac**	**Pr Nwk**
Priority mechanisms should be available on private systems to give preference to home registered users over visitors.	-	-	✓	✓
It should be possible for users roaming onto private systems to receive the same services that they would expect to receive when roamed on to a public UMTS network.	-	-	✓	✓
Where a call originates and terminates on base stations served by a common RNC it should be possible to avoid tromboning of the traffic through the core network (although the core network would still control the call).	D	D	✓	D

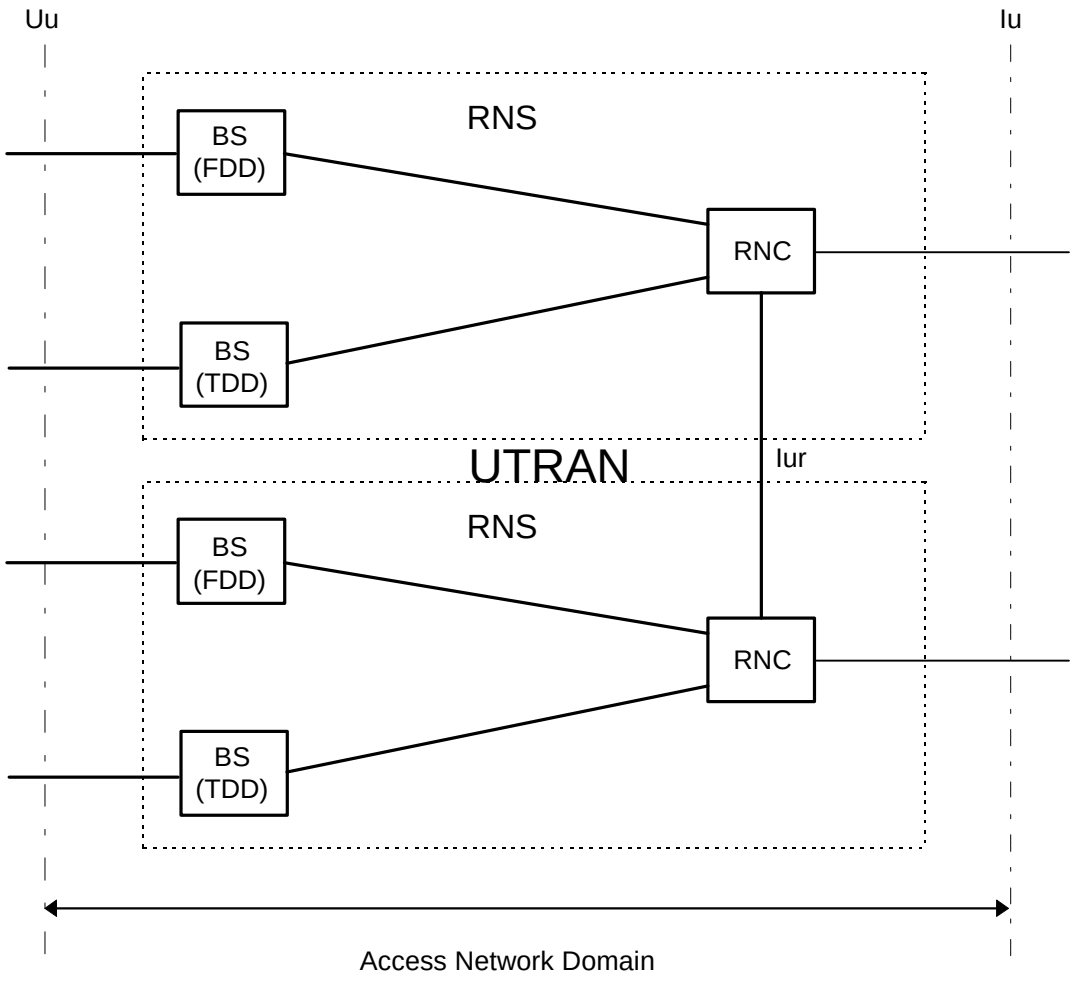
Legends

✓	required, should be provided	D+	important, should be provided if possible
D	desirable	-	not required, or not applicable

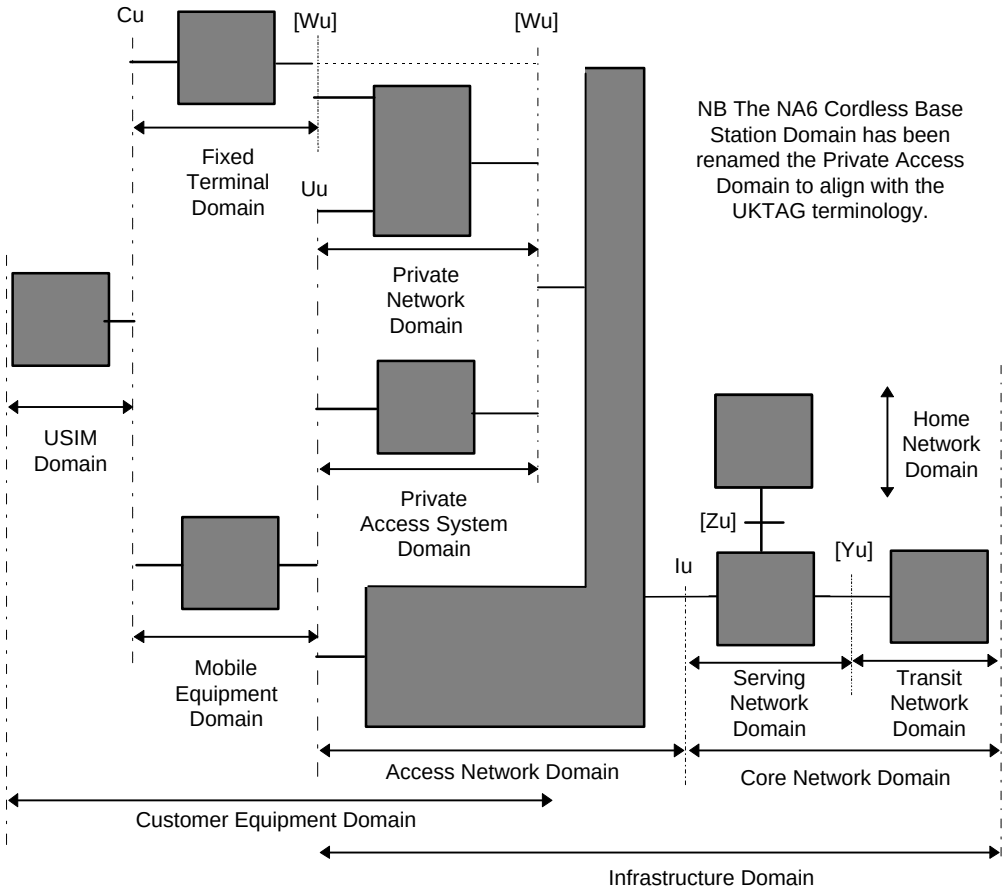
ETSI SMG UMTS Model



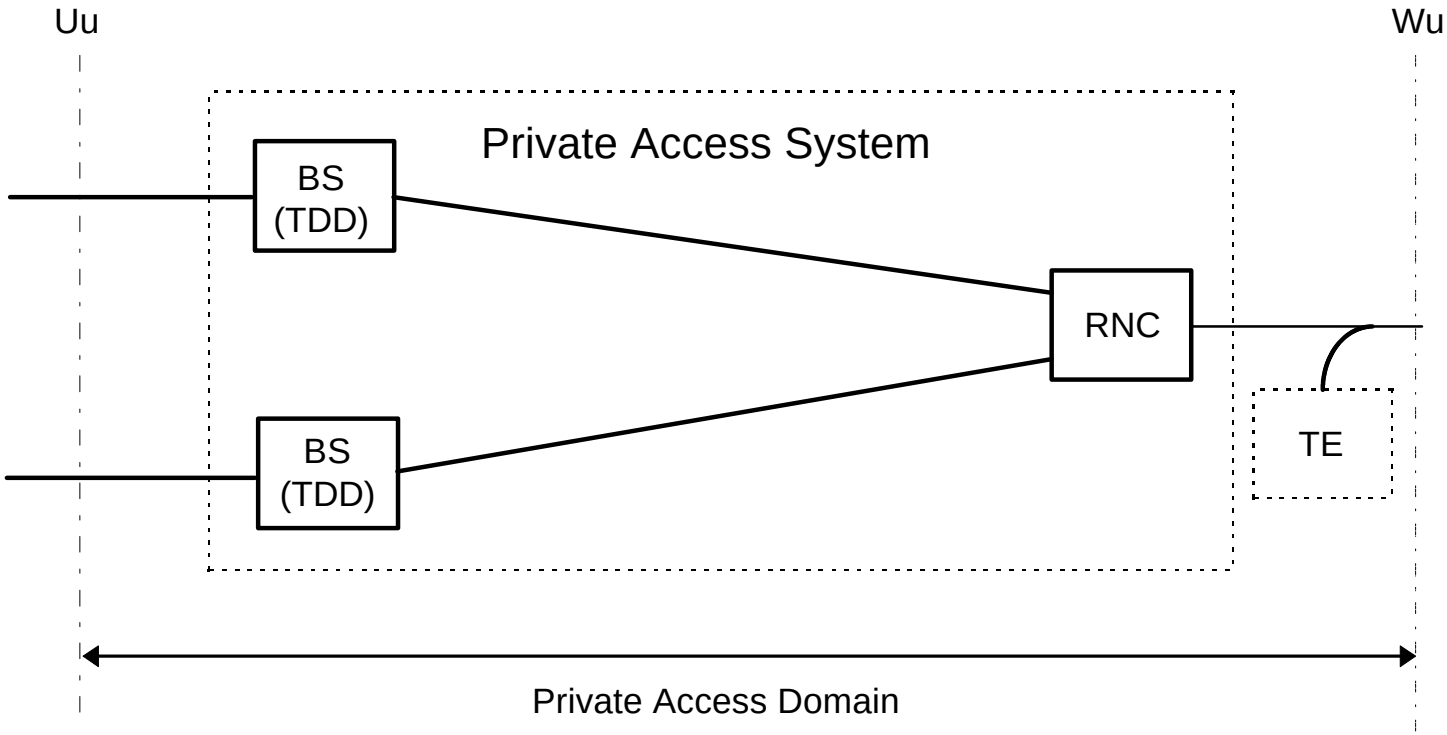
UMTS Access Network Domain



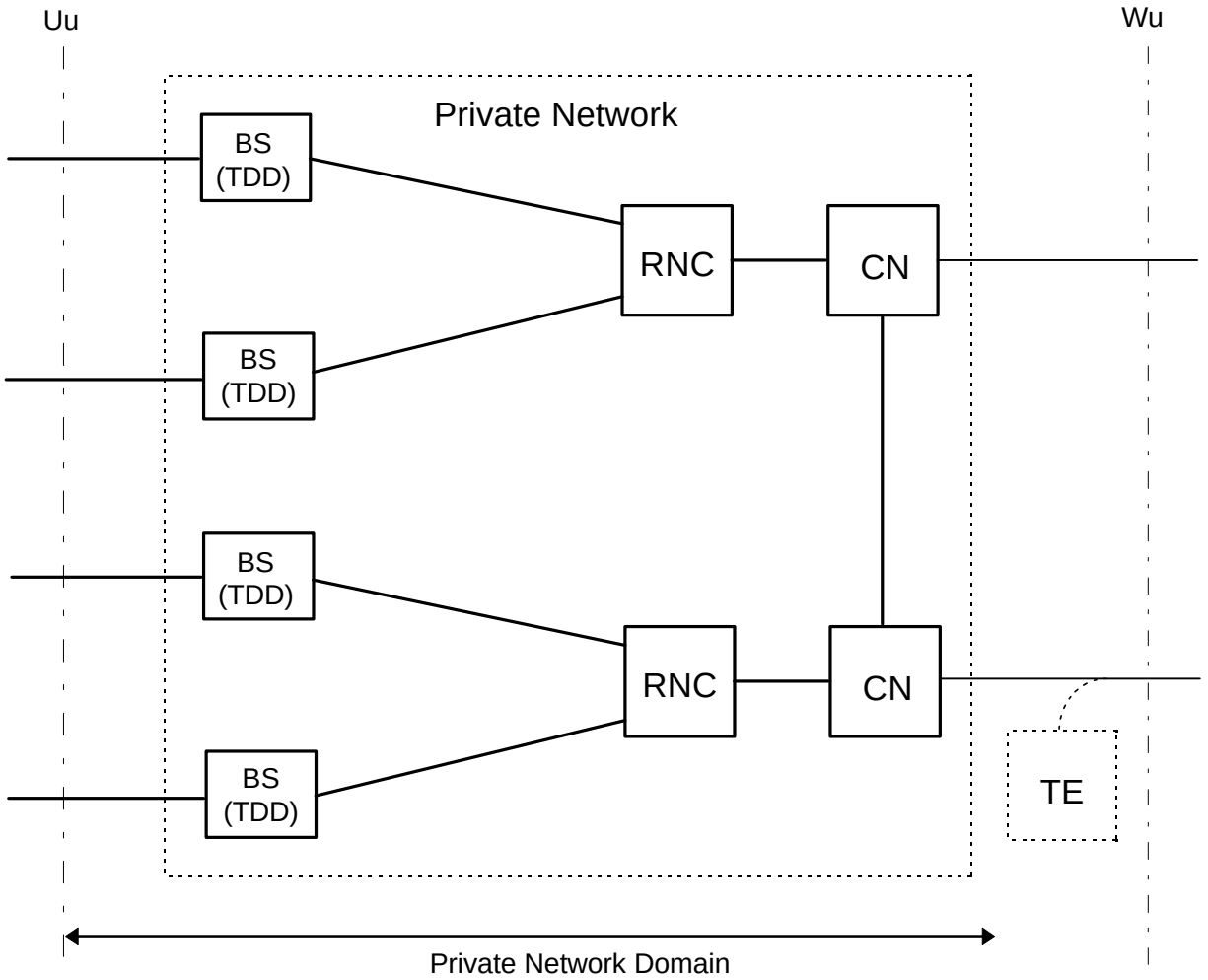
ETSI NA6 UMTS TF extension of the UMTS Model



UMTS Private Access Domain



UMTS Private Network Domain



3GPP Responsibilities for - UMTS Initial Phase

Scenario	Service Aspects	System Aspects	Radio Aspects	Protocol Aspects
Public Access - licensed spectrum	✓	✓	✓	✓
Private Access - licence exempt spectrum	?	?	✓	?
Private Network - licence exempt spectrum	?	?	✓	?
Public Access - licence exempt spectrum	?	?	✓	?

Closing comments

- TSG RAN are developing the dual TDD and FDD mode radio
- The requirements for the TDD mode need to be specified
- That requires the definition of the Service and Architecture Aspects of the Cordless Applications