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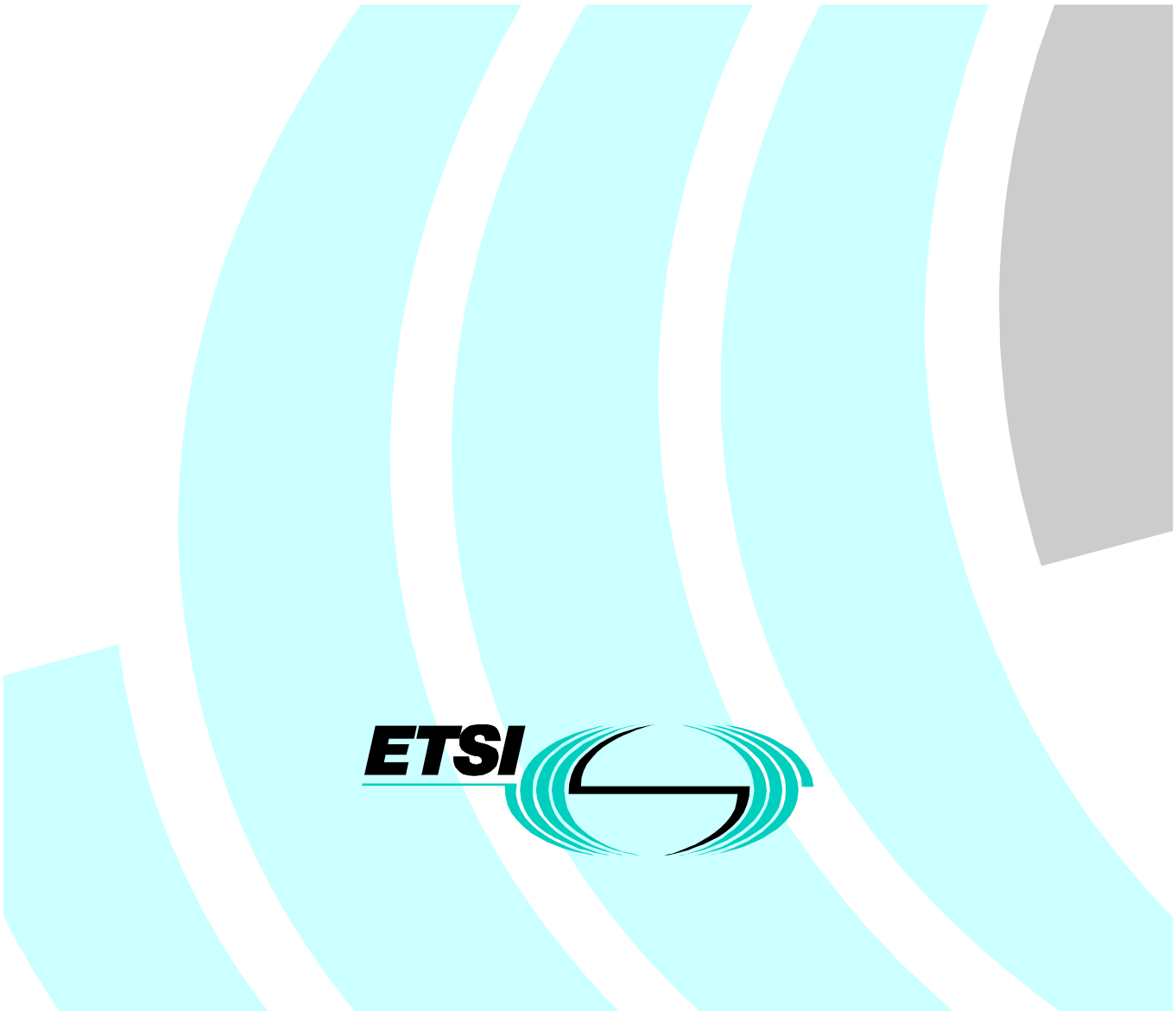
Technical Report

Terrestrial Trunked Radio (TETRA); Technical requirements specification for Digital Advanced Wireless Service (DAWS)



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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Project Terrestrial Trunked Radio (TETRA).

Introduction

The present document has been prepared (based upon the finalized work of EP-TETRA) as a communication to the ETSI Membership and Board and as a general working document for EP-TETRA Working Group 4 in the field of Mobile Networking.

The present document describes the basic ideas behind Digital Advanced Wireless Services (DAWS), relevant to market aspects and positioning within the present portfolio of ETSI Projects and Standardization activities.

Following the publication of the Strategic Review Committee (SRC6) Report on EII, June 1995 and the Global Multimedia Mobility (GMM) Report, October 1996 an ever increasing pace of activities within the field of Multimedia, Internetworking and 4th Generation Broadband technologies has been experienced throughout all three ITU Regions.

New approved ETSI Projects in this field are EP TIPHON, EP BRAN, and to some extent EP EASI. With formal liaison with the ATM Forum, ETSI is well prepared to meet the increasing pressure from the market to realign capacity and throughput of the wireless world with that of the fixed networks.

In order to be successful, both:

1) short time to market; and

2) careful forward migration of second generation Infrastructure,

have to be addressed.

Both these criteria lead to the initiative of building upon existing standards and already expended effort. Emergence of new generations should happen through evolution not revolution.

Well known examples are the current implementation of GPRS (General Packet Radio Services) onto the existing GSM platform to expand throughput and the reuse of GSM Protocol Architectures in the 1 800 and 1 900 MHz bands to expand capacity.

Likewise within EP TETRA a number of members (initially SIMOCO, TeleDanmark, BT, Motorola and UK Home Office), based on a study report decided to work on migrating the TETRA Packet Data Optimized (PDO) wireless networking standard (ETS 300 393 [1] to [3]) to provide full mobility/roaming and Wireless ATM bit rates up to 155 Mbit/s. This enhancement was given the code-name DAWS and has already been studied with much interest within the ATM Forum (Working Group WATM).

The cellular telephone users have been pampered with seamless on-line facilities and functions. Full mobility is essential for future hand-held "Wireless WEB-Surfers" offering continuous transmission of live pictures as well as Automatic Vehicle Location (AVL) and Automatic Person Location (APL).

In the early seventies, some forward-looking heads of laboratories within the old telephone monopolies of Europe proposed the addition of mobility to communication services, not realizing they were giving birth to one of the largest success stories of communications of this century, the digital cellular industry.

Now envisage a wireless hand-held WEB-Browsing device (a DAWS terminal) featuring the same mobility as a wireless phone service with throughput enough to process Wireless Packet Voice Telephony (The Mobile TIPHON-Phone) and other future "bit-hungry" applications.

Just as telephone subscribers were waiting to go unwired 25 years ago, the exploding Internet/Intranet community is still waiting for a solution which also satisfies the requirements of network operators. DAWS is a valuable addition to the current menu of ETSI Standardization activities.

1 Scope

The present document is to inform ETSI Members how far the work on DAWS has progressed and to outline the market potential for seamless high data rate mobile services. A proposal for deliverables in this field and an assessment of the time to deliver is presented later in the present document.

The DAWS Standard, complying with the ETSI TA Decisions, will be divided into three parts:

1) network aspects including Wireless Node Interlink Protocol Specifications;

2) terminal Air-Interface, including layer 3 entities;

3) authentication, encryption and security aspects.

Current work has shown that major reuse of the ETS 300 393 [1] to [3] standard is feasible and highly recommended.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] ETS 300 393-1: "Terrestrial Trunked Radio (TETRA); Packet Data Optimized (PDO); Part 1: General network design".

[2] ETS 300 393-2: "Terrestrial Trunked Radio (TETRA); Packet Data Optimized (PDO); Part 2: Air Interface (AI)".

[3] ETS 300 393-7: "Terrestrial Trunked Radio (TETRA); Packet Data Optimized (PDO); Part 7: Security".

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

APL	Automatic Person Location
AVL	Automatic Vehicle Location
BS	Base Station
DAWS	Digital Advanced Wireless Services
EII	European Information Infrastructure
GMM	Global Multimedia Mobility
GPRS	General Packet Radio Services
GW	Gateway
IP	Internet Protocol
LLC	Logical Link Controller
MAC	Medium Access Controller
MS	Mobile Station
PDO	Packet Data Optimized
PHY	Physical Layer
SRC	Strategic Review Committee
SW	Switch
TRAC	Technical Regulations Applications Committee
WATM	Wireless Asynchronous Transfer Mode

4 Market Considerations

Today, over 100 million Internet connected computers are in daily operation, a number exceeding currently the world population of private TV-dish receivers. These fixed terminals are supported by more than 16 million servers - up from 1 000 back in 1988, according to Frost & Sullivan, 1997.

By the year 2000, MCI estimates that 200 million active Internet terminals will be in constant operation, a lucrative market trend for the development and operation of "Personal Seamless Internet Access" as well as offering a vehicle for the European Information Infrastructure (EII) Services.

As entertainment and information technology become more integrated it is also interesting to observe the market acceleration seen from the media side:

- in the US (see US Investment Bank) it took about:
  - 38 years for radio broadcasting to reach 50 million listeners;
  - 13 years for television to reach that same number of viewers;
  - 10 years for cable TV; and

by 1998 this number of active Internet users will be reached, just 5 years after its commercial roll-out.

According to Business Newspaper "Boersen", 5 % of all international telephony will be Internet based by the turn of the millennium. This means a total accessible market of more than 5 million potential users of wireless high capacity links, including telephony, is waiting to be served by the time the DAWS standard is completed.

The DAWS approach is in full compliance with the new ETSI initiative of bringing professional products to market faster. DAWS will reduce the technical risk involved in bringing the EII to fruition and it will further reduce spending for both ETSI and the European Union (EU).

4.1 Positioning of DAWS

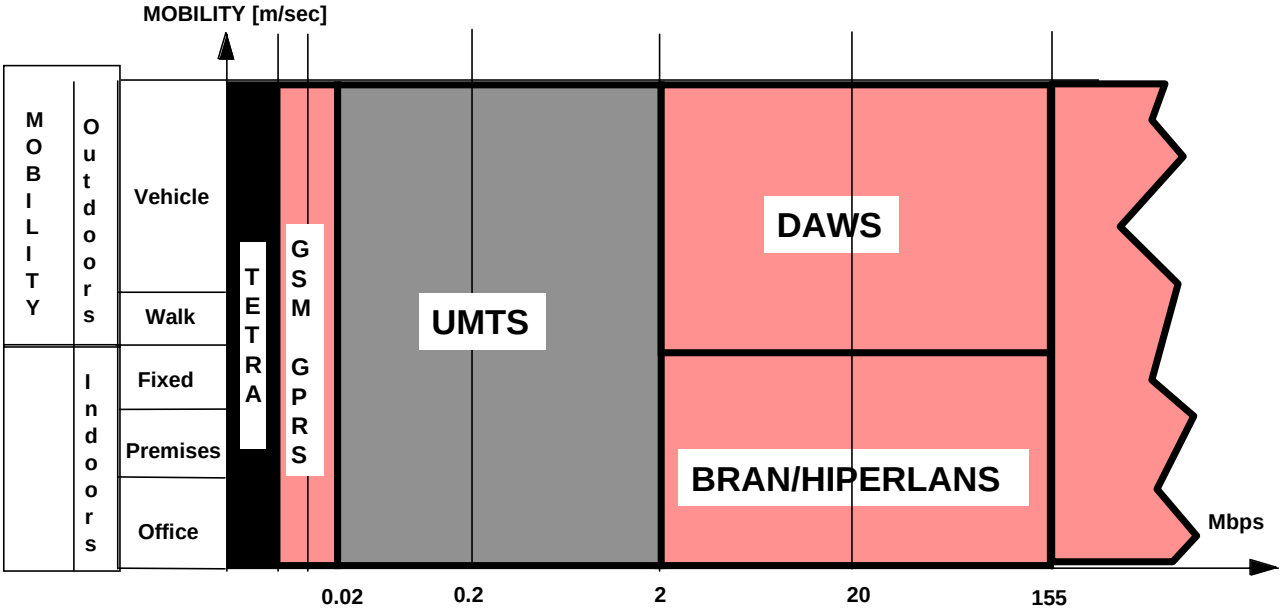

Figure 1: The segmentation of different platforms

As figure 1 indicates, the large segment from UMTS into WATM (X-axis) and from the top of the HIPERLANs and (Y-axis) into outdoor coverage with terminal mobility and roaming has been identified by the ETSI DAWS team as hitherto not covered. At present, the common view regarding implementation of UMTS Packet Services indicates that GSM-GPRS standardization should lead the way. Regrettably, little attention has yet been paid to dedicated UMTS Packet Radio Services.

5 The Scenarios

As shown in figure 2, the DAWS protocols enable wireless Internet access in a variety of ways. DAWS networks can be directly connected to the global Internet by network operators to provide high-speed wide-area Internet access to customers. System administrators can install DAWS networks throughout a corporate campus to provide wireless intranet access to employees. A DAWS network can be installed within a residence to permit high-speed wireless Internet access at home. Police and military personnel can use DAWS terminals to access ad-hoc IP networks. The DAWS protocols permit full, seamless terminal mobility throughout all areas serviced by a DAWS network.

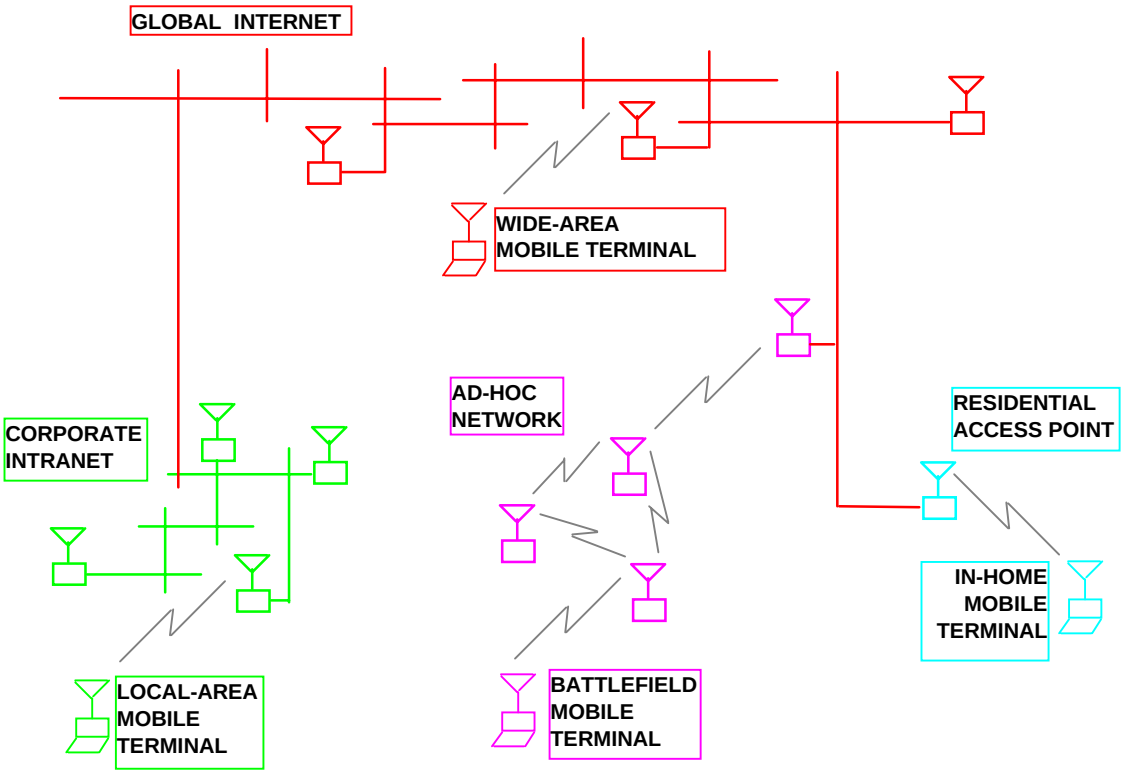

Figure 2: DAWS Scenarios

6 DAWS System Architecture

There are four distinct types of functionality within a DAWS network:

1) Gateway (GW);
2) Switch (SW);
3) Base Station (BS);
4) Mobile Station (MS).

A DAWS node is a single piece of equipment with well-defined input and output interfaces. A DAWS node may integrate several of the four basic functions. The following node configurations are possible:

1) GW;
2) GW + SW;
3) GW + BS;
4) GW + SW + BS;
5) SW;
6) SW + BS;
7) BS;
8) BS + MS;
9) MS.

Node configurations 1-7 and 9 support fixed wireless access networks; node configuration 8 supports mobile wireless access networks. The IEFT Mobile Ad-hoc Network (MANET) working group is defining the protocols required to support mobile wireless access networks. The current DAWS standards do not specify procedures and protocols for the BS + MS node configuration. This configuration will be supported in a future version of the DAWS standard.

Figure 3 provides an example of a DAWS wireless access network. A data packet destined for a DAWS Mobile Station within the DAWS network is received by the DAWS Gateway and is sent to the Switch (SW). The Switch forwards the packet to Base Station #1, Base Station #2, or the downstream Switch (SW + BS). If the packet is forwarded to Base Station #1, it is then transferred over the DAWS wireless interface to Mobile Station #1 or #2. If the packet is forwarded to the downstream Switch, it is then either sent over the DAWS wireless interface to Mobile Station #5 or forwarded to Base Station #3. If the packet is forwarded to Base Station #3, it is then transferred over the DAWS wireless interface to Mobile Station #3 or #4. A data packet originated by a Mobile Station within the DAWS network is forwarded to the Gateway by intermediate switches and then sent into the Internet. Mobile Stations can roam freely between Base Stations within the DAWS network without requiring mobility operations at the network layer.

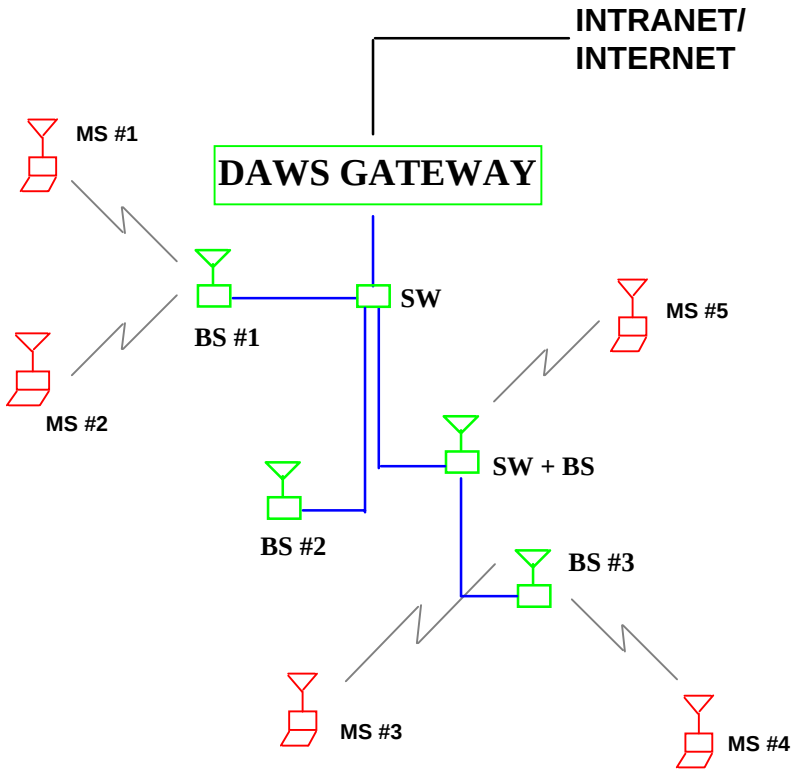

Figure 3: An Example DAWS Access Network

6.1 Minimum Complexity Architecture

Figure 4 shows the DAWS network architecture with minimum complexity. A DAWS Mobile Station communicates directly with the Gateway via a Base Station integrated into the Gateway.

Figure 4: DAWS Minimum Complexity Network Architecture

Figure 5 shows the protocol stacks corresponding to the minimum complexity architecture. The DAWS specifications describe how data packets are transferred between the GW + BS and MS nodes.

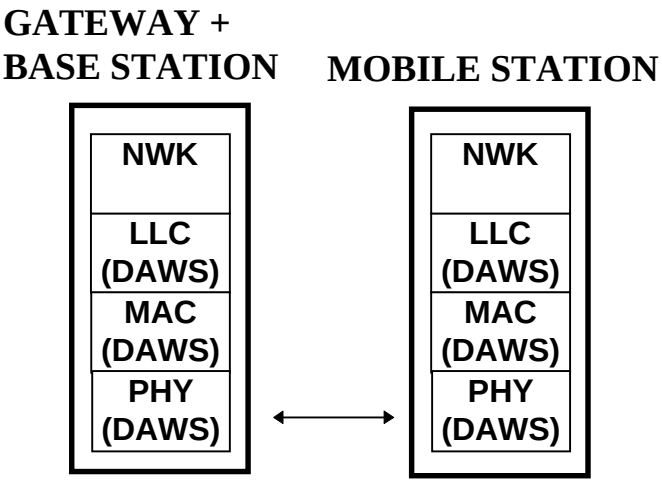

Figure 5: DAWS Minimum Complexity Network Protocols

6.2 Maximum Complexity Architecture

Figure 6 shows the DAWS network architecture with maximum complexity from the perspective of a DAWS Mobile Station. A DAWS Mobile Station communicates with a Base Station over the DAWS wireless interface. The Base Station communicates with the Gateway through a series of Switches.

DAWS network topologies are limited to those which permit data packets originating at a Mobile Station to be forwarded to the Gateway without requiring prior state creation at intermediate Switches. In general, prior state creation will be required for correct routing of packets from the Gateway to a particular Mobile Station. Downlink routing state creation in intermediate Switches is performed during Mobile Station registration.

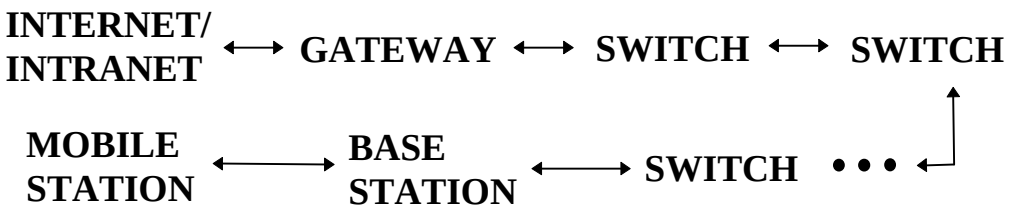

Figure 6: DAWS Maximum Complexity Network Architecture

The protocol stacks for the DAWS Gateway to Switch interface are shown in figure 7, and the protocol stacks for the DAWS Switch to Base Station interface are shown in figure 8. The DAWS Logical Link Control (LLC) protocol makes the distributed network of Switches and Base Stations appear as a single IP subnet to the Gateway. The MAC and PHY protocols which unite Gateways, Switches, and Base Stations are not specified by DAWS. The protocol stacks for the Base Station to Mobile Station interface are shown in figure 9.

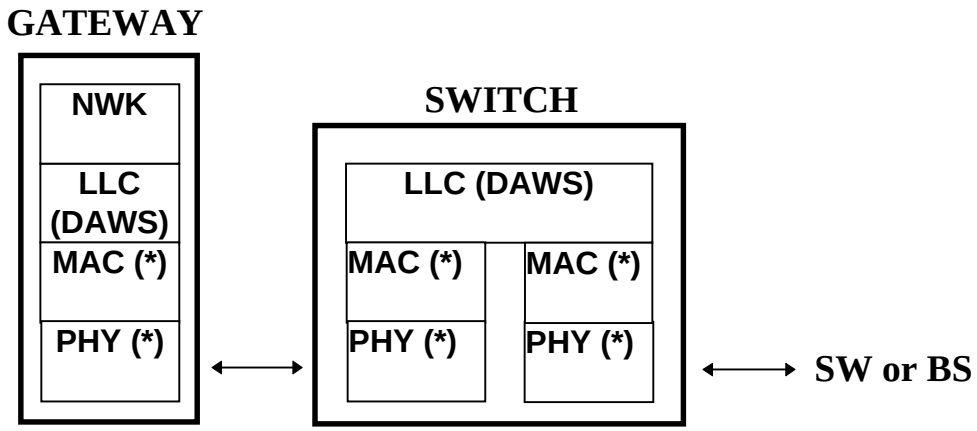

Figure 7: DAWS Gateway to Switch Protocols

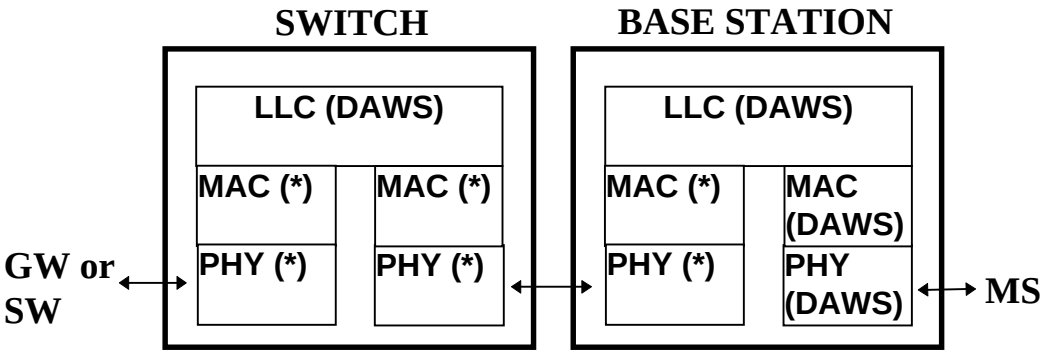

Figure 8: DAWS Switch to Base Station Protocols

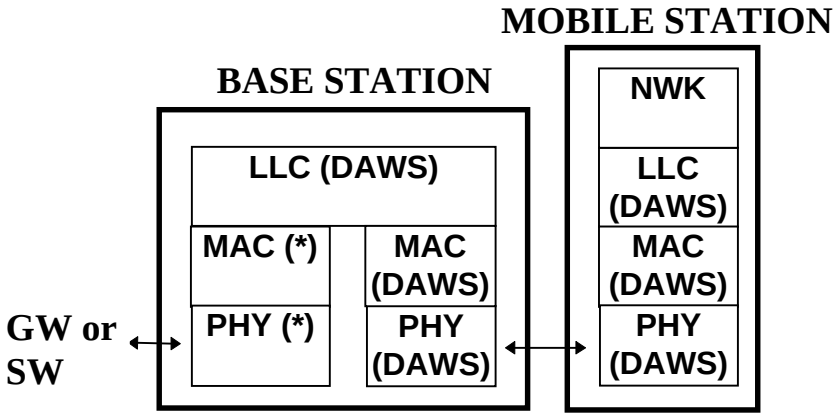

Figure 9: DAWS Base Station to Mobile Station Protocols

7 DAWS Frequency Allocation

For technical reasons it will not be possible to apply frequencies below 3 GHz for this very high bit-rate technology. It has been noted that the CEPT/ERC currently is studying the frequency range 862 MHz to 3 400 MHz under the programme of DSI III (Detailed Spectrum Investigation III) managed by the European Radiocommunications Office (ERO) in Copenhagen. Pursuant to the ETSI procedures a spectrum requirement document will be elaborated for the attention of the Technical Committee Electromagnetic Compatibility and Radio spectrum Matters.

8 Suggested work plan

Table 1

SUBJECT	ACTIVITY	START	COMPLETED
Drafting	Draft LLC and MAC service descriptions	2Q98	1Q99
	Draft LLC and MAC protocol specifications	1Q99	3Q99
	Draft PHY service description and protocol specification	3Q99	2Q00
ETSI formal procedures Eventual transfer to a harmonized standard	Public Enquiry - Resolution and Vote EU/ETSI Involvement	3Q00	4Q00

Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

- TRAC/29/01 Minutes of the 28th TRAC Plenary, 14/15 May, 1997.
- US Investment Bank, Stanley Morgan as quoted by FT March 17, 1997.
- EPT.4/DAWS(97)03 rev 2, Digital Advanced Wireless Services.
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History

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