Paper

User services of tactical communications in the digital age

Esra Çiftçibaşi Erkan and Şenol Uzun

Abstract—Increasing demands on an extensive amount of digital data and information flows for C4I is forcing the modern armies to freeze and omit EUROCOM based tactical area communications system and to develop new concepts based on the adoption of modern communication systems such as ISDN, ATM described in the TACOMS Post 2000 Final Report II in NATO. ASELSAN, as a leading company in the military electronics arena, is following and participating all the activities of TACOMS Post 2000 together with Turkish Ministry of Defense. Turkey's tactical area communications system TASMUS is a mature and fielded system, which will satisfy future communication needs of the 21st century C4I systems. In this paper, we describe the basic features and user services of TASMUS. With the support of simultaneous voice and data capabilities, TASMUS aims to form mobile, survivable, flexible and secure network to support all the present and future communication requirements of the tactical commanders. Using the near real time data communications feature, TASMUS is also significant for the network-centric warfare applications such as tactical sensor and weapon systems, besides the communication needs of the Turkish Army.

Keywords— tactical communications, IP, X.25, C4I systems.

1. Introduction

Tactical battlefield is now becoming a ground for extensive digital data exchange where many sensors, weapons, computers and command centres need to exchange high-speed data in order to perform effectively and coherently. More so, these units need to carry out their data exchange while on the move because the new military doctrines heavily emphasize mobility and flexibility.

Future battlefield, no doubt, will be a digitized one. The emerging issues related to the implementation of the digitized battlefield are listed below.

1. Common picture of the battlefield in near-real time.
2. Shared data among battlefield operating systems.
3. Ability to concentrate on combat power effectively and decisively.
4. High-speed exchange of data.
5. Fusion and display of intelligence information to commanders at all levels.
6. Rapid exchange of targeting data from sensor to weapon.

All of these issues are related to reliable and efficient exchange of information on the tactical field.

On the battlefield, several command and control functions such as fire support, manoeuvre control, intelligence, electronic warfare, and logistics support need to be executed simultaneously. Command and control functions rely on rapid and reliable exchange of information on the tactical field. These command control functions may have different communication requirements, however in consequence what needed is an integrated solution that will provide the necessary communication support to all of these command and control applications.

Existing tactical area communication systems, such as EUROCOM, are not sufficient to meet the demands of the future battlefield. Even NATO, the originator of EUROCOM standards has an ongoing project the Tactical Communications Post 2000. The aim of this project is to define the next generation tactical area communication systems for NATO.

So, looking at the today's tactical picture, new concepts and state-of-the-art technologies need to be utilized in order to meet the communication requirements of the future battlefield. This is exactly what the TASMUS project is all about. The TASMUS project has been realized to meet the challenges of the future battlefield.

2. Digital information age and TASMUS

The tactical communication system TASMUS aims to form: mobile, survivable, flexible, secure network to support all the present and future communication requirements of the commanders, and also to provide the commanders with the communications background to form the real time picture of the battlefield. TASMUS makes the crucial near real time data communications needed by the tactical sensor and weapon systems available.

TASMUS is deployed in area (theatre) of military operations such that, seamless communication between the army command and battalion/company commander level is achieved. TASMUS provides interfaces to the strategic systems above the army level, while providing connection to the existing CNR systems via CNRI.

TASMUS brings together the state of the art technologies in military communications. It incorporates ATM and ISDN switching technologies, together with digital ISDN terminals with built-in crypto module, enabling simultaneous voice and data capability with synchronous, asynchronous, X.25 data, IP data and video interfaces. Video conferencing is also supported over the TASMUS network.

Mobile subscribers in TASMUS acquire service thorough TDMA radios, namely, iSTAR (Integrated Services Tactical Radio) acting as the mobile access terminal. The iSTAR concept is based on radio networking and packet communications. On the tactical field, TDMA radios use time division multiple access technique for accessing the medium and automatically form a radio network where all the network management functions are carried out in a distributed fashion. The TDMA radio network can provide multiple simultaneous voice and data connections to the mobile users. The TDMA radios have built-in encryption/decryption, ECCM and LPI/LPD features enable secure communications in the battlefield. The TDMA radios are also equipped with GPS receivers. The TDMA radio system automatically distributes the GPS information of each mobile unit over the entire TASMUS network.

3. TASMUS features

In the tactical field:

1. TASMUS responds to all of the voice, data, fax and video communication requirements of the battle groups, with an integrated system solution.

2. TASMUS presents a communication infrastructure, providing survivable and reliable communication services with prompt response to all kinds of sudden changes using distributed routing algorithms and flexible system topology upgrades.

3. ATM technology, incorporated in TASMUS nodal points, enables efficient use of link capacities between switches and makes the support of flexible and distinct services possible to its users.

4. ISDN technology, incorporated in TASMUS access switches, furnishes integrated communication service support such as simultaneous voice and data (asynch., synch., X.25, IP, video, video conference) to its users through the tactical ISDN terminals.

5. ADSL technology, incorporated in TASMUS access switches, gives the support of IP service to its users through the tactical ADSL terminals. Each ADSL terminal has 3 Ethernet interfaces for generating LANs.

6. In terms of communication services, TASMUS provides plain and encrypted voice, async data up to 38.4 kbit/s, synch. data up to 64 kbit/s, X.25 packet data up to 64 kbit/s, IP packet data up to 640 kbit/s, video up to 64 kbit/s and video conference up to 384 kbit/s to its wired digital subscribers by using tactical ISDN terminals and ADSL terminals. TASMUS also provides plain and encrypted voice, async data up to 38.4 kbit/s, synch. data up to 64 kbit/s, X.25 packet data up to 9.6 kbit/s, IP data up to 64 kbit/s depending on the application and video up to 64 kbit/s to its mobile subscribers by using iSTAR TDMA radios.

7. All the voice traffic in TASMUS is carried with 4.8 kbit/s CELP voice coding.

8. In terms of information services TASMUS provides communication background to figure out near real time picture of the battlefield to the tactical commanders. At any time during the battle, commanders are provided with the geographical positions of all of their subordinate units on the tactical field. Visualizing the real time picture of the battlefield to the tactical commanders will enhance the tactical decision-making process will also reduce the voice communication traffic.

9. Near real time data communications is required by tactical sensor and weapon systems. This kind of sensor to weapon communication involves exchanging target data and is intolerable to delays. The communication system must deliver the information to the destination in time. TASMUS provides near-real time communications required by tactical systems.

10. TASMUS supports all of the teleservices, bearer services and supplementary services including military features such as “priority”, “pre-emption”.

11. TASMUS network management and planning system, “SYSCON” meets military network management and planning requirements by using both ITU-T M.3000 TMN system control concepts and NATO TACOMS Post 2000 system control concepts.

There is also a tactical data bank in TASMUS, which provides digital maps, geographical data, meteorological info, intelligence reports, and logistics info.
TASMUS forms a rapid, flexible, reliable, survivable and secure tactical communication network to meet the current and future’s armed forces mobility needs.

4. TASMUS network architecture

As shown in Fig. 1 TASMUS has a layered architecture.
Highest layer is the Wide Area Subsystem (WAS), which carries out the backbone switching, constituted of the nodal points. Interfaces to the strategic systems and PTT are located on the WAS.
The middle layer is the Local Area Subsystem (LAS), which is formed by access points (AP) connected to the nodal points (NP). The APs contain the access switches through which the users access the system. The APs also constitute a gateway for the mobile users.
The lowest layer is the Mobile Subsystem (MS). In the Mobile Subsystem mobile subscribers use mobile subscriber terminals (MST) to access the TASMUS switching backbone.

In addition to those layered subsystems, the system control SYSCON carries out all the necessary control functions such as system planning, control and management.

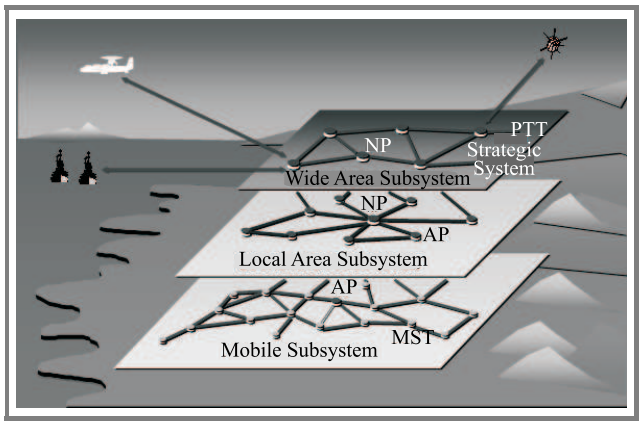

Fig. 1. TASMUS layered architecture.

Detailed architecture, interconnection of the subsystems and interfaces to the other systems such as CNR, PTT and strategic system is shown in Fig. 2.

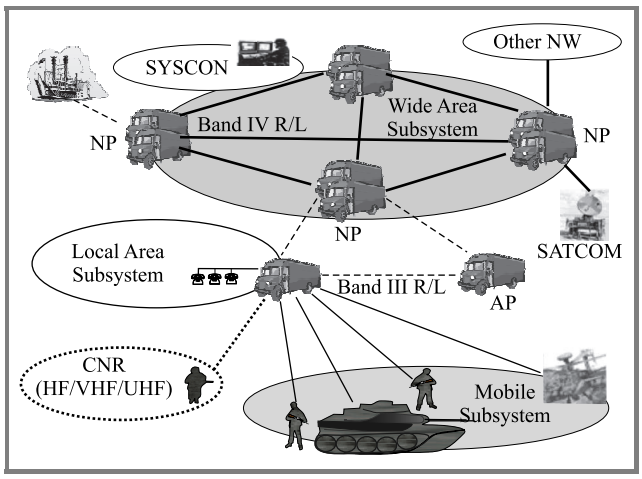

Fig. 2. Detailed architecture of TASMUS.

For different radio applications at WAS, LAS and MS, TASMUS uses multi-band multi-role iSTAR radios.
iSTAR is a new generation radio family which combines both single channel radio access (SCRA) and packet radio concepts.
iSTAR is capable to be used as mobile terminal (both for voice and data) and mobile terminal access equipment to switching backbone. Those two types of applications are given below.

1. iSTAR radio functioning as radio access point (RAP) for the access of mobile subscriber (AP switch connection to mobile subscriber).

2. iSTAR radio functioning as mobile subscriber terminal (MST) meets all the communication requirements of the mobile subscribers and forms independent network among the MSTs.

5. User terminals in TASMUS

TASMUS has digital subscriber terminals, ADSL IP terminals, iSTAR mobile subscriber terminals (iSTAR-MST) and iSTAR personal subscriber terminal (iSTAR-PST) all of which have build-in encryption.
The digital subscriber terminals have ISDN S_0 interface with the ISDN switch. They have voice and data capability at the same time. They are capable of performing asynchronous data transfer up to 38.4 kbit/s, synchronous data transfer up to 64 kbit/s, and near real time X.25 transfer up to 64 kbit/s. They also have IP packet data transfer capability. Each digital subscriber terminal can serve IP addresses and IP capability, via the switch which it is connected, to maximum 5 external host computers. They can also send SMS messages to the other user terminals among the TASMUS and to the ordinary GSM phones via a GSM modem.
ADSL IP terminals have ADSL interface with the ISDN switch. They are used for IP packet data communication. They have 3 Ethernet ports and via these 3 ports totally 510 host computers can be connected to TASMUS IP network or any other connected strategic/tactical IP networks. They act as IP routers.
iSTAR-MST and iSTAR-PST terminals are the devices of TDMA radio family. They have voice and data capability at the same time. They are capable of performing asynchronous data transfer up to 38.4 kbit/s, synchronous data transfer up to 64 kbit/s, and near real time X.25 data transfer. They also have IP packet data transfer capability. iSTAR-MST's can serve IP addresses and IP capability to maximum 5 external host computers. iSTAR-MST's and iSTAR-PST's can also send SMS messages to the other user terminals among the TASMUS and to the ordinary GSM phones via a GSM modem.

6. User services in TASMUS

TASMUS provides several services to the tactical area users such as secure voice, file transfer (using near-real time X.25, IP packet data service, synchronous and asynchronous protocols), web access, e-mail, short message service, video conferencing, digital fax, and wireless LAN applications.

Secure voice service. TASMUS provides encrypted and non-encrypted voice services using the end-terminals such as iSTAR-MSTs, iSTAR-PSTs, digital subscriber terminals and analog subscriber terminals. TASMUS secure voice service is 4.8 kbit/s CELP encoded. These terminals are located in every point of TASMUS, such as the nodal points, access points or the system control point.

File transfer service. TASMUS has capability to transfer files between hosts connected to the end-point terminals. Asynchronous, X.25 and IP packet data services can be used for file transfer. File transfer protocol (FTP) is used for file transfer using IP.

For FTP applications, an FTP server is located in the system control point in TASMUS as shown in Fig. 3.

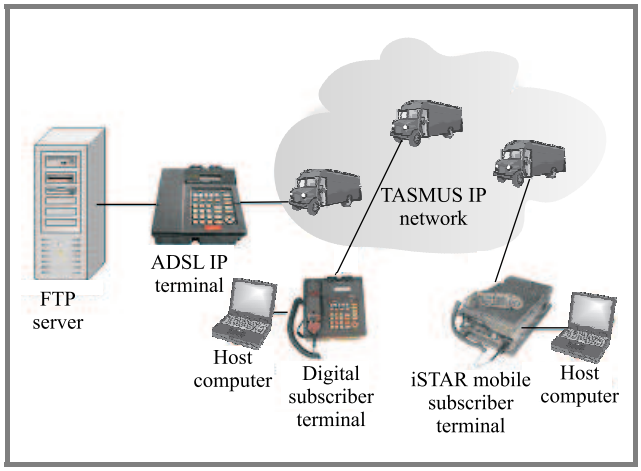

Fig. 3. TASMUS FTP service.

The file transfer can also be performed using the near-real time X.25 service in TASMUS via the user terminals digital subscriber terminals, iSTAR-MST and iSTAR-PST.

Web service. With the use of an HTTP server TASMUS has capability to support web services in the tactical area. Via the end-terminals digital subscriber terminal, ADSL IP terminal, iSTAR-MST and iSTAR-PST; the hosts can be connected to the TASMUS IP network and can access the web applications through the HTTP server, which is located in the system control point of TASMUS. A similar web access application is shown in Fig. 4.

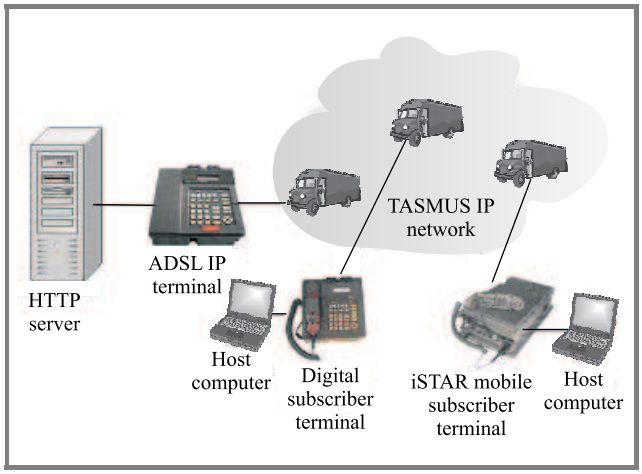

Fig. 4. TASMUS HTTP service.

E-mail service. TASMUS can serve e-mail service to its hosts that are connected to the TASMUS IP network. The end-points, digital subscriber terminal, ADSL IP terminal, iSTAR-MST and iSTAR-PST can be used to be connected to the TASMUS IP network.

For an e-mail application, the SMTP is used between the hosts and the mail server. The mail server (SMTP server) is again located in the system control point and the hosts can create accounts and send e-mails to each other via this server. A typical application of this service is shown in Fig. 5.

In this service the mail that host computer-1 creates, is first sent to the e-mail server by the network. The server then processes the mail and sends it back to its original destination host computer-2.

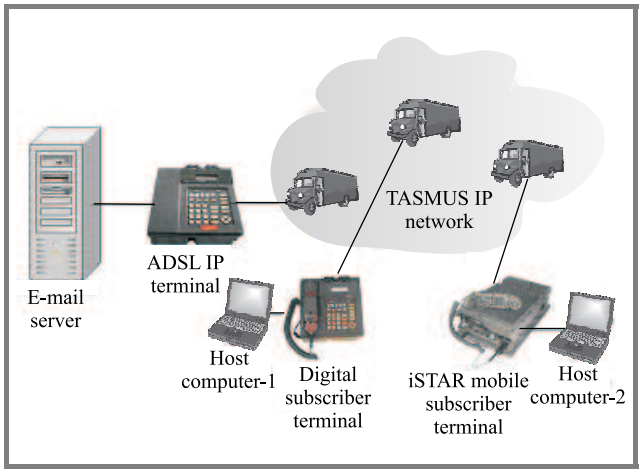

Fig. 5. TASMUS e-mail service.

SMS service. TASMUS end-terminals digital subscriber terminals, iSTAR-MST's and iSTAR-PST's have capability to send and receive SMS messages like commercial GSM phones but all are encrypted. This facility is handled with the use of an SMS server, again located in the system control point of TASMUS. The created SMS messages are first sent to the SMS server. They are logged in the server and forwarded to the original destination terminal afterwards. A typical application is shown in Fig. 6.

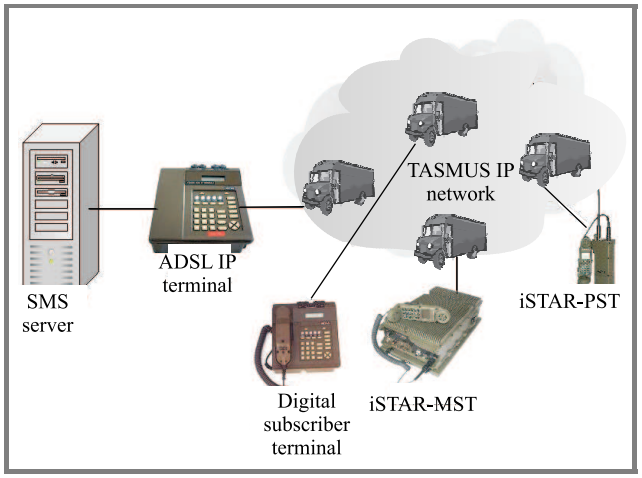

Fig. 6. TASMUS SMS service.

Video conferencing service. The video conference units (VCU) of TASMUS can be connected to the access point shelters through the switch's ISDN-BRI interfaces.

The video coding standard H.263 is used and the rate of the video session depends on the number of BRI lines used. The supported rates are 128, 256 and 384 kbit/s, corresponding to 1, 2 and 3 BRI lines. Two VCU units can establish point-to-point video sessions. A video server, which is located in the nodal point, is used to arrange the conference between more than two VCU. The video server does not join the conference; instead it decides the rate of the conference. It has a 2 Mbit/s. ISDN PRI interface with the nodal point switch. A video server can serve a video session with maximum 6 VCU. A typical application is shown in Fig. 7.

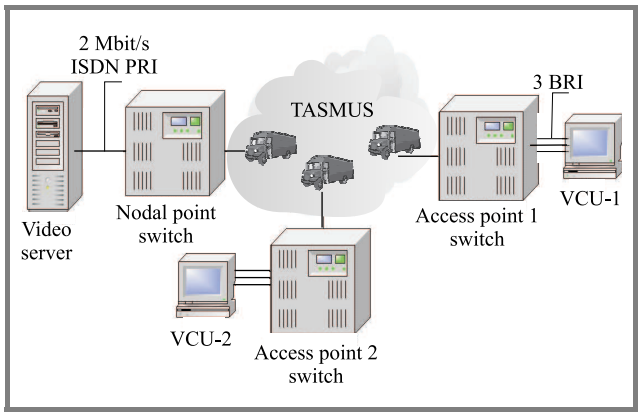

Fig. 7. TASMUS video conference service.

Fax service. Using the end-terminals digital subscriber terminals, iSTAR-MST's and iSTAR-PST's; up to 9600 bit/s. Digital fax applications can be performed in TASMUS. A typical application is shown in Fig. 8.

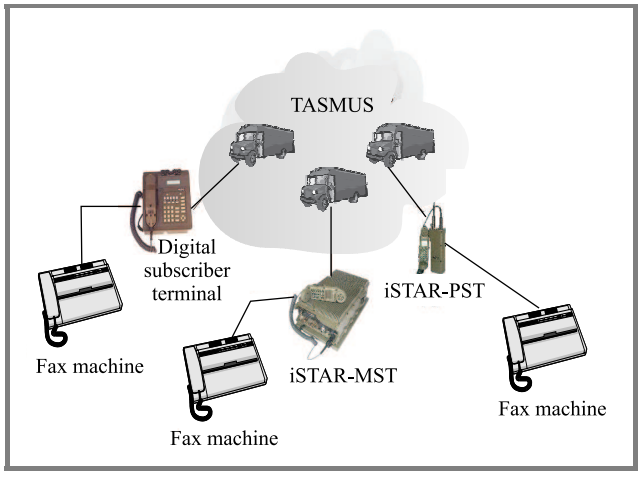

Fig. 8. TASMUS fax service.

Wireless LAN service. With the secure access point units placed in the access point shelters, TASMUS supports WLAN service to its tactical area users. The secure access point units are connected to the high capacity ADSL IP terminals, or the digital subscriber terminals in the access point. The standard IEEE 802.11b is implemented and the 2.412–2.472 GHz frequency band (the ISM band) is used. With this service, the tactical area users who are located in the 500 meter range of the access point have the TASMUS IP service. The configuration of TASMUS wireless LAN service is shown in Fig. 9.

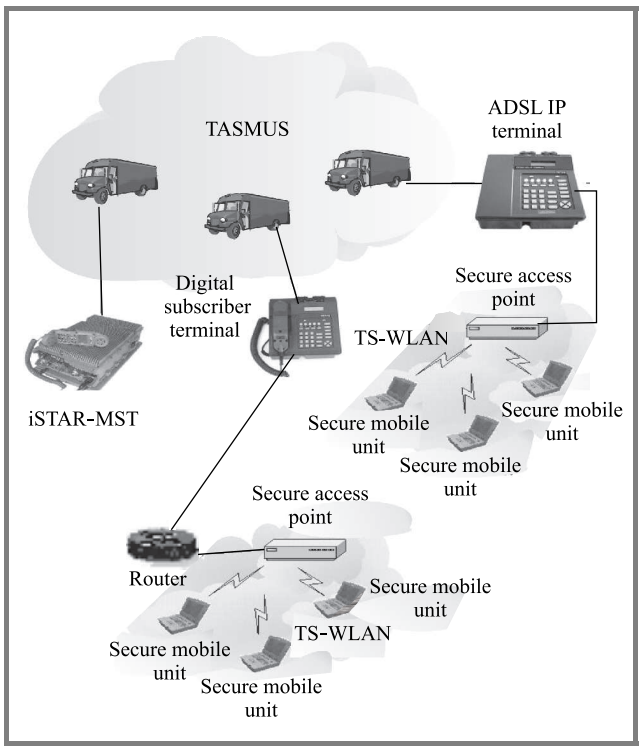

Fig. 9. TASMUS WLAN service.

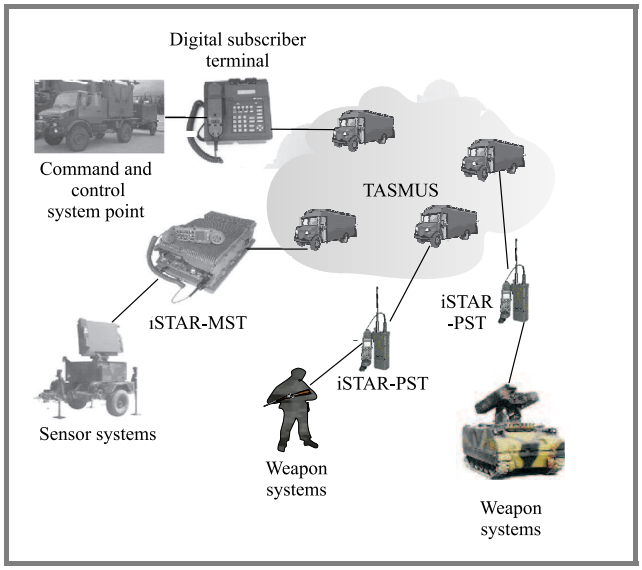

Fig. 10. Near-real time X.25 service.

Near-real time X.25 service. Near real time data communications is supported in TASMUS for the interoperability with the tactical sensor and weapon systems. The sensor and weapon systems involves exchanging target data and is their communication is intolerable to delays.

The end-terminals digital subscriber terminal, iSTAR-MST's and iSTAR-PST's are used for near-real time X.25 data communication. A typical TASMUS-sensor and weapon system integration using iSTAR radio is shown in Fig. 10.

7. Conclusion

TASMUS aims to form mobile, survivable, flexible and secure network to support all the present and future communication requirements of the tactical commanders. TASMUS also conveys the real time picture of the battlefield to the commanders. TASMUS system provides the crucial near real time data communications needed by the tactical sensor and weapon systems.
TASMUS brings together the state of the art in military communication technologies. It incorporates ATM and ISDN switching technologies used with digital ISDN terminals with built-in crypto module, simultaneous voice and data capability with synchronous, asynchronous, X.25, IP data and video interfaces. Video conferencing and digital fax are also supported over the TASMUS network. TASMUS supports all of the teleservices, bearer services and supplementary services that the TASMUS subscribers need. The communication subsystem is the base of all activities in the battlefield. No sophisticated device or system would be useful if the communication requirements are not satisfied. TASMUS, which is a mature and fielded system, will satisfy future communication needs of the 21st century C4I systems.

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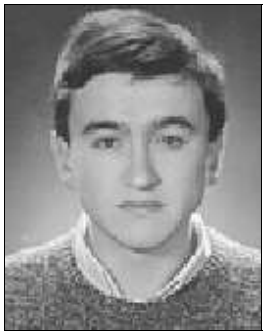

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