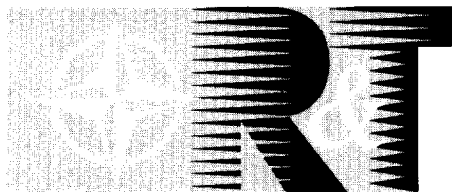


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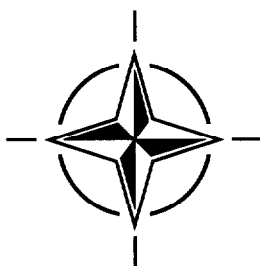
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RTO MEETING PROCEEDINGS 26

# Tactical Mobile Communications

(Communications tactiques mobiles)

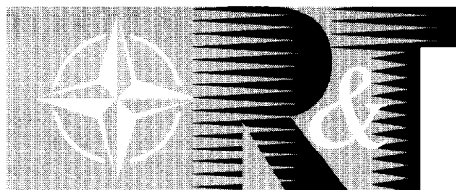
*Papers presented at the RTO Information Systems Technology (IST) Symposium held in Lillehammer, Norway, 14-16 June 1999.*



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**RTO MEETING PROCEEDINGS 26**

## **Tactical Mobile Communications**

(Communications tactiques mobiles)

*Papers presented at the RTO Information Systems Technology (IST) Symposium held in Lillehammer, Norway, 14-16 June 1999.*



# The Research and Technology Organization (RTO) of NATO

RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote cooperative research and information exchange. The objective is to support the development and effective use of national defence research and technology and to meet the military needs of the Alliance, to maintain a technological lead, and to provide advice to NATO and national decision makers. The RTO performs its mission with the support of an extensive network of national experts. It also ensures effective coordination with other NATO bodies involved in R&T activities.

RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also coordinates RTO's cooperation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of initial cooperation.

The total spectrum of R&T activities is covered by 7 Panels, dealing with:

- SAS Studies, Analysis and Simulation
- SCI Systems Concepts and Integration
- SET Sensors and Electronics Technology
- IST Information Systems Technology
- AVT Applied Vehicle Technology
- HFM Human Factors and Medicine
- MSG Modelling and Simulation

These Panels are made up of national representatives as well as generally recognised 'world class' scientists. The Panels also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

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# **Tactical Mobile Communications**

**(RTO MP-26)**

## **Executive Summary**

The concept of Ubiquitous Communication and Convergence Technology is a global trend, which will influence tactical military communications and make impact on the military acquisition programs throughout the world. During recent operations in the Gulf War and in Bosnia, there was a need to support the military units with more information than ever before and during an international military operation. The security risk involved in using civilian telecommunications services was continuously traded against the use of slow and reliable military services. In the future, these differences will be smaller. During the cold war military products were developed first and were technologically advanced and expensive. Now the situation is different since military products will need to adapt to civilian standards due to budgetary constraints. Mobile civilian systems will influence the future of tactical military communication systems.

Progress in command and communication systems interconnected with new sensors calls for more and better communications links. There is a need to support higher data rates. This is a problem in terms of available frequencies and possible area of coverage. Higher frequencies are used to permit higher bandwidths to be used. Military systems will use both spread spectrum techniques to achieve robustness to jamming, and a low-density transmitted spectrum to make it difficult to detect.

Higher frequencies in particular, along with the need for higher bit-rates, will limit the maximum range between the communicating parties. Multipath propagation, and the desire to use higher bit-rates, represent engineering challenges.

Military effectiveness requires the ability to acquire and assimilate intelligence in real time and to communicate this effectively on a wide front in the command chain. This is also a very important requirement of operations as demonstrated by the recent conflicts. With increasing NATO responsibilities in joint military operations involving many different national Communications and Information System environments, the need for a unified approach to support information / data transfer services becomes more crucial.

This symposium covers this large but very important operational area from all aspects; system characteristics, internetworking, spectral efficiency, propagation, security, and other relevant factors.

### **The symposium**

The event attracted 150 participants. 19 Partners for Peace nations were represented. The technical program was focused on Personal communications & COTS, Protocols and Networks, Propagation, Speech & Signal processing, and H.F. and comprised oral presentations as well as a poster session. The topics of the poster sessions could quite easily have been included in the following sessions and are therefore not addressed separately.

### ***Personal Communication Systems & COTS***

There are several papers, which cover the possible military applications of existing and emerging PCS technologies. The area is very interesting and there is a clear trend in military industry, as well as in civil, for using COTS products in system design.

### ***Protocols and Networks***

Protocols and networks are gaining more interest within the communications community. The impact of the Internet, together with continuously increasing needs for high-speed data communication, has made networking one of the key areas in communication technology.

### ***Propagation***

Wave propagation is an important subject of never-ending interest. The usage of higher frequencies and the demands for higher data rates call for continuing research on, and measurements of, wave propagation.

### ***Speech & Signal processing***

Speech & signal processing is a topical subject, not least regarding the ongoing selection work in NATO on new speech coding algorithms. This was also the focus for the majority of papers in the session, although results on image coding also were presented. In total, three papers were presented. The papers summarise the algorithms of interest and indicated the increased performance available offered by new, improved algorithms.

### ***HF***

The H.F. spectrum is of high importance for military applications. In this session, principles and applications for data communication at HF frequencies were presented in four papers. The papers are mainly of tutorial character, and do not focus on scientific research results.

# **Communications tactiques mobiles**

**(RTO MP-26)**

## **Synthèse**

Le concept de la technologie des communications omniprésentes et de la convergence, qui est universellement accepté, aura une influence appréciable sur les communications tactiques militaires et se répercutera sur les programmes d'approvisionnement militaires dans le monde entier.

Lors des opérations récentes de la guerre du Golfe et en Bosnie, le besoin s'est fait sentir de soutenir les unités militaires en leur fournissant plus de renseignements que jamais, tant avant que pendant les opérations militaires internationales. Les risques au niveau de la sécurité liés à l'utilisation des services de télécommunications ont dû être en permanence contrebalancés par le recours aux services militaires moins rapides mais plus fiables. A l'avenir, ces différences diminueront. A l'époque de la guerre froide, les produits militaires étaient développés en priorité. Il s'agissait de produits technologiquement avancés et chers. Aujourd'hui la situation est différente, car les produits militaires doivent se conformer aux normes civiles à cause des contraintes budgétaires actuelles. Les systèmes mobiles civils auront ainsi un effet sur l'évolution des systèmes de communications militaires tactiques.

Le développement des systèmes de commandement et communications interconnectés à de nouveaux capteurs nécessite d'envisager des liaisons de communications meilleures et plus nombreuses. Il va aussi falloir supporter des débits de plus en plus grands, ce qui pose un problème de disponibilité de fréquences et de couverture possible. Des fréquences plus élevées sont utilisées pour disposer de bandes passantes plus larges. Les systèmes militaires tireront avantage à la fois des techniques d'étalement du spectre pour assurer la protection contre le brouillage, et d'un spectre émis de faible densité pour rendre leur détection plus difficile. En particulier, des fréquences plus élevées, associées à la demande de débits plus grands, auront pour effet de limiter la portée maximale entre deux interlocuteurs. Aussi, la propagation multitrajets et le souhait d'utiliser des débits plus grands, représentent des défis techniques importants.

L'efficacité militaire dépend de la capacité d'acquérir et d'assimiler le renseignement en temps réel et de le communiquer avec efficacité à une grande partie de la chaîne de commandement. Cette capacité est aussi l'une des principales conditions requises pour les opérations, comme en témoignent les conflits récents. Avec l'implication croissante de l'OTAN dans des opérations interarmées mettant en jeu de nombreux environnements nationaux de communications et d'information différents, le besoin d'une approche unifiée pour appuyer les services de transfert de données et de renseignements se fait de plus en plus sentir.

Ce symposium a couvert tous les aspects de ce large et très important domaine opérationnel, en prenant en compte les caractéristiques opérationnelles, l'efficacité spectrale, la propagation, la sécurité, ainsi que d'autres facteurs pertinents.

### **Le Symposium**

Cent cinquante personnes ont participé à cette manifestation. Dix-neuf pays partenaires ont été représentés. Le programme technique a porté sur les communications personnelles et les produits sur étagère (COTS), les protocoles et les réseaux, la propagation, le traitement du signal et de la parole et la HF. Ces sujets ont été traités par le biais de présentations orales et d'une exposition d'affiches. Les sujets de cette exposition auraient très bien pu être présentés lors des sessions présentées ci-après. Par conséquent, nous n'en donnons pas ici une description distincte.

### ***Les systèmes de communications personnelles et les produits COTS***

Les applications militaires possibles des technologies des systèmes de communications personnelles existantes et émergentes ont fait l'objet de plusieurs présentations. Ce domaine est d'un grand intérêt, car une tendance nette se dessine tant dans l'industrie militaire que civile, en faveur des produits COTS pour la conception des protocoles, des réseaux et des systèmes.

Les protocoles et les réseaux sollicitent de plus en plus d'intérêt de la part des spécialistes en communications. L'impact de l'Internet, associé à la demande de plus en plus pressante de systèmes de transmission de données à grande vitesse, a fait du travail en réseau l'un des domaines clés des technologies de communication.

### ***Propagation***

La propagation des ondes est un sujet important d'intérêt permanent. L'utilisation de fréquences plus élevées et la demande de débits plus grands nécessitent d'engager des travaux de recherche continus et des mesures sur la propagation des ondes.

### ***Le traitement du signal et de la parole***

Le traitement du signal et de la parole est un sujet d'actualité, en particulier en ce qui concerne les travaux en cours à l'OTAN sur le choix de nouveaux algorithmes de codage de la parole. La majorité des communications présentées lors de cette session ont traité de ce sujet, même si des résultats de travaux sur le codage de l'image ont également été présentés. En tout, trois communications ont été présentées. Elles ont résumé les algorithmes intéressants et ont souligné l'amélioration des performances autorisée par de nouveaux algorithmes améliorés.

### ***HF***

Le spectre HF est d'une très grande importance pour les opérations militaires. Les principes et les applications de la transmission de données à des fréquences HF ont été présentés dans quatre communications. Il s'agissait de présentations de nature plutôt pédagogique, n'ayant pas pour objet d'exposer des résultats de travaux de recherche scientifiques.

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† This paper has not been included because of its classification. Copies may be available to certain members of the NATO nations on request to RTA/IST.

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# Theme

Mobile communications are an important military requirement. Recent operations in the Gulf War and in Bosnia have made this requirement even more obvious. Such communications are naturally also a very important part of civil sector needs from the viewpoint of value added “wireless access solutions” to connect itinerant users to the proliferating fixed, primarily fiber-optic/photonic, networks. As a result many COTS products are available and under development, exemplified particularly by such systems as GSM, LEO/MEO satellite systems, TETRA, TDAB, wireless LANs, LAN bridges, low power SS microwave links, etc. The emerging PSC, UMTS concepts and systems will embody integrated mobile communications in the coming decade.

At the same time there is a need to support higher data rates. This is a problem in terms of available frequencies, transmitted power needed especially in non line of sight conditions in non-flat and vegetated terrain. Higher frequencies are used to permit higher bandwidths to be used. Military systems will use some spread spectrum technique to achieve robustness to jamming and a low density transmitted spectrum to make it difficult to detect. Higher frequencies, in particular along with the need for higher bit rates, will limit the maximum range between the communicating parties. Multipath propagation and the desire to use higher bit rates, represent engineering challenges.

This Symposium will cover the following topics:

- use of present PCS systems for military crisis management operations,
- characteristics and use of emerging PCS, UMTS systems,
- wireless radio, wide area communication,
- mobile networks for land, air and maritime applications,
- wireless LANs,
- terrestrial and satellite network services,
- adaptive modem, antenna techniques.

with emphasis on:

- system characteristics,
- system management,
- internetworking and interoperability,
- spectral efficiency, efficient modulation schemes, propagation & antenna issues,
- security.

# Thème

Les télécommunications mobiles sont un besoin militaire important. Les récentes opérations de la guerre du Golfe et en Bosnie n'ont fait que souligner l'utilité de ces moyens. Naturellement, de telles télécommunications répondent en grande partie aux besoins du secteur civil en matière de « solutions d'accès sans fil », représentent une valeur ajoutée pour les connexions et pour les très nombreux réseaux fixes photoniques où à fibres optiques des abonnés itinérants. En conséquence, plusieurs produits sur étagères (COTS) sont disponibles ou en cours de développement, comme par exemple, le système global pour téléphones mobiles (GSM), les systèmes utilisant les satellites à orbite basse terrestre et à orbite terrestre moyenne (LEO/MEO), le système radio terrestre à commutation automatique de canaux (TETRA), la radiodiffusion numérique terrestre (TDAB) les réseaux locaux (LAN) sans fil, les passerelles LAN, les liaisons hyperfréquences à étalement de spectre (SS) de faible puissance etc. Les concepts et systèmes de communications personnelles par satellite (PSC), et systèmes universels de télécommunications mobiles (UMT) naissants seront dotés de télécommunications mobiles intégrées au cours de la prochaine décennie.

En même temps, apparaît un besoin de débits de plus en plus grands. Il existe un problème en ce qui concerne le nombre de fréquences disponibles et la puissance émise demandée, en particulier dans des conditions autres que celles de visibilité directe en terrain accidenté et/ou recouvert de végétation. Des fréquences plus élevées permettent d'utiliser des bandes supérieures. Les systèmes militaires tireront avantage de certaines techniques d'étalement du spectre pour assurer la protection contre le brouillage, avec un spectre émis de faible densité pour rendre ces communications plus difficiles à détecter. Les fréquences plus élevées, associées à la demande de débits plus grands, auront pour effet de limiter la distance maximale entre deux interlocuteurs. La propagation multitrajets et la décision d'utiliser des débits plus grands, représentent des défis techniques à relever.

Ce symposium traitera des sujets suivants :

- utilisation des systèmes PSC actuels adaptés à la gestion d'opérations militaires en temps de crise,
- caractéristiques et utilisation des systèmes PSC, UMTS naissants,
- radio sans fil, télécommunications en réseau étendu,
- réseaux mobiles pour applications terre, air et mer,
- services de réseaux terrestres et par satellite,
- modems adaptatifs, techniques d'antenne.

l'accent étant mis sur :

- les caractéristiques des systèmes,
- la gestion des systèmes,
- l'interconnexion des réseaux et leur interopérabilité,
- le rendement spectral, les schémas de modulation performants, la propagation et les types d'antennes,
- la sécurité.

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## REPORT DOCUMENTATION PAGE

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                   |                                                   |                                                                             |                         |                         |                  |                  |                      |                    |                        |                   |                                |                  |                                      |                           |                                 |                          |           |  |
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| <b>6. Title</b><br>Tactical Mobile Communications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                   |                                                   |                                                                             |                         |                         |                  |                  |                      |                    |                        |                   |                                |                  |                                      |                           |                                 |                          |           |  |
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| <b>13. Keywords/Descriptors</b> <table border="0"><tr><td>Tactical communications</td><td>Communications networks</td></tr><tr><td>Mobile equipment</td><td>Wave propagation</td></tr><tr><td>Secure communication</td><td>Speech recognition</td></tr><tr><td>Military communication</td><td>Signal processing</td></tr><tr><td>Command control communications</td><td>High frequencies</td></tr><tr><td>PCS (Personal Communication Systems)</td><td>LAN (Local Area Networks)</td></tr><tr><td>COTS (Commercial Off The Shelf)</td><td>WAN (Wide Area Networks)</td></tr><tr><td>Protocols</td><td></td></tr></table> |                                                                   |                                                   |                                                                             | Tactical communications | Communications networks | Mobile equipment | Wave propagation | Secure communication | Speech recognition | Military communication | Signal processing | Command control communications | High frequencies | PCS (Personal Communication Systems) | LAN (Local Area Networks) | COTS (Commercial Off The Shelf) | WAN (Wide Area Networks) | Protocols |  |
| Tactical communications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Communications networks                                           |                                                   |                                                                             |                         |                         |                  |                  |                      |                    |                        |                   |                                |                  |                                      |                           |                                 |                          |           |  |
| Mobile equipment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Wave propagation                                                  |                                                   |                                                                             |                         |                         |                  |                  |                      |                    |                        |                   |                                |                  |                                      |                           |                                 |                          |           |  |
| Secure communication                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Speech recognition                                                |                                                   |                                                                             |                         |                         |                  |                  |                      |                    |                        |                   |                                |                  |                                      |                           |                                 |                          |           |  |
| Military communication                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Signal processing                                                 |                                                   |                                                                             |                         |                         |                  |                  |                      |                    |                        |                   |                                |                  |                                      |                           |                                 |                          |           |  |
| Command control communications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | High frequencies                                                  |                                                   |                                                                             |                         |                         |                  |                  |                      |                    |                        |                   |                                |                  |                                      |                           |                                 |                          |           |  |
| PCS (Personal Communication Systems)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | LAN (Local Area Networks)                                         |                                                   |                                                                             |                         |                         |                  |                  |                      |                    |                        |                   |                                |                  |                                      |                           |                                 |                          |           |  |
| COTS (Commercial Off The Shelf)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | WAN (Wide Area Networks)                                          |                                                   |                                                                             |                         |                         |                  |                  |                      |                    |                        |                   |                                |                  |                                      |                           |                                 |                          |           |  |
| Protocols                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                   |                                                   |                                                                             |                         |                         |                  |                  |                      |                    |                        |                   |                                |                  |                                      |                           |                                 |                          |           |  |
| <b>14. Abstract</b> <p>This volume contains the Technical Evaluation Report and 35 unclassified papers, presented at the Information Systems Technology Panel Symposium held in Lillehammer, Norway from 14th to 16th June 1999.</p> <p>The papers were presented under the following headings:</p> <ul style="list-style-type: none"><li>- Personal Communications and COTS</li><li>- Protocols and Networks</li><li>- Propagation</li><li>- Speech and Signal Processing</li><li>- High Frequency</li></ul>                                                                                                            |                                                                   |                                                   |                                                                             |                         |                         |                  |                  |                      |                    |                        |                   |                                |                  |                                      |                           |                                 |                          |           |  |





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