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ESF/PESC Exporatory Workshop: Is Mobile Ad Hoc Networking Part of the Future of Mobile Networking in Europe?

By Marco Conti, Italy and Silvia Giordano, Switzerland

The first ESF/PESC Exporatory Workshop on Mobile Ad hoc Networking, co-sponsored by the IIT Institute of the Italian National Research Council (CNR), was held in Monterosso al Mare (Italy) on 10–12 October 2002 (http://www.iit.cnr.it/esf2002). The aim of the workshop was to investigate the technical issues, potentialities and market perspective of the mobile ad hoc network (MANET) paradigm.

A MANET is a system of wireless mobile nodes dynamically self-organizing in arbitrary and temporary network topologies. People and vehicles can thus be internetworked in areas without a preexisting communication infrastructure, or when the use of such infrastructure requires wireless extensions. Therefore, such networks are designed to operate in widely varying environments, from military networks (with hundreds of nodes) to low-power sensor networks and other embedded systems.

The workshop debated challenging aspects of mobile ad hoc networking from different points of view (the researchers community of this workshop is very heterogeneous) in order to evaluate the future impact of this technology in European research and real life.

In a MANET, no infrastructure is required to enable information exchange between users' mobile devices. These devices, which we call terminals, are an evolution of current mobile phones and emerging PDAs equipped with wireless interfaces. Terminals are goods that people can purchase at (relatively) low cost and operate without per-use service fees. The only external resource needed for operation is the bandwidth in the (unlicensed) industrial, scientific, and medical (ISM) band. This is the band in which wireless access technologies such as IEEE 802.11 and Bluetooth operate. Nearby terminals can communicate directly; specialized media access control (MAC) protocols are necessary to coordinate their transmissions in order to avoid radio interference. Terminals that are not directly connected communicate by forwarding their traffic via a sequence of intermediate terminals. As the network topology changes due to user mobility, traffic must be rerouted to compensate. Because the users' terminals provide this cooperative multihop forwarding functionality, no specialized devices (e.g., Internet routers or cellular towers) are required. In addition to connectivity, the terminals of a MANET must also cooperatively provide the host of services (naming, security, service discovery, data replication) needed to support applications used in the MANET network.

MANETs are not intended to replace current infrastructure-based (wired and wireless) networks, but to complement them and enable new application scenarios in which a centralized infrastructure is impossible, undesirable, or unnecessary. Also, intercommunication between a MANET and the Internet is envisaged. This can be provided by terminals with simultaneous access to the MANET and the Internet, perhaps via special access points or user terminals with multiple network interfaces (e.g., a PDA equipped with both Bluetooth and GRPS interfaces). The challenges of building a self-organized MANET are substantial: How can we achieve self-organization in a highly dynamic and completely decentralized network environment? Therefore, the workshop addressed such issues as wireless ad hoc technology, network and transport layer protocols, supporting social-operated networking, and cooperative middleware services.

A MANET supports a kind of "citizens' network" that can reduce communication costs and complexity and improve people's ability to share information anywhere and anytime. MANET will enable the self-organization of people that share common interests (e.g., students at a school) into virtual ad hoc networks in which they can freely communicate. MANETs can play a key role in advancing this user-centric approach to the information society, enhancing open communication and the free flow of information within society.

The MANET approach also has industrial relevance. It complements existing wireless communications services with efficient low-cost local multimedia services. It offers a solution to the problem of "wireless operator as kingmaker" by introducing a new technical, economic, and social model of a self-organized network. For emerging wireless commerce, some analysts say "wireless operators are best placed to assume the role of kingmaker because they control the wireless networks and own the subscriber relationships." In an infrastructureless approach this position is challenged, and the economic and social model changes. Moreover, the deployment of new developments does not require involvement of major infrastructure players, significantly reducing the cost barriers to creating services on a temporary or experimental basis. The new paradigm of low-cost self-organized local network communication can effectively complement the services available in wireless infrastructure.

Finally, the MANET paradigm has humanitarian relevance, considering Europe's increasing role in providing aid during conflicts and natural disasters. A MANET can support local emergency communications without relying on expensive and vulnerable infrastructure.

The MANET approach therefore constitutes a challenging research area that may lead to the creation of a secondary wireless market. Through research and industrial efforts, Europe has established world-renowned leadership in infras-

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Cell Phone Jamming Controversy in Europe

By Juan Antonio Mayayo, Francisco J. González-Castaño, and Javier Vales-Alonso, Spain

Cell Phone Jammers

Cell phone jammers are interference generators that block radioelectric activity in their band, whose typical goal is eliminating call alarms.

These devices are intended to block cell phones in their influence area. Their primary goals are reasonable: to block cell phones in areas where they are forbidden by law, such as jails, and in other places where they are a nuisance, such as churches, theatres, concert or conference halls, and the like. Certainly, the best solution would be to request attendants to switch their terminals off and trust them to do so. Actually, it is the area responsible who usually takes a pre-emptive action and installs a cell phone jammer. Unfortunately, radio frequency is difficult to control, and the influence of the devices is typically not restricted to the protected area, and also interferes with the surroundings.

What Has Happened So Far?

The first devices appeared in the European market clandestinely, and were not subject to any control or validation. Some users protested, and European Directive 99/05/CE banned cell phone jammers, which meant that legal sales were no longer possible. Once the situation arrived at this point, it happened that a regional European regulation institution issued a certification for a jamming unit. When this fact was known in Brussels, the national telecommunications administration in the European country affected invalidated the certification, and the European Commission issued a public declaration against cell phone jammers. Controversy started when diverse member countries did not support the declaration.

In the particular case of Spain, at SICUR 2002 cell phone jammers were openly publicized and offered. Of course, they were tested during the event, and at least one mobile telephony operator protested.

Later, in March 2002, a priest from a small town in Alicante was interviewed on a top-audience TV program, where he described the advantages of using cell phone jammers during ceremonies. Inevitably, an increasing number of customers began to request them, and finally, in May 2002, mobile telephony operators claimed their rights on exclusive cell phone band usage, for which they pay the corresponding fees.

Controversy Perspectives

The most relevant perspectives are that of vendors, the position of mobile telephony operators, and above them, the decisions of the telecommunications administration.

On one side, vendors argue that there exists a harmless justified demand from private spaces, and that regulations are not clear enough. In fact, there is an absence of national regulations, which means that although the devices are not legal, they are not illegal!

Mobile telephony operators wish to protect their investments in public frequencies. However, they also have social arguments to support their view: cell phone jammers disable terminals completely, and emergency calls are blocked. As a result, they say, the devices also affect individual rights. They also state that, against their will, they cannot provide essential services they must offer, including coverage guarantees specified in user contracts.

And, regarding the Spanish Telecommunications Administration, in principle it must apply European regulations, which state that cell phone jammers cannot be sold, installed, or used in European territories. However, there exists a gap between those regulations and national laws in European countries nowadays, and it should be understood that it is the states who have to enforce regulations. This opens the possibility of different local scenarios, an undesirable situation in Europe, where convergence should be a must at all levels nowadays.

There is a fourth actor, the user community, where all positions are present. One would expect most people to like cell phone jammers, but this is an oversimplification: doctors, policemen, or businessmen do need their terminals to be active. In fact, many customers use silent alarms regularly, and if those are not available, they respect indications to turn their terminals off. For those users, freedom is more important than enforcement. Note that cell phone jammers imply that a considerable number of citizens cannot attend social events. Finally, we cannot forget that, as previously said, jamming also affects people outside the target area but close enough. This is a potential source of complaints for which there is no counterpart.

Possible Solutions

Spain, as a European Union state, must apply the decisions of the European Commission. The TCAM Committee has unanimously determined that cell jammers should be banned (99/05/CE directive). According to it, local authorities must retire all devices present in the market and notify the European Commission of this fact. Both vendors and final users would be responsible for misuse. The Commission document (approved in the TCAM 11 Committee, 4–5 September 2002 meeting) can be consulted at the CIRCA database (http://europa.eu.int/comm/enterprise/rtte/jammers.htm).

Meanwhile, local authorities have not taken any measures yet. Cell phone jammers exist, are sold by intermediaries or via Internet orders (not in shops), installations have become common, and the devices work regularly in Spanish concert halls, jails, museums, meeting rooms in private companies, temples, and even government premises. To cite some examples, the Parliaments of Galicia and Murcia and Silos Abbey (which houses the well-known Gregorian choir) block terminal phones systematically. Clearly, Spanish authorities are not prosecuting misuse once the devices arrive at the final user. They simply ban massive sales and legal manufacturing (which is dangerous, because intermediaries tend to import devices without any technical guarantee from foreign manufacturers).

Consequently, the Ley General de Telecomunicaciones, which was being written at the time this was written, includes the possibility of limiting the exclusive rights of mobile communications companies in order to protect the rights of third parties under specific terms. In doing so, cell phone jammers will have to satisfy technical requisites, be manufactured with safeguards, and be allowed in appropriate circumstances.

On 11 November 2002, the French delegation at one of the meetings on this subject announced that their telecommunications administration had prepared a regulation draft that will allow the use of cell jammers in theatres, temples, and other places. They explained that before permitting installation, it will be verified that the influence of the systems is null outside the place protected, health-related radiation limits are fulfilled, and the systems allow specific calls such as emergencies, police, and fire department. Both the administration and mobile telephony operators will be involved in the verification of these conditions, and their permission will be required for installation. Misuse will be considered a major offense.

The French authorities consider that these conditions guarantee the rights of mobile operators, since they must grant cell phone installation. In this scenario, cell phone jammers would become similar to base stations, although, in this case, they would filter communications instead of establishing them.

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Cell-Phone Jamming Controversy in Europe/(continued)

The French authorities consider that those selective devices would fulfill Directive 99/05/CE under adequate license terms subject to the conditions of each member state.

When the French explained this position, the remaining delegations had different opinions. Austria agreed with the license approach, and indicated that they are also considering that strategy. The United Kingdom said that the approach was legally impossible because it violated other directives associated with electronic equipment. The Belgians simply said that they did not understood the purpose of the original text, since it was not going to be respected, and Germany solicited a recommendation to be issued to request operators to control cell phone jammers directly so that they would be entirely responsible for all equipment in their frequencies. Finally, the Spanish delegation raised the fact that in the current situation, cell phone jammers are everywhere, and eliminating them would only be possible at a prohibitive cost. In their opinion, compensation for mobile telephony operators or operator-controlled cell phone management seem good solutions, but do not imply that correct usage is guaranteed. This is simply a responsibility shift from the administration to the operators, which will not necessarily be willing to assume it. Spain also supports an eventual consensus, departing from Directive 99/05/CE, instead of letting each member state develop local solutions.

The TCAM committee recently held a meeting (11–12 December 2002) in which the jammer question was again debated. Switzerland has detected a model in its market that claimed legality, which was false. France has finally prepared a regulatory draft that will admit jamming in public places if (i) it is guaranteed that jamming is restricted to a given limited space, and (ii) specific incoming and outgoing calls, health radiation limits, and EMF limits are respected. In any case, those jammers will require two official licenses to operate (telecommunications authorities and ART). The position of the remaining countries did not change significantly. However, diverse members pointed that the system proposed by the French would be difficult to manufacture for the mass market at low cost.

Technical Issues

From a technical point of view, the French proposal can be implemented with centralized network-operated solutions or with independent devices installed in the target areas. Next, we discuss the advantages and drawbacks of these solutions.

A first approach to this problem, using operator-dependent infrastructures, suggests the creation of special cells inside protected places. These cells would have a *cell mask* that would be used together with a *user mask* (stored in home location registers, HLRs, for all users). Only if both masks overlapped would the user be allowed to access the network from the special cell. The main drawback of this approach is cost, since it requires a base station per target area as well as protocol modifications.

A second possible solution would be the use of a local selective interceptor, like the one proposed in [1]. A selective interceptor sniffs protocol exchanges between mobile terminals and base stations. When a communication start message belonging to an invalid identity is detected, the selective interceptor blocks the corresponding responses from the base station. This solution has a low radiation level, because it only affects downlink transmissions. The selective interceptor needs a local database of valid identities, but it does not impose changes on existing network infrastructures. Since the French proposal will force the participation of the operators if it finally succeeds, the local database is not unrealistic. In fact, it may be perfectly possible to reserve a range of temporal identities for doctors, firefighters, and the like, which would be stored a priori in interceptor local memories. As a result, no further communication would be required to update those databases.

In any case, verification of null influence outside target areas will be challenging, and will probably require ad hoc regulations.

Reference

[1] F.J. González Castaño *et al.*, "Real-Time Interception Systems for the GSM Protocol." IEEE Trans. Vehic. Tech., vol. 51, 2002, pp. 904–14.

Competition and Investments in Mexico

By Carlos Hirsch, Mexico

Sometimes it is a good idea to compare past and recent events, and to understand where we are compared to our initial goals. In 1990, Mexico started a thought out project to have a modern and competitive telecommunications sector. In order to achieve this goal, Mexico used a combination of standard and creative decisions. The first move was the Telmex privatization, which had a long distance monopoly for six years, investment obligations, and a regulation based on price cap minus productivity factor.

In 1995, an advanced Telecommunications Law was promulgated, establishing an independent regulatory body (COFETEL), clear rules to declare and control any dominant carrier, some foreign investment limitations, and a completely transparent auction procedure to assign spectrum.

The real competition began in 1997 with domestic and international long distance services. This deregulation effort attracted US$3 billion in investments, primarily in fiber optic networks between the larger cities, from several first class international competitors. In 1998, in a transparent auction process, four new PCS licenses were granted: one to the cellular incumbent America Movil, two to Mexican companies (Unefon and Pegaso), and the remaining still pending judiciary definition. At the same time, four national wireless local loops (WLLs) (3.4 GHz band) were assigned: one to the fixed incumbent Telmex, two to Mexican companies (Unefon and Axtel), and the other pending judiciary definition. The PCS and WLL new entrants invested another US$1 billion in their networks.

At this moment, Mexico has 15 million fixed lines and 25 million mobile subscribers. A Calling Party Pays system covers only local calls, affecting the possibility of extending the mobile service to the rural areas, which are also the poorest.

Even with this initial phase and after six years of sustained effort, some important holes in the regulation became highlighted. Two major issues are endangering the whole process. The first is a weak definition of COFETEL activities and enforcement attributions. Conflicts between the regulator and the Communications Ministry (or between the technical and political agendas) are common in many countries, because in reality, there is no such thing as a pure and politically independent regulator. The second issue is that the dominant car-

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tructure-based mobile communications. Long-term research in infrastructureless mobile communications has the potential for technological innovation that will allow Europe to continue being an actor in future-generation mobile systems. Currently, the United States drives research in this area, mainly in the context of defense-related projects.

The aim of the workshop was threefold:

- To analyze the state of the art in European research in this field
- To construct a European community that can balance the current U.S. leadership in this area
- To analyze the role of the MANET paradigm in future mobile ad hoc networking in Europe

The workshop was organized in three main parts:

- A discussion on the main MANET technical issues and how they are currently addressed by European researchers in this field. The workshop covered issues such as the enabling technologies (wireless networks, multiple access protocols, etc.), the network-layer issues (addressing, location, routing, etc.), as well as the higher layers.
- A presentation of the main projects (at national and European levels) that are addressing the problems of self-organizing networks.
- A final discussion that provided an answer (still partial) to the workshop's main question: "Is Mobile Ad Hoc Networking Part of the Future of Mobile Networking in Europe?" As a further action, with the aim of continuing the discussion and collaboration, the creation of a European community that can balance the current U.S. leadership was considered.

The ambitious goal for the development of Europe will be based, among other technologies, on knowledge and deployment of ad hoc networking. This development requires that researchers in the field of information technology develop a shared vision of goals and join forces in working toward them. Cooperation among all European researchers and projects in the field holds great potential in this respect: bringing together advanced research results provides a forum for discussion of ad hoc networking issues as they affect Europe, leading to strategy and policy inputs.

From this first sharing opportunity, several issues have already emerged:

1. Current ad hoc networks have just a few hops.
2. The current 802.11 cannot support ad hoc networking as it is. 802.11 was developed mainly for supporting infrastructure-based WLANs. Evolution of the 802.11 technology for efficient support of the ad hoc mode is expected.
3. Security and cooperation are musts for economic and social development of ad hoc networking.
4. Research must not concentrate on killer applications for ad hoc networking, but stress the fact that applications can be killer because of ad hoc technologies.
5. Ad hoc networking is a rare example of technology in the hands of users.

More information about the workshop's participants and presentations can be found at the Web page of the workshop.

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COMPETITION IN MEXICO/*(continued from page 3)*

rier took intelligent advantage of this weakness, avoiding, until now, being declared dominant. At this moment, there are no asymmetric rules (other than the initial Telmex concession title), and several services (e.g., 900 services or collect calls) remain in a monopoly without any prospects for change.

With this scenario, the worldwide telecom crisis, and a new political environment in Mexico, it was a general agreement to ask the Congress for a new Telecom Law to fix the holes to give the necessary push for another period of telecommunications growth. The Congress created a multiparty commission to find consensus between the government and the telecom sector. After two years of intense work, it is clear that it will be very difficult to achieve such consensus. Issues like foreign investment, effective dominant carrier regulation, and transparency in spectrum assignment rules affect some actors in the industry, and in the end there are huge benefits in this confusion — but not for the country.

Unfortunately, it is very unlikely that the new law will be approved any time soon, and the many Mexicans waiting for an opportunity to have access to a telephone will be disappointed.

It is obvious that most countries have similar problems with local flavors and particularities. For several reasons, competition is being weakened, and a dangerous concentration process is starting to grow. That seems normal during a crisis. Some people will call it overinvestment, while others will call it overcompetition. However, the only way to succeed is to have a smart regulator, fair laws and rules, and the ability to continue to attract investments in our countries. This could be the last call to avoid mistakes such as special taxes levied on mobile services, which are impacting most carriers in Latin American countries.

The conclusion could be expressed as: "Give telecommunications a chance to develop in a competitive environment."