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Highlights: IEEE ITS Society Technical Committee on "Mobile Communications Networks for ITS"

Chai Keong Toh[1],
[1]National Tsing Hua University
TAIWAN

Teuro Higashino[2],
[2]Osaka University,
JAPAN

Juan-Carlos Cano[3],
[3]Universitat Politècnica de València
SPAIN

Michele C. Weigle[4]
[4]Old Dominion University
USA

Emails: ck_away@hotmail.com higashino@ist.osaka-u.ac.jp   jucano@disca.upv.es, mweigle@cs.odu.edu

Abstract. *The TC on "Mobile Communication Networks for ITS" was first proposed by C.K. Toh to IEEE ITS Society in 2005. It was subsequently accepted and approved by IEEE ITS Board of Governors. The TC provides a forum to broadly address the importance and relevance of mobile communications and wireless networking technologies on intelligent transportation systems. Recently, the committee has witnessed the potential of using wireless communications and networking technologies for transportation systems safety. In the future, each automotive vehicle will be a unique node on the global communications network, which will support interactions within the automobile, with the surrounding environment and among automobiles, over smart wireless links, and directly with nearby vehicles. Under this panorama, many potential applications could be supported including safety, health and status of the automobile, user services, traffic congestion relief, passenger entertainment, and better efficient use of the transportation and telecommunications infrastructure. Overall, the mission of this TC is to promote awareness, participation, activities, research, and engineering in the areas of wireless communications, mobile networking, and vehicular-based computing for ITS.*

I. Missions, History and Organization of the Technical Committee

We have now witnessed the transformation on our road transportation systems. No longer is the emphasis solely on building expressways to interconnect cities or states. "Intelligence" has been added to our transportation grid to empower the driver, assisting him to navigate and drive safely to his destination. Such intelligence is made possible through the utilizations of advance electronics, wireless, and communication technologies. Realizing the importance of this transition, the TC on "Mobile Communication Networks for ITS" was established in 2005. Currently, the TC has the following members: Prof. CK Toh (chair), Prof. Tero Higashino (co-chair), Prof. Juan-Cano Carlos (co-chair) and Prof. Michele Weigle (co-chair). The TC is well represented, covering Asia, Europe, and North America. Over the years, the TC has supported a variety of technical activities related to ITS conferences, workshops, transactions, magazines, keynotes, panels, etc. These will be elaborate later. The TC also has a website [1] established and a mailing list for members to join. The TC operates entirely based on volunteers and does not have an operating budget. It currently has **XXX** members.

II. TC Technical Coverage

The ITS field is vast and multidisciplinary in nature. Our TC focuses on the wireless, mobility, communications, networks, systems, architectures and standardization aspects. Specifically, our TC covers wireless – such as IEEE802.11p, ITS architectures, communication protocols – such as CALM, routing, information dissemination, etc. Technologies related to road safety, road congestion and regulation, hazard warning, emergency rescue, telematics, VANETs (Vehicular Ad Hoc Networks), and communications security. At the user level, ITS computing topics include O-T-R (On-The-Road) services, content downloading and sharing systems. Issues related to connected electric vehicles are also considered. The TC also tracks topics on ITS Network Simulation involving detailed modeling of city and road topologies and on future ITS mobile applications [2].

III. TC Technical View on ITS

The symbiosis between communication technologies and transport infrastructure helps to jointly form the concept of Intelligent Transport Systems (ITS). By sharing vital information, ITS allows people to get more from transport networks, in greater safety and with less impact on the environment.

ITS will play a leading role in our society, where each automotive vehicle will be a unique node on a global and ubiquitous vehicular communications network in the future. These intelligent communication systems will support scenarios where the interactions within the vehicle, with the surrounding environment and directly with nearby vehicles, will offer real-time communication among thousands of cars daily crossing our cities and highways, and opening new opportunities to many challenging applications dealing with security, management and entertainment on the road.

Nowadays, many initiatives [3] [4] [5] look not only for the implementation of smarter, more efficient and sustainable transportation systems, for example controlling CO2 emissions, but also on the development of safer systems to prevent accidents and mitigate their effects.

The development and standardization of cost-effective wireless communication systems to improve traffic safety has been a priority not only for government transportation

agencies and vehicle manufacturers, but also for the scientific community in general. In fact, in the developed economies, traffic accidents cause millions of people killed or severely injured each year on the roads [6]. The design of intelligent transportation systems should be aimed not only at reducing the number of traffic accidents, and therefore the number of victims [7], but also at providing and deploying enhanced rescue coordination mechanisms so that, once the accident occurs, its consequences can be reduced [8]. A second area of great public concern focuses on intelligent transport systems to significantly alleviate the growing traffic congestions affecting urban areas [2]. Congestion causes heavy pollution and it results in significant wastage of energy and people's time. Such systems should be combined with efficient communication systems to provide up-to-date information to drivers about alternative routes, traffic information, problems on the roads, and entertainment information which would alleviate the stress while driving, as well as reducing both fuel and time consumption. Finally, a third major challenge faced by the transportation industry is how to make transportation sustainable by significantly reducing the energy consumed and the pollution generated by vehicles, while promoting real monitoring on the road. This refers to low carbon emissions and the strive for a greener environment. This panorama motivates the need to strengthen efforts to move forward into the development of new architectures which will enable safer, smarter, and sustainable transportation systems. Figure 1 shows the overall ITS vision of The European Telecommunications Standards Institute (ETSI) which include a variety of communications scenarios for different vehicular systems (cars, train, trucks, etc).
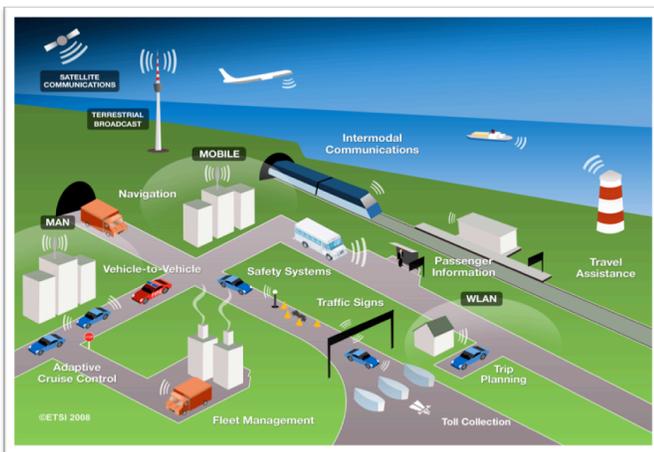
Figure 1. ITS vision of the European Telecommunications Standards Institute (ETSI) [source: ETSI].

From the point of view of Communication Technologies for vehicular networks, most ITS applications, such as road safety, fleet management, and navigation, will rely on the close collaboration of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication technologies. In recent years, extensive research has taken place to develop vehicle-to-vehicle (V2V) communication technologies, known as VANETs or Vehicular Ad hoc Networks [9]. These technologies, based on short-range communication radios such

as the Dedicated Short-Range Communications (DSRC) system, act as the support for active safety applications between vehicles. In fact, the IEEE 802.11p working group has recently released the wireless 802.11p standard, providing a candidate solution for V2V traffic safety application. It takes into account signal fading, mobility, and interference while communicating on the road. Rigorous research from the academia and industry has also been carried out to develop vehicle-to-infrastructure (V2I) technologies to support safety, mobility, management, and sustainability applications. Figure 2 shows the basic system architecture of the ITS communication scenarios based on V2V and V2I.
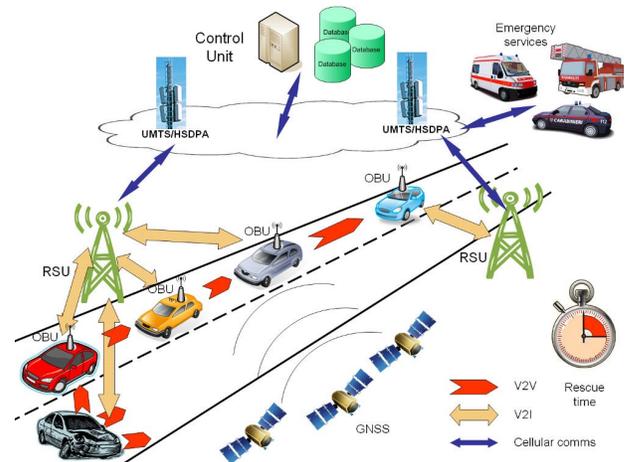

Figure 2. ITS Communication technologies based on the combination of V2V and V2I communications.

IV. TC WEB PAGE

As pointed out above, we have now witnessed the potential of using wireless communications and networking technologies for future transportation systems, which include safety, health and status of the automobile, user services, traffic congestion relief, passenger entertainment, and more efficient use of the transportation and telecommunications infrastructure.

One of the missions of this TC is to provide a forum to address how such a vast service and network system can be scaled, supported, made reliable and economical. For this purpose, the TC on "Mobile Networks for ITS" has its own webpage [1] (see Figure 3). It provides recent information about ITS as "ITS News". We have two editors to provide up-to-date news and information on ITS happening around the world: (i) Prof. Juan Carlos Cano, Technical University of Valencia, Spain (ITS News Editor, Europe) and (ii) Prof. Takaaki Umedu, Osaka University, Japan (ITS News Editor, Asia). They will also collect ITS news from the USA.
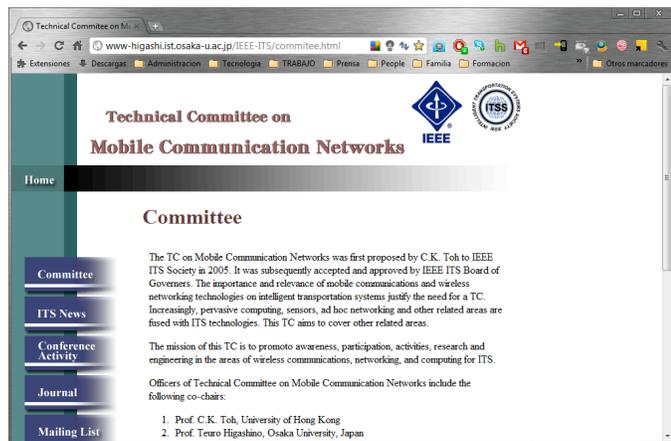
Figure 3: Snapshot of the TC on Mobile Communication Networks Webpage [source: http://www-higashi.ist.osaka-u.ac.jp/IEEE-ITS/].

In Europe, there have been a lot of integrated projects dealing with ITS funded by the European Commission under the EU FP6 (2002-2006), and FP7 that extents the program further till 2013, i.e.,: AIDE, AWAKE, CarTALK 2000, COM2REACT, COMUNICAR, CVIS, CyberCars2, eIMPACT, E-MERGE, eSafety Support, GST, HIGHWAY , PREeVENT SAFESPOT, SEISS , SEVECOM, TRACE, or WATCH-OVER, and so on [10]. Also, ERTICO - ITS Europe was founded at the initiative of leading members of the European Commission, Ministries of Transport and the European Industry. It represents the interests and expertise of around 100 Partners involved in providing ITS and services, and facilitates the safe, secure, clean, efficient and comfortable mobility of people and goods in Europe through the widespread deployment of ITS. Our webpage provides several research projects and related links for FP7 and ERTICO – ITS Europe.

In Japan, there exist 2.5M probe vehicles with cellphone-equipped car-navigation systems (e.g. HONDA's Internavi and TOYOTA's G-BOOK). In those services, vehicles collect their GPS positions, speeds, directions, and record them at every few seconds. Aggregated data correspond to semi real-time information about where vehicles have recently traveled. ITS Japan gathered trajectory information from probed vehicles in Tohoku regions after a great earthquake occurred on March 11, 2011. From March 19 to April 28, on Google map, it showed where vehicles had recently traveled. Many disaster victims in Tohoku regions used this information to decide on their evacuation plans in the disaster areas. This is a concrete proof showing how recent ITS technologies can be used to construct well-informed and safe society. Our webpage introduces such topics and related links. Also, we include several news and topics from the Road Bureau of Japanese Ministry of Land, Infrastructure and Transport. This agency decides on ITS policies. On our web page, we have also provided several news and links to many public organizations in ITS areas. For USA, there are links to US Department of Transportation and Research and Innovative Technology Administration (RITA). Members of the IEEE ITS Society will be able to join the TC and be included in our mailing list.

V. TC ACTIVITIES

Over the past 5 years (since 2007), the TC has supported many technical activities. The TC officers have served as editors of journals and special issues focusing on vehicular networks, chaired conferences, panels, and workshop TPCs, and presented invited keynote speeches.

Dr. Cano is the ITS Europe news editor for the TC and has served as TPC vice-chair for the IEEE Vehicular Networks & Applications Workshop (Vehi-Mobi) in 2010 and the IEEE Vehicular Communications System Workshop (IVCS) in 2011. He also served as the Workshop Publicity Chair for IEEE IVCS in 2010.

Dr. Higashino has served as a general co-chair for the IEEE ICNP 2010 and IEEE P2P 2011 conferences, as the TPC chair of IEEE Vehi-Mobi in 2010, and as a member of the TPC for the IEEE Conference on Network Protocols, the IEEE Workshop on Pervasive Wireless Networking, the IEEE Vehicular Networking Conference (2009-2011), the IEEE International Symposium on Wireless Vehicular Communications in 2010, and the IEEE Intelligent Vehicles Symposium (2011-2012). He has also reviewed papers for *IEEE Transactions on Intelligent Transportation Systems* and *IEEE Transactions on Vehicular Technology*. In addition, Dr. Higashino organized an ITS forum at IEEE Globecom 2010 and will organize a forum at IEEE Globecom 2011.

Dr. Toh is serving as an editor of the IEEE *ITS magazine* (since 2009) and IEEE *Transactions on ITS* (since 2005)*,* has served as a guest editor on the special issue of *IEEE Wireless Communications Magazine* on "On-The-Road (OTR) Communications" in 2009. He has served as general co-chair to numerous conferences and workshops including IEEE Vehi-Mobi (2008-2010), the IEEE Intelligent Vehicular Communication Systems workshop (2009-2011), the IEEE Workshop on Networking Intelligent Vehicles and Infrastructures (2009). He has also given several keynote speeches related to ITS, including at the 2007 IEEE TENCON Conference, 2008 IFIP Networking Conference, and the 2009 IEEE WAVE Conference. He also organized a panel on "The Future of VANETs" for IEEE ICC 2008. Dr. Toh has also been serving as an award committee member of the IEEE Medal on Safety and Environmental Technologies since its inception in 2009.

Dr. Weigle serves on the steering committee for the IEEE International Workshop on Intelligent Vehicular Networks, and has served as TPC vice-chair for the IEEE Workshop on Networking for Intelligent Vehicles and Infrastructures in 2009 and IEEE Vehi-Mobi in 2010. She has also served as a reviewer for *IEEE Transactions on Vehicular Technology, IEEE Transactions on Intelligent Transportation Systems, IEEE Wireless Communications Magazine,* and the special issue of *IEEE Journal on Selected Areas in Communications* on "Vehicular Communications and Networks" in 2010.

Collectively, through the volunteer work of the TC officers and its members, the TC on "Mobile Communications Networks for ITS" is active and well represented in the ITS mobile networking communities.

VI. TC FUTURE PLANS

The IEEE ITS Society is a relatively young society. It was founded in 1999 and started as the ITS Council within the IEEE. It was then given full society status in 2005. While the early participants were from Civil engineering, increasingly over the years, electrical, electronics, and computer engineers have joined the society. It has become an active society with people coming from different backgrounds across the globe. Our TC focuses on "Mobile Communication Networks for ITS". We foresee new topics within this umbrella field will evolve and plan to include them into our TC. Since 2005, our TC have been supporting IEEE Transaction special issues, IEEE magazine special issues, IEEE ITS conferences, and have organized special workshops in the field. We plan to continue to do so, and expanding the number of volunteers, members and supporters. Our TC officers have also been active in serving as conference chairs, co-chairs, TPC members, reviewers, and in giving invited keynote speeches. Indirectly, they have been promoting the visibility of the TC and the IEEE ITS Society.

VII. CONCLUSION

The TC on "Mobile Networks for ITS" has been in existence since 2005. It will continue to initiate activities (through journal and magazine special issues, workshops, conferences, forums, etc.,) and to promote the technical interactions among professionals in the field. The success of the TC will depend on the contributions of its members and organizers. We would like to thank Prof. Urbano Nunes (VP Technical Activities) for inviting us to submit this highlight. We would also like to thank all the TC members who have supported us over the years. We look forward to your continual participation in the future.

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