

## **MICROWAVE AND MILLIMETER-WAVE APPLICATIONS IN AUTOMOTIVE ELECTRONICS**

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### **ABSTRACT**

This article will survey the issues and concepts related to microwave and millimeter wave product applications for Intelligent Transportation Systems. As the article will show, there is very significant worldwide opportunity and activity in improving transportation infrastructure by using capacity and safety enhancing products.

### **INTRODUCTION**

This article is a survey on transport telematics - specifically the microwave building blocks of Intelligent Transportation Systems (ITS). This is a companion lecture to the in-vehicle automotive electronics talk given in another session. There is a boom going on in the microwave and millimeter wave applications of products for the automotive industry. This is being fueled by a surgent growth in ITS deployments in virtually every major North American city, and most developed countries of the world. Why? Simply because use of this technology provides greater public safety and convenience for lower cos than simply building more roads. This paper provides an overview of the various ITS initiatives, some timings, and examples of deployments throughout the world.

## ITS EXPERIMENTAL SITES

There seems to be a general skepticism about the question of deployment. This paper hopes to provide a glimpse of what is being done, and what more is possible. There are a world-varying descriptors of what could fit under this title, and indeed many efforts are already underway to improve traffic flow and driver safety. The conference presentation will show the experimental sites within the US and around the world. Virtually every major metropolitan area and virtually every industrialized country has effort underway to evaluate the benefits of 'smart' transportation systems. The discussion will focus on microwave and millimeter wave products and how they can enhance the performance of current transportation infrastructure. Competing against optics and ultra-sonics, microwave phenomenology provides rugged all weather operation.

interfaces are needed for navigation support. Finally, millimeter wave radar systems for ICC (Intelligent Cruise Control), lane change aid and back-up warning products for HOV (High Occupancy Vehicle) platooning.

These products generally all include the fundamental building blocks of antennas, communications and/or ranging head, and digital signal processing. And as these are generally deployed in unattended road-side locations, they also include power storage and power generation capability (usually solar cells and batteries), and diagnostic and interrogation capability for servicing and calibration. Advances in Gallium Arsenide based microwave ICs, and Si based microprocessors ICs have fueled new low-cost product configurations which can easily be incorporated in the changing transportation architecture. The key lies in incremental and compatible add-ons to a core must-have product.

## PRODUCT OPPORTUNITIES

Product opportunities for microwave and millimeter wave products can be grouped into a few major categories. Those which provide driver navigation and congestion information, those which aid in driver safety and occupant comfort, those which aid in vehicle location and security, and those which improve traffic capacity and flow. Typically these are microwave and radiowave roadside beacons for monitoring pollution, congestion, traffic flow, cross-section management, traffic density, and road hazard. Also for communication, these include cellular and pager systems, DSRC (Direct short range communications) transponders for automatic toll collection and MayDay-type emergency dispatch transponders. Additionally, using GPS (Global Positioning Satellite) signals and detailed cartological information, communications

## MARKET SIZE

There is general consensus that actual large scale deployment will not happen till there is mass market appeal and standardization. The National ITS architecture efforts are aimed at developing such constituencies and protocols. However, to meet today's requirements of reduced government spending and minimal direct involvement, means that new approaches will be required for public-private partnerships, like pay-per-use etc.. The actual size of the market can be safely estimated to be in the 'billions' worldwide, but timing and deployment is dependent on commonality and compatible incremental add-ons. Stand alone and unique format products will have very limited or niche deployments. Consumer awareness and cost effective benefits will fuel demand for deployment - and compatible protocols will allow economies of scale for manufacturers.

## SUMMARY

This paper has provided an overview of the various microwave and millimeter wave product opportunities in the growing Intelligent Transportation Systems market. There is already a surge in experimental sites, with many municipalities and local governments trying to evaluate the benefits of 'smart' roads and OEMs experimenting with 'smart' cars. The opportunities for suppliers is to work towards compatible protocols and to offer interconnecting products. With increased consumer awareness, the small trickle of experiments will grow into a large market.

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