



Present and future transport in M&WC technologies

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Part 1:

Transport Chapter of the SAA

Transport Chapter of the SAA

- **Mobile and wireless communication** technologies can contribute to the sustainable development of cities and facilitate national and international transportation.
- New approaches for decongesting traffic and reducing the time needed to travel are under development through the creation of **Intelligent Transport Systems (ITSs)**.
- At the same time, users desire to obtain as **many services as possible during their travel** to allow them to take advantage of the time used when travelling.
- Some examples include: location based services, context-aware services, spare time applications, transportation-based services, etc.



Transport Chapter of the SAA

- In the Transport chapter we explore future trends for mobile and wireless technologies to enhance the users experience when travelling.
- As key research areas we have considered:
 1. Urban and road traffic management.
 2. Efficient trip management.
 3. Communication services and applications for Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I).
 4. The mobile office.



Part 2:

R&D in M&WC at the GTI Group in the University of Vigo

Related R&D at UVigo

■ Research Work

- Modelling and Simulation by means of Multi-agent Systems:
 - Self-Organization and Urban Traffic Control
 - C2C2E exchanges
 - V2V & V2I communications using IEEE 802.11p

- Security and Privacy: How secure are M&WC in car technology?

■ Development Projects

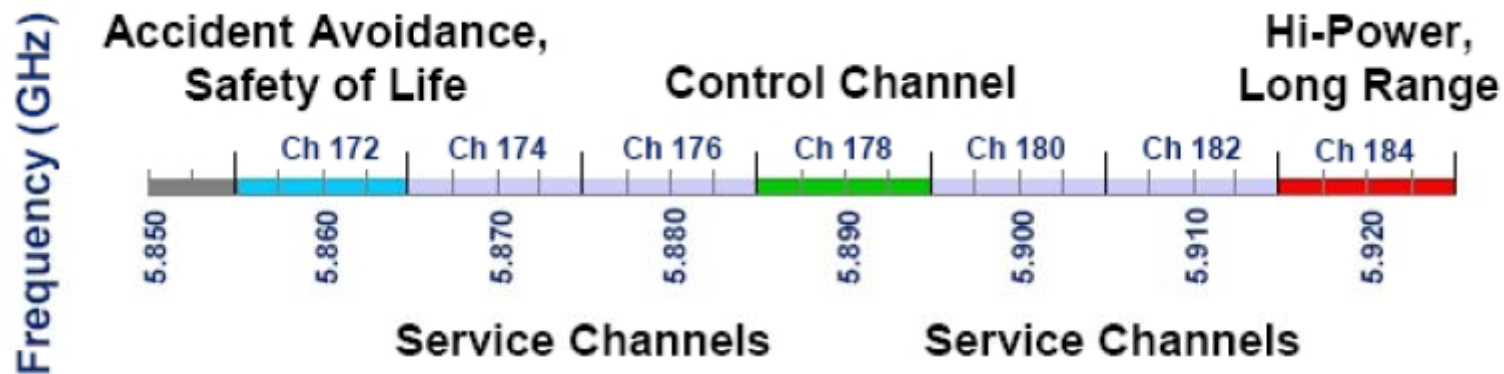
- Sensor networks for evaluating environmental parameters integrated in surface public transport.

- Ambient Intelligence to profile and assist sportsmen

R&D : C2C Technology

- Communications among cars and/or with road-side equipment:
 - Security issues
 - Incident warning
 - Internet access
 - Publicity
 - Exchange of information (P2P models)

IEEE 802.11p



EDCA PARAMETERS

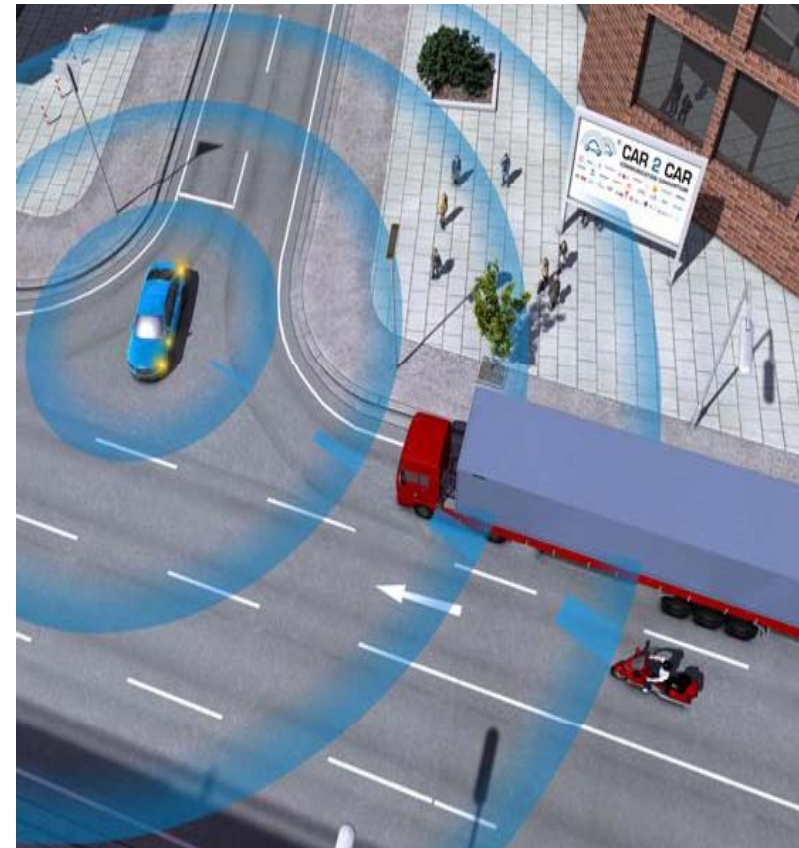
AC	CW_{min}	CW_{max}	$AIFS$
$AC0$ (background)	15	1023	9
$AC1$ (best effort)	7	15	6
$AC2$ (voice)	3	7	3
$AC3$ (video)	3	7	2

C2C: Networks

- ❑ Vehicular Ad-Hoc Network (VANET \subset MANET)
- ❑ Consider each vehicle as a node
- ❑ Not random movements, because vehicles follow organized paths (roads)
- ❑ Connection lasts longer than in a typical MANET
- ❑ These kind of networks have a large number of nodes

C2C: Networks (II)

- The mobile nodes have mobile radio units (On Board-Unit, OBUs).
- There are also stations on the road side (Road-side Units, RSUs).
- OBUs can share information between them, and also with the stations on the roadside.

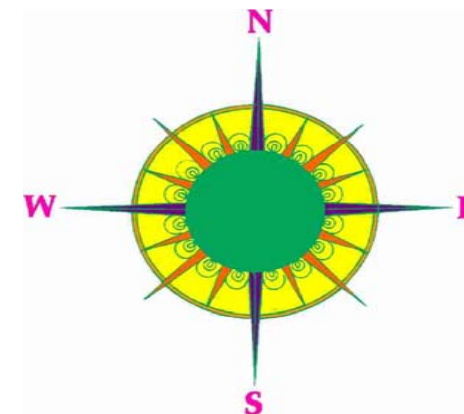


Safety applications

- Safety is one of the main goals of using communication technologies in vehicle environment.

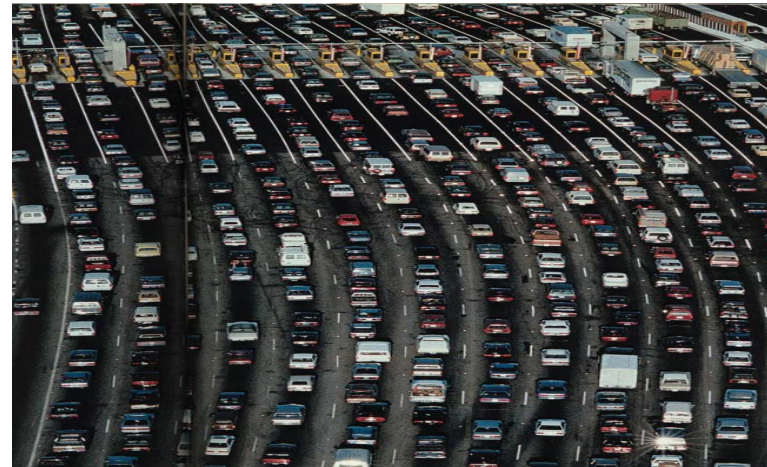
- These services are delay critical.

- Examples:
 - Assistance
 - Cooperative Collision Warning and Navigation
 - Information (e.g., speed limit)
 - Warning information:
 - Sudden hard braking events
 - Cooperative driving systems (transmitting our position to avoid crashes)



Non-safety applications

- Commercial services and applications.
- Objective: improving passenger comfort and traffic efficiency:
 - Weather information
 - Instant messaging
 - File transfer
 - P2P services
 - Electronic payments
 - Providing vehicles information on the current traffic conditions along its planned route
- Non-safety services must not interfere with safety services.



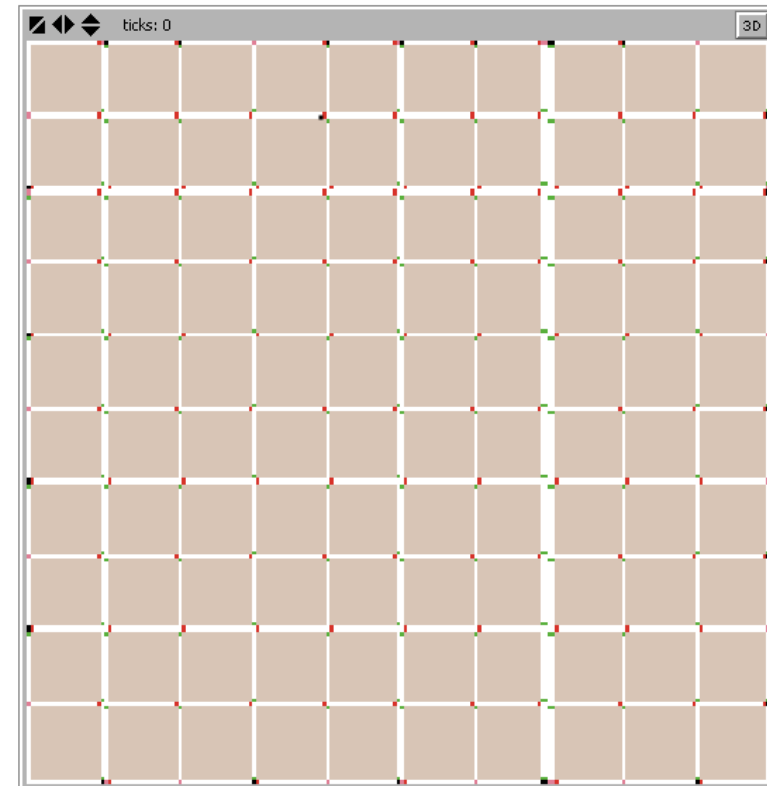


City Model

- ❑ Implemented in NetLogo, a MAS modelling environment for simulating natural and social phenomena.
- ❑ Each car is an agent.
- ❑ Manhattan-like traffic grid with intersections between single or dual-lane bidirectional streets.
- ❑ Car creation/elimination schema: a car created at a source, and moves (following the shortest path) to its destination.

City Model

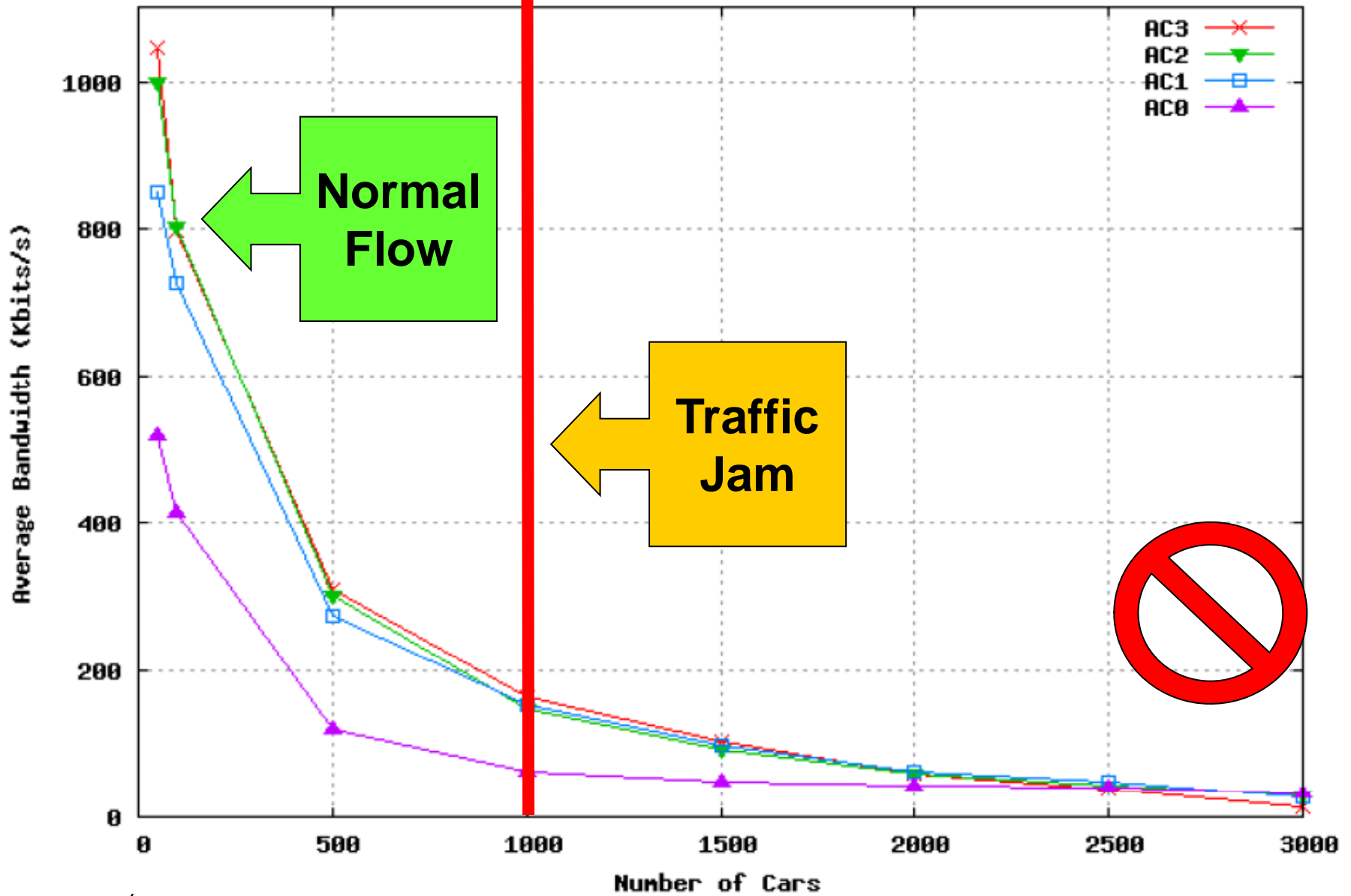
- Area: 1 Km x 1 Km
- $10 \times 10 = 100$ blocks
- Car size: $4\text{m} \times 2\text{m} = 8 \text{ m}^2$
- % Dual lane bidirectional



Communication Setup

- ❑ Line of sight communications.
- ❑ Transmission is half-duplex, i.e., the station can only send or receive at a given time.
- ❑ Half of the time is spent in the Control Channel (CCH) and the other half in the Service Channels (SCH).
- ❑ Each car transmits sequentially in the 4 different SCH in order to reduce interference.
- ❑ All moving cars have information to transmit (only during SCH):
 - ❑ Packets of 500 bytes
 - ❑ Data rate of 6 Mbits/s
 - ❑ Radio range of 250 meters

IEEE 802.11p C2C Analysis

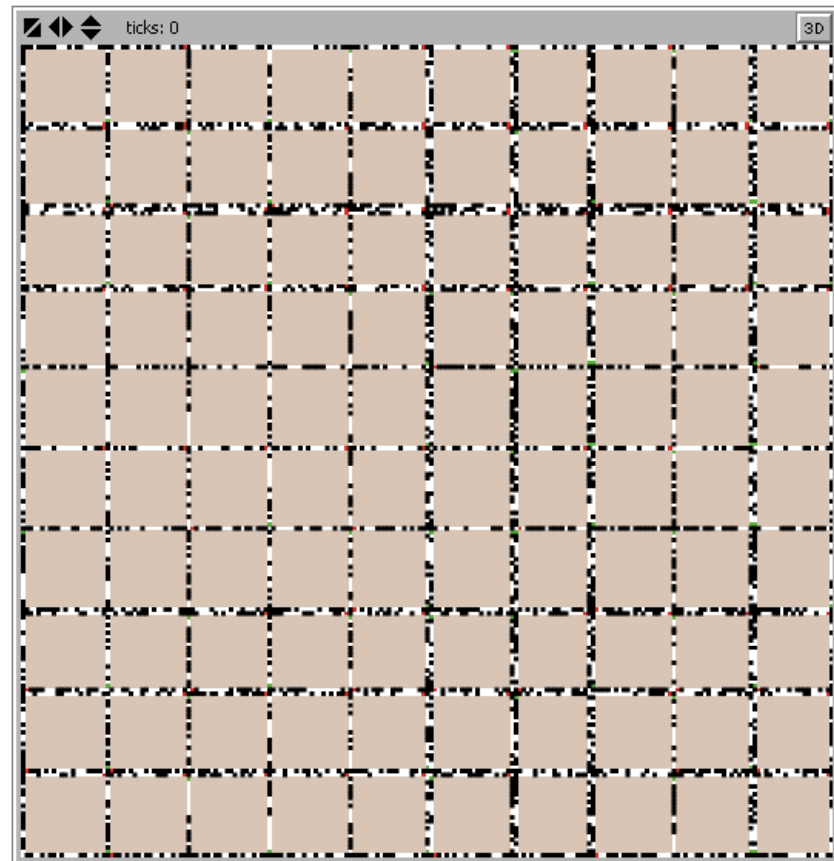


Scenario density

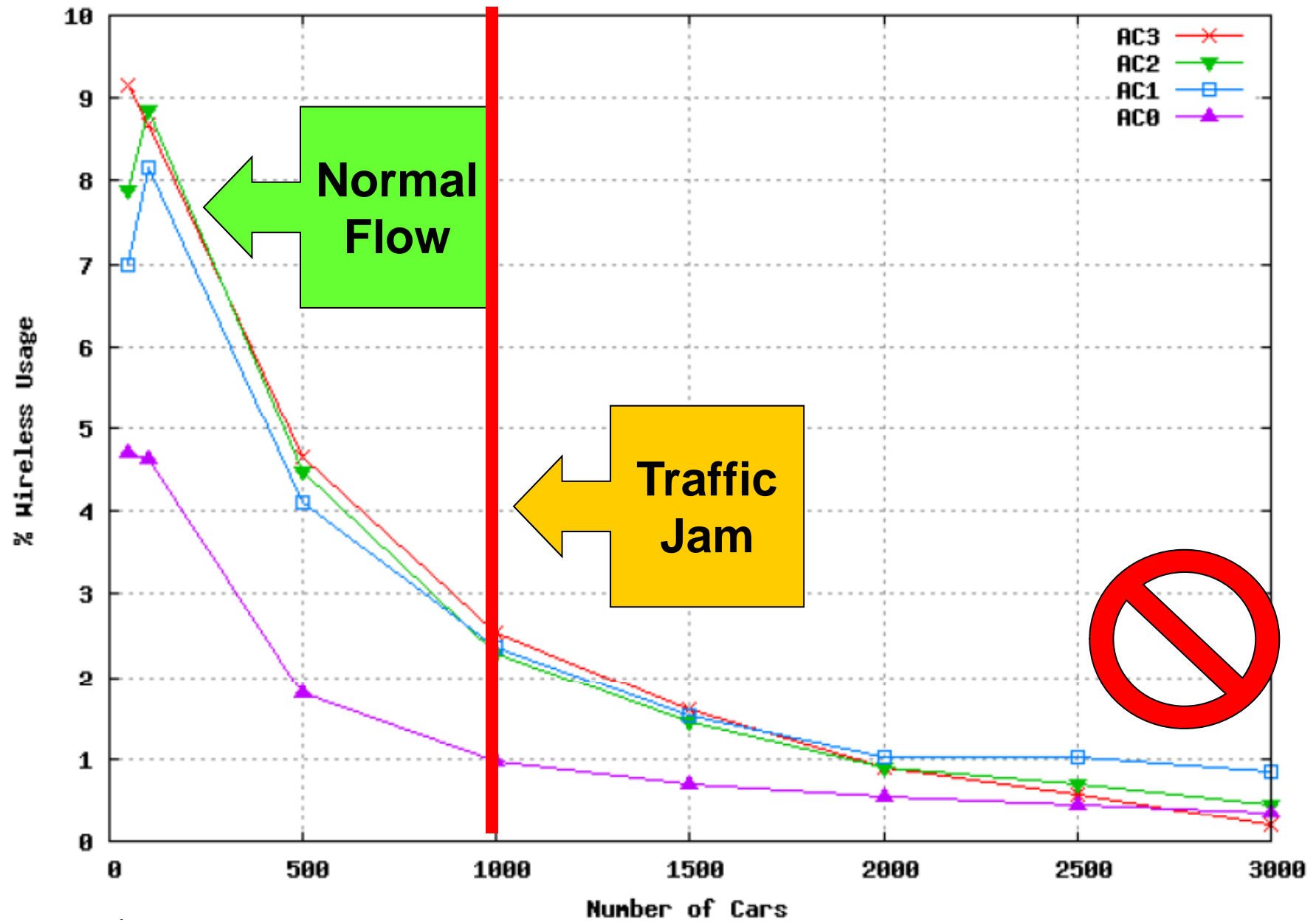
1000 cars



3000 cars



IEEE 802.11p C2C Analysis



Summary

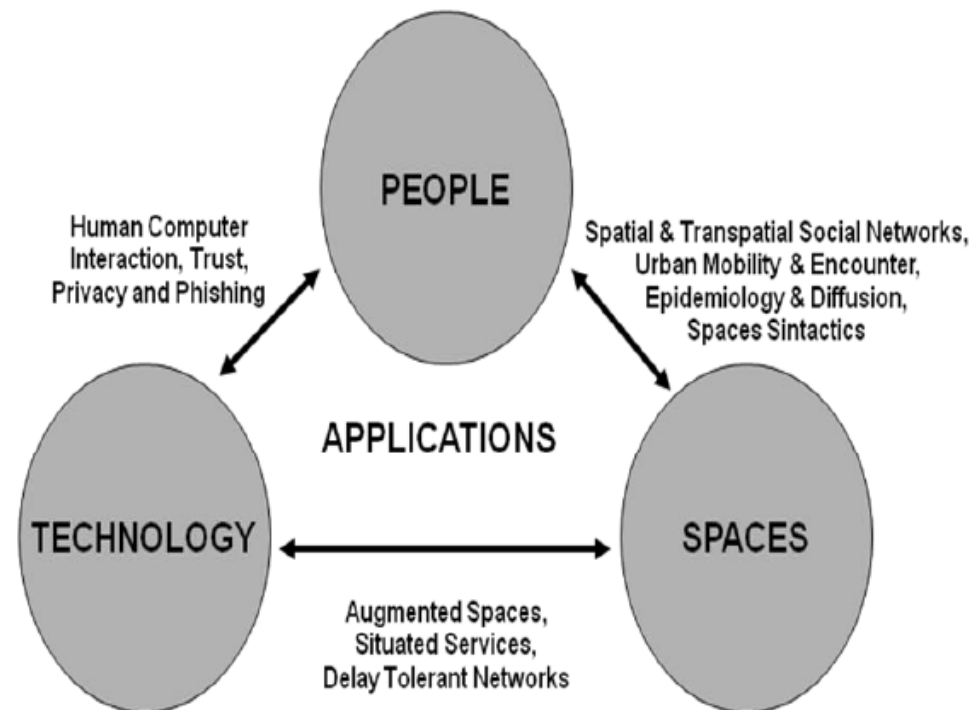
- The results provide data about information spreading concerning congestion, road conditions and accidents.
- Cars can also have access to Internet services, publicity from business nearby, tourist information or even file exchanges.
- Main goal: provide safety and connectivity to passengers.
- Problems: how to manage data spreading in a extreme dynamic environments, percentage of bandwidth wasted and privacy.

Part 3:

Future Mobile Interfaces

Urban computing

- **Urban computing** is defined as computer-supported activities that are performed within a new third space existing besides the traditional computing locations at workplaces and homes.
- It is the intersection between the mobile computing and social computing paradigms.
- Urban environment can be interpreted as a system organized around the three interacting elements: people, spaces and technologies.



Augmented reality



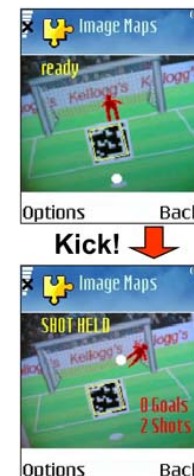
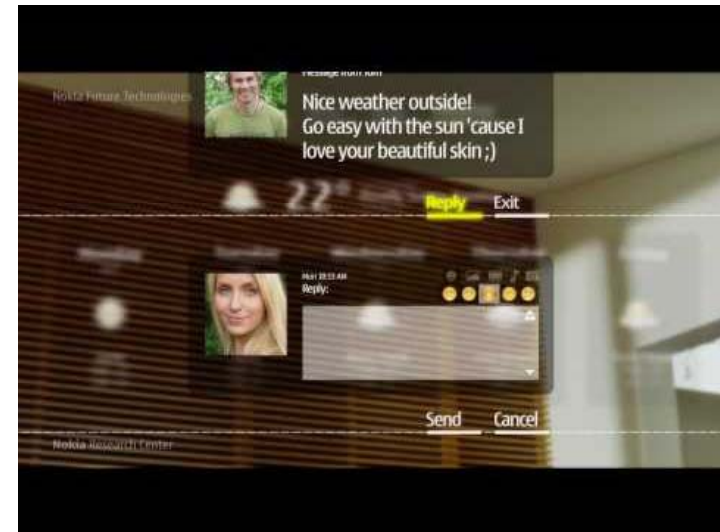
petit invention
Better Designs for a Better Life

Augmented reality

- **Augmented reality (AR)** denotes viewing the physical real-world that is augmented by virtual imagery creating a **mixed reality**.
- Augmented reality enables users to experience the physical world complemented with computer-generated objects that co-exist with real objects.
- Augmented reality research explores the application of computer-generated imagery in live-video streams to **expand the real-world**.
- Three basic features to be considered as virtual reality: **combination of real and virtual elements, real-time interaction, and 3D tracking**.
- With the help of advanced AR technology (**computer vision and object recognition**) the information about the surrounding real world of the user becomes interactive and digitally usable.

Augmented reality

- **Augmented reality (AR)** devices are typically classified into three categories:
 - Head mounted displays (HDMs)
 - Handheld displays
 - Spatial displays



Augmented Reality in the car

- General Motors has been working on a heads-up display that transforms a windshield into an augmented reality information dashboard.
- The display overlays the enhanced view to the actual scene.
- The windshield is turned into a transparent display, using glass coated with red-emitting and blue-emitting phosphors, which is a synthetic material which glows when excited by ultraviolet light. The display is activated by ultraviolet lasers.
- Driver's head and eyes are tracked to know where he/she is looking.

Augmented Reality in the car (II)

- Sensors, including night vision, navigation systems, and cameras to sense what is in front of the car.
- Combining sensors' data, images are projected in the windshield.
- The system can point out and give warning about road hazards: as children playing in the street, animals, or vehicles in the driver's blind spot in real time.
- It should point out obstacles even in foggy or night conditions.



Augmented Reality in the car (III)

- With an overlay screen, safety is improved. Compared to head-down systems, the user have not to move the head to check anything.
- It can also include GPS functions to point out the address you are going.
- The main barrier is not only the displaying, but the sensor work of tracking objects on the road, and the position and angle of the driver's eye, since objects displayed depend on the driver's point of view.



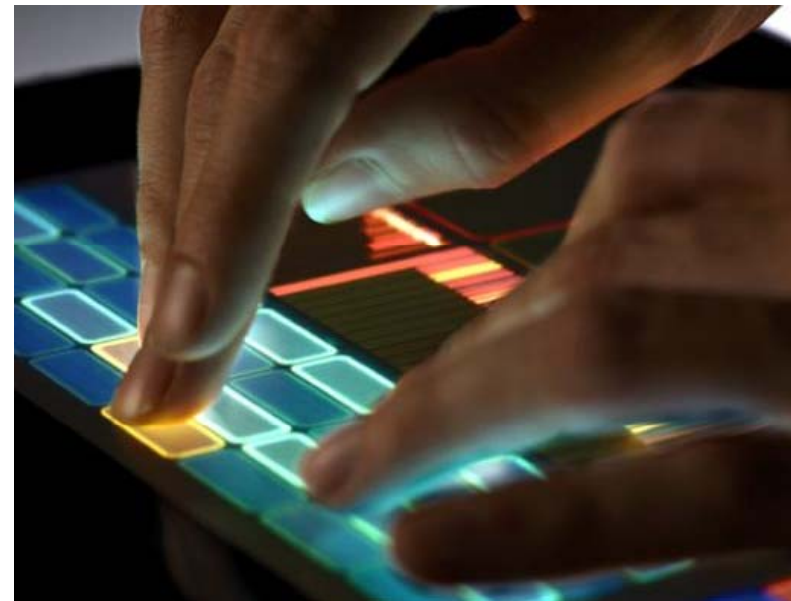
The Mobile Office: interfaces

- New technologies and multi-touch interfaces provide us the opportunity to “Move” our office and work wherever we want.
- Potential of new mobile phones in the future.
- Potential of new interfaces in the future
- Multi-touch without touching the screen
- Better and more intuitive devices for *interaction*.
- Everyday devices connected to internet.
- Interfaces aware of context.



Multi-touch interface

- Great improvement of mono-touch interface
- Allows multipoint sensing. We can interact with the interface with one, two, three fingers, etc.
- Able to accommodate multiple users simultaneously.
- Integrated in mobile phones



Distance interfaces

- Distance control of interfaces
- No more touchable screens
- Change the way we control our devices
- With that an user can modify programs interface, without the need of using a peripheric as a remote control.
- For example Sony patented a system where the user should wear rings in his fingers, and the movements would be detected by a camera.



Future systems: they are here

- Systems that allow you to augment the physical world with digital information and use hand and gestures to interact with that information
- Sixth sense
 - Camera: recognizes objects around
 - Micro projector
- Recognize objects around you. You can manipulate your information using your fingers.
- Connect the real world and internet: the camera recognizes something, and the device provides the information it can get from the internet.





Future Transport and M&WC

- Legal, regulatory and institutional challenges.
- Social, economic and cultural challenges.
- A world where services are made available to all citizens everywhere, at any time, in any condition and by anyone.
- New technologies for **service creation, customization, deployment and provisioning** are needed by service providers.



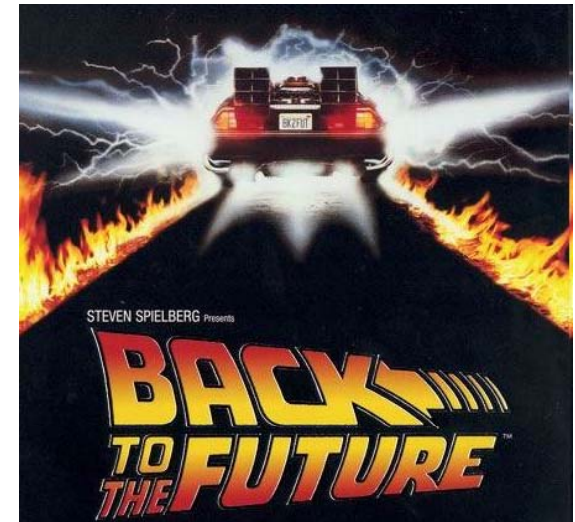
Future Transport Services

- Services for increasing the safety of pedestrians in the traffic.
- Services for providing the right information required (e.g., free parking places).
- Context aware, potentially with context prediction, at your fingertip.
- Smart user interfaces (HMI).
- Multimodality of travel information services.



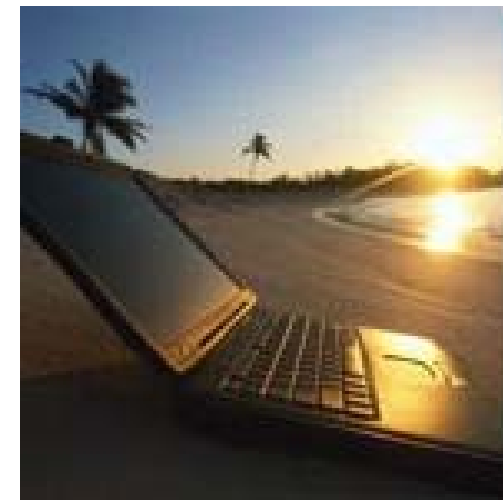
Future M&WC in Vehicles

- Adequate combination of V2V and V2I technologies to ensure the continuous and cost-efficient operation of traffic management.
- Within vehicular networks, the routing, broadcasting and dissemination **communication protocols have to incorporate reliable transmission policies**, such as congestion control or back fire algorithms.
- Wireless communications for vehicular applications have not yet reached the “one technology fits all” solution. Regardless of the selected technology, there are competing factors:
 - **Cost**: equipment and usage (airtime, flat fee, data volume, ...)
 - **Quality of Service**: bandwidth, latency, scalability, ...
 - **Availability**: coverage area, indoors, outdoors, ...



Future Mobile Office

- **Ambient Intelligence and context awareness** will become necessities.
- Communication, via technological means, needs to preserve the richness and subtle characteristics of human to human interaction.
- **Multimodal interfaces** need to be exploited, improved and adapted to provide a suitable working space to the mobile workers:
 - Speech recognition,
 - Tangible user interfaces,
 - User interaction, and
 - Augmented Reality.



Conclusions

- M&WC are changing the way people interact around the world and it will also affect how they travel.
- The transport chapter of the SAA evaluates the present State of the Art and foresees the needs and opportunities waiting to be created or discovered.
- You are welcome to join us at the SAA for collaborative thinking about our future eMobility.
- You can visit us at:
 - Web site: <http://www.emobility.eu.org/saa.html>
 - Wiki: <http://papa.det.uvigo.es/~eMAP>



Thanks !!!

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