SUMMARY

WHAT IS THE PROJECT

- The project is valuable two credits of this course

- It has to be done, with the oral examination, in order to pass this course

- These two can be taken together or in two separate moments

- The project can be on any possible theme, if considered by Palazzi interesting enough

- If big enough, the project can be united with Mobile Programming and Multimedia (it will go on second semester instead of first one)
    o basically, it's an app for Mobile Programming course
    o you will create the relation and app for that course
    o you will write a relation for WNMA
    o you have to do a meeting with the two professors in order to get the right idea and do the project for both, however

LESSONS ON THE PROJECT

The first example is shown is M2MShare, which is a delay tolerant, proximity based, P2P application for file sharing among smartphones. Phones in proximity may exchange files or assign file retrieval task ("please find this file for me so that you can give it back to me tomorrow"). This was made inside urban area networks. Project reference is here.
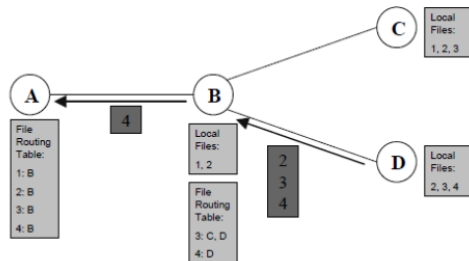
The second one is Shared Paths, finding the best possible path in a town (by all means, like (by car, public transportation, on foot). In this case, we talk about accessible paths, with no ramps/curbs (wheelchairs) or no acoustic traffic light (blind people). Reference of project here. There is the automatical detection of crossroads and acoustic signals, over the following context:

- During the day, several days per week, a person does the same path over and over again
  - o To go to work, or to the grocery store, or to school, etc.
- This person (especially commuters) often meets the same people
- Created an app for mobile phones:
  - o Identifies repeated paths
  - o Using proximity-based connections (Bluetooth?, wifi?) allows to detect users met during this repeated
  - o Allows to contact people that do the same path
  - o Upload repeated paths into a server to let the server know that it is a desirable path for similar users (e.g., a person on a wheelchair, someone with heels or a stroller, etc.)

Moving on:

- There is also a project about Road Crossing Recognition through Accelerometer, enriching Web Squared and giving maps with points that can be accessible and recognized. Reference here.

- Again, a project via the use of sensor, catching data and analyzing it via interconnected devices, with Web Squared. Reference here.

- Then, the node detection at a wireless range level (*Project Node Detection*). Reference here.

- *Evaluation of DTN on Android phones*, creating a network fault-tolerant even without connectivity for mobile phones. Reference here.

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- *Multiplayer games over Ad Hoc Networks*
  - o Users are mobile
    - ▪ Risk of disconnection
    - ▪ Possible impact on delays & packet losses due to ad-hoc routing protocols and bandwidth fluctuation
  - o Radio interfaces necessitate some energy consumption – Risk of node failure (could be dramatic in C/S architecture)
    - ▪ Need of new architecture for gaming over MANET

- Other entertainment projects
  - o Creation of a game for mobile devices (e.g., Android, iOS, etc.)
    - ▪ Even digital versions of old games
  - o Creation of a mobile application for cultural heritage
  - o Creation of any application for mobile devices (e.g., Android, iOS, etc.) that exploits Wi-Fi, Bluetooth or other connectivity means can be discussed
    - ▪ We have smartphones to lend if needed

There can be something very specific based on *Drone Networks, Services and Applications*. Ideas can be:

- Creation of software to manage drones
- Simulations to verify classic MANET protocols (2D topology) in DANETs (3D topology)
- Survey/Analysis of drones in Agriculture 2.0 or Industry 4.0

Note: if the project is bigger than the class, it can count as credits for Other Training Activities or even for the Master Thesis if it's particularly big.

A curious theme (already shown here somewhere) are the *Mobile Ancient Games*, implementing ancient games on smartphones/tablets. Another interesting theme can be the *TCP Versions comparison*:

1. Real experiments with a particular configuration of the network (even just Linux TCP vs Windows TCP)

   a) Evaluate fairness / friendliness
   b) Evaluate Starbuck's scenario
   c) Evaluate mobility impact
   d) Error link impact
   e) Even just download performance

2. Simulations (as above…)

- with well-known and documented simulators (e.g., NS-2, NS-3)

Otherwise, some *comparison* projects can be made:

- Realistic networks and heterogeneous flows with multimedia
  - o Measure different protocols (TCP)
  - o Simulations vs real experiments
  - o Test with some new application (AR/VR/MR…)

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In case, even some *Game Flow Measurement*:

- Measure bandwidth, delay, jitter…
    - Classic online games
    - Thin client games (aka cloud games)
        - OnLive, Stadia, Luna
        - VoIP
    - Simulations vs Sniffers (e.g., Wireshark)

Other ones:

- Scavenger Hunt Game
- Strega comanda colore – Simon Says the Color
- Ubiquitous Social Cam – something like Periscope and look for something in real-time
- Participation 2.0
    - Crowdsourcing regards outsourcing tasks to a public
        - E.g., a participative online activity
    - Through smartphones, with tasks automatically distributed to specific categories based on
        - Profiles, location, sensors on smartphones, current activity, etc
- ARDUECO
    - Creation of a sensor box attached to a bicycle to sense air pollution and collect data
- GeoComments
    - Attaching audio/video/text comments to a specific location – Users have to be in a certain location to see local comments
    - Comments: messages, touristic guides, games, information, art

Another idea can be:

- Take a specific topic and make a survey paper on the state of the art (with comparison)
    - Drone networks (protocols or even applications)
    - Underwater networks
    - Alert propagation in urban (grid) vehicular networks
    - Web Squared applications
    - Internet of Things or Internet of Everything
    - eHealth
    - Smart city
    - Smart traffic/transportation
    - Nanonetworks
    - Network of cubesats

Another interesting application is the recording and analyzing the different voices and conversation between spaces and people, or even analysis of sexist topics inside social media and avoid them. Some solution of avoid sexting/blackmailing and crypt images sent/avoid problems in sending this kind of content.

Any project you choose ask the teacher for further references: e.g., slides/books/examples on programming smartphones.

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Other examples are:

- D2D (Device to Device) interaction, providing a comprehensive survey as state-of-the-art approaches (arriving to at most 5 papers):
    - A Survey on Device-to-Device Communication in Cellular Networks (link)
    - Device-to-device communication as an underlay to LTE-advanced networks (link)
    - LTE Direct as a Device-to-Device Network Technology: Use Cases and Security (link)

- UAV (Unmanned Aerial Vehicle) route planning, useful when designing autonomous flight paths for drones. It involves determining the optimal trajectory that a UAV should follow to reach its destination while avoiding obstacles and adhering to any specified constraint
    - Routing military aircraft with a constrained shortest-path algorithm. Military Operations Research (link)

- Body Area Networks, in which the goal is to provide a study regarding state-ofthe-art proposals employing predictive / behavioral algorithms
    - Body Area Sensor Networks: Challenges and Opportunities (link)
    - Active Assistance Technology for Health-Related Behavior Change: An Interdisciplinary Review (link)

- 2D Vehicular Networks; Vehicular communications will become a reality in the near future. A research topic spanning from Physical/MAC (propagation) to data dissemination aspects. Message forwarding in 1D, platoon scenario is well-understood and optimal schemes have been proposed. However, in the general case, the road topology is 2D.
    - A real-time adaptive dissemination system for VANETs (link)
    - Evaluation of flooding schemes for real-time video transmission in VANETs (link)

- 2D/3D Drone Networks; drones and other mobile/statice devices (IoT devices) with communication capabilities are becoming popular. The objective is to provide a comprehensive survey of possible applications and challenges related to 2D/3D Drone networks and to provide a survey of mobility models for the mentioned applications
    - Starting Material
        - https://www.sigmobile.org/mobisys/2016/workshops/DroNet/program.html
        - https://www.sigmobile.org/mobisys/2015/workshops/DroNet/program.html

- Seamless Communication, in which no user interaction is required. Pairing process between wireless enabled devices requires initial setup (user intervention). Solutions have been proposed for seamless data transfer. These proposals exploit advertisement frames to exchange data, hence avoid pairing, making the solution user-transparent
    - Two-Way Communication Protocol using Bluetooth Low Energy Advertisement Frames (link)
    - "mumble: Framework for Seamless Message Transfer on Smartphones (link)

Other topics can be:

- Green Computing
- Information-Centric Networks (ICN)
- QoS/QoE in multimedia (specific for smartphones)
- Activity Recognition (e.g., from smartwatches… even used for side channel attacks)

Others project ideas sparse in slides:

- End of WNMA01 set of slides:
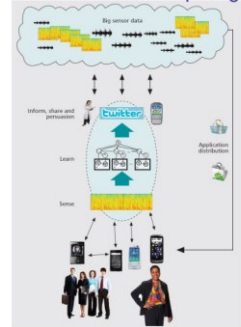
- End of WNMA04.pdf set of slides

- From WNMA06.pdf at slide 16

<u>Class Project Idea:</u>
Describe or test (NS3 simulations?) some routing
protocols for MANET, or VANET, or FANET, or Space…

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- End of WNMA08.pdf set of slides

- Take various TCP protocols and test/compare them in a realistic new environment
  - Mobility
  - Starbuck's / Coffee Shop
  - UMTS
  - …
- NS-2/NS-3 simulations or Linux

- <u>Alternative</u>: read and present paper(s) on TCP (or general congestion control) for some wireless environment

- End of WNMA-HCW3-ext.pdf set of slides (denoted as "Future work, project, thesis)

- Dynamic lower and upper bounds for Fast-Broadcast's waiting time calculation
  - Based on vehicle density

- Junction identification backup mode
  - Reliance on GPS
  - Compute angle between received messages to identify vehicles within junctions

- Study regarding FANETs (Flying Ad-Hoc Networks)

- Simulations or Real experiments in Antwerp
  - NS3, Omnet, etc.
  - Actual 5G+VANET highway

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WHAT TO DO FOR THE PROJECT

Generally, the first course slides specify the following:

- Project development
    - o To be decided with the Professor
- Project (simulation, implementation testing)
    - o Paper presentation + oral discussion
- Survey (topics to be determined)
    - o Slide presentation + Paper + oral discussion

These ways are alternative to each other:

- if you do the implementation, discuss it with the professor, he will give you info on what to do, then you will send him the results
    - o then report (of this or other ones) must be done in the [template IEEE](#)
    - o some info is [here](#) on this
    - o then you will discuss with him what you did
- if you do the research/survey
    - o you have to select a list of papers to use and get them approved by the professor
    - o the more you are, the more papers shall be approved
        - ▪ if I recall correctly, possibly 5 each, but I can be wrong

Given the professor is usually very busy, it's advisable to try to meet him in person, rarely he gets back in emails – be prepared to that.