



UNIVERSITY OF ŽILINA, SLOVAKIA

Sensors of human mobility

DEPARTMENT OF CONTROL AND INFORMATION SYSTEMS



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Agenda

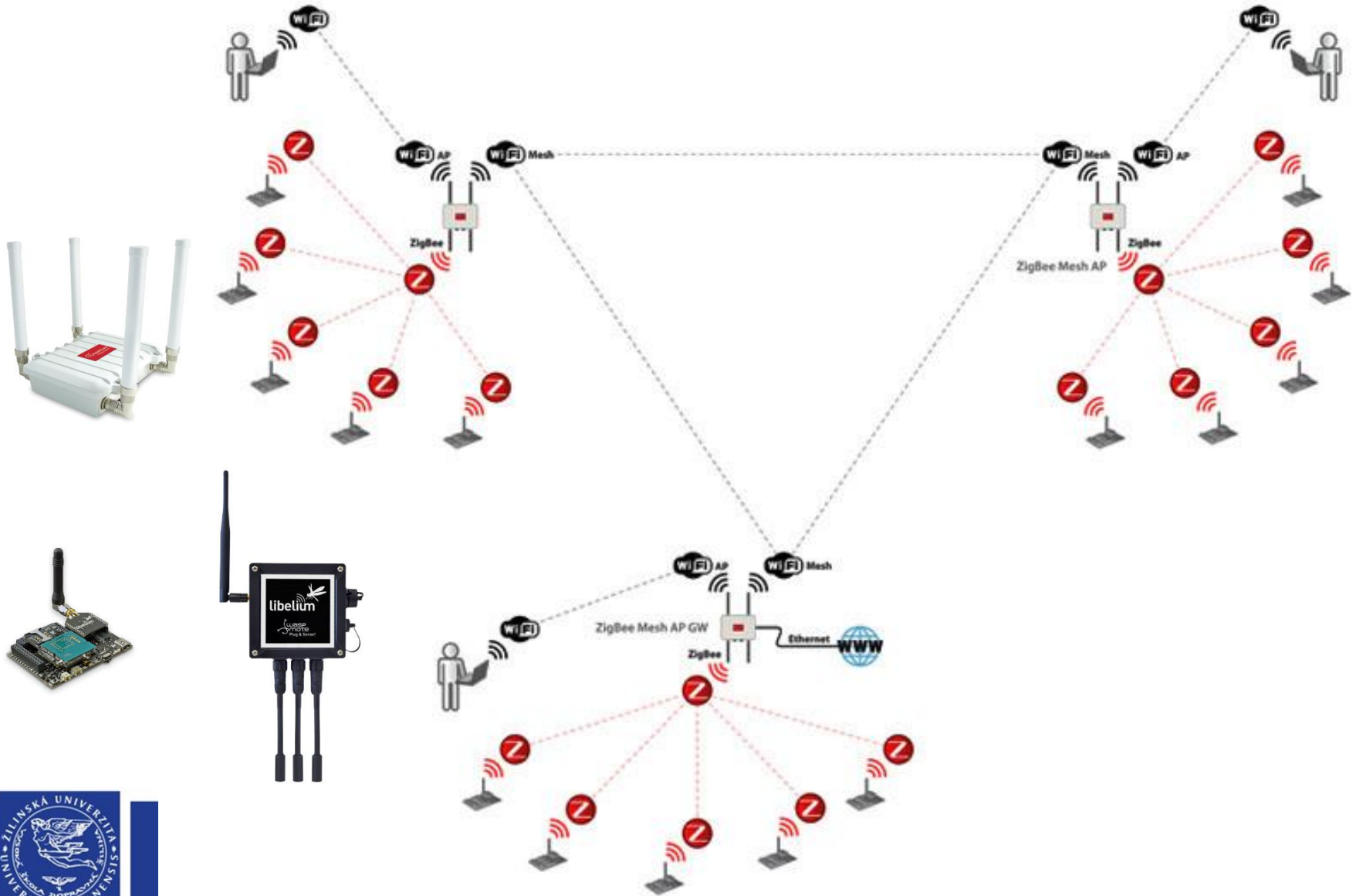
- The Libelium Technology
- Data gathered
- Data utilisation

The Libelium Technology



- 110 sensors
- Radios: 802.15.4, 868, 900, WiFi, 4G, Sigfox and LoRaWAN
- Cloud integration (Amazon, esri, IBM Bluemix, IoT Ticket, Microsoft Azure, MQTT, Telefónica, ThingWorx...)

The Libelium Technology

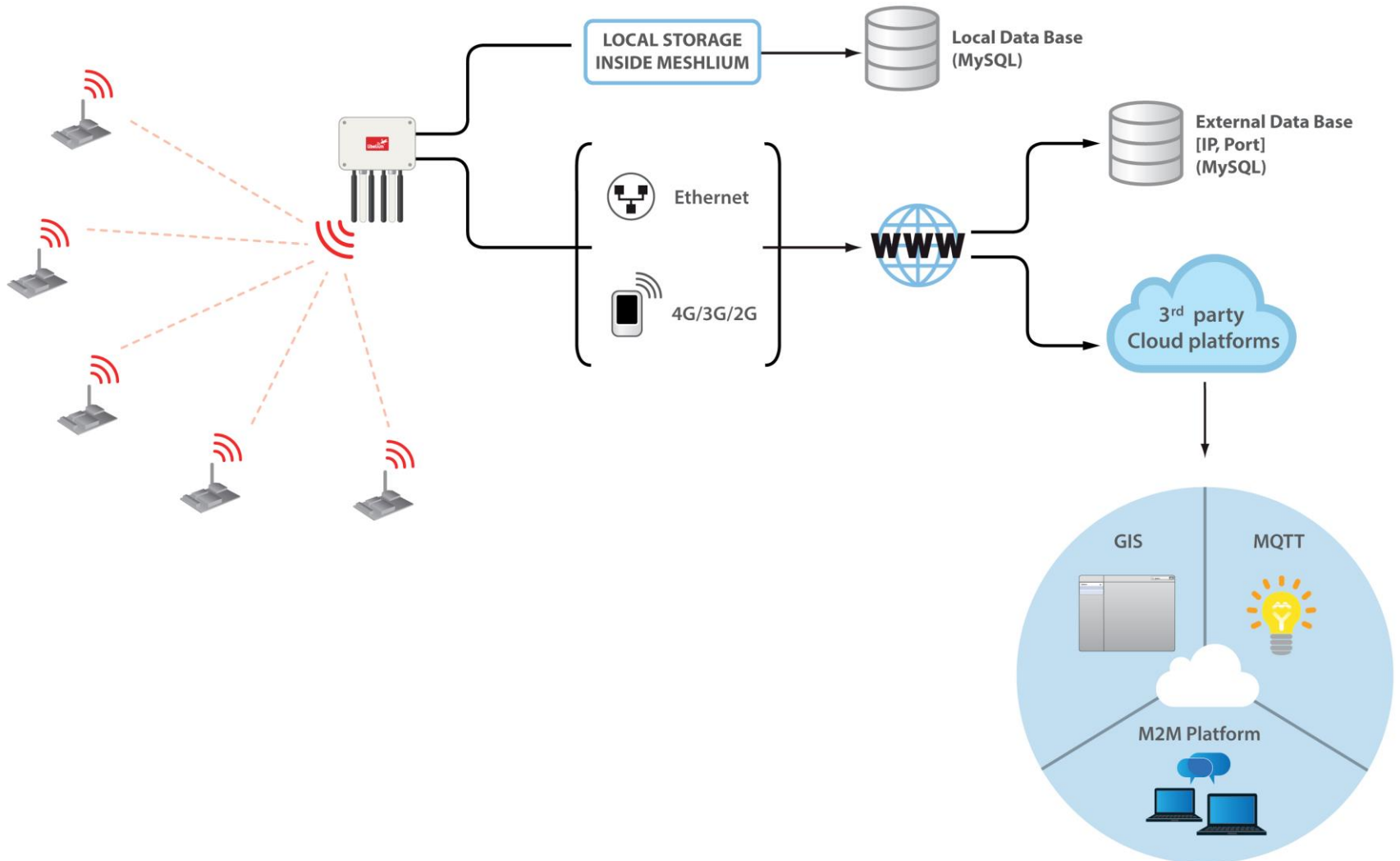


The Libelium Technology

- **Smart Cities** (Parking, Noise, **Mobile Devices Detection**, **Traffic Congestion**, Lighting...)
- Smart Environment
- Smart Water
- Smart Metering
- Security & Emergencies
- Smart Agriculture...



The Libelium Technology



Data gathered

- MAC address (device ID)
- Device type (smartphone, tablet, laptop, personal/car hands-free)
- Device name
- Vendor
- Velocity



NetStat



Wifi Scan



Bluetooth Scan



GPS



Beep

phpMyAdmin



Encryption

Captured Data

Local Database

External DataBase

Local file

Connection data

Database: MeshliumDB

Table: bluetoothData

IP: localhost

Port: 3306

User: root

Password: libelium2007



☒ Store frames in the local data base

Save

Show data

Last 100 insertions.

Delete data

TimeStamp	MAC	ID	RSSI	CoD	Vendor
2016-11-06 17:32:42	00:14:09:0C:4E:8A		-77	Handsfree	MAGNETI MARELLI S.E. S.p.A.
2016-11-06 14:48:27	FC:62:B9:F4:DC:9A		-82	Handsfree	ALPS ERECTRIC CO.,LTD
2016-11-06 12:23:10	00:26:7E:32:74:94		-81	Handsfree	Parrot SA
2016-11-06 10:13:39	FC:62:B9:5C:DE:D8		-88	Handsfree	ALPS ERECTRIC CO.,LTD
2016-11-06 09:00:59	00:08:C6:44:E6:1D		-80	Handsfree	Philips Consumer Communications
2016-11-05 21:57:42	00:23:3D:1E:A8:D3		-87	Handsfree	Novero holding B.V.
2016-11-05 20:29:15	BC:72:B1:18:86:D6		-86	Smartphone	Samsung Electronics Co.,Ltd

Data utilisation

- Detect nodes passing through gates
- Correlate (related) nodes movement
- Bidirectional cloud access



Thank you for attention



Supporting slides



Tools used for analysis:

1. Wireless sensor scanning gates capturing information (MAC address, device type, device name, device manufacturer, velocity, ...) on passing wireless devices (Bluetooth, WiFi). The data from these gates is stored in a central database.

2. Analysis potential: advantages of the technique:

The penetration of wireless devices is very high, therefore most of the physically passing nodes is captured.

Based on the MAC address information it is possible to determine the type of the device (smartphone, tablet, laptop, vehicle)

The data gathered from different gates can be correlated in order to analyze movement of a node and a relation between nodes.

3. Analysis limits & boundaries: Problems

Anonymization of data is demanded and one node (person) can be identified by several devices (redundant data).

4. Compare to traditional survey?

After a thorough analysis the data acquired can provide much higher accuracy of mobility behavior.

5. Relevance for urban / transportation analysis and models

Description ability? In this area the description ability is limited to the information mentioned (MAC address, device type and name, velocity).

Ability to forecast? Forecasting is potentially possible after acquiring a sufficiently large data sets.

Ability to use in models? The data format (a structured SQL database) is very well suited for models.

Conclusions / Recommendations

6. What are the gaps? Which complementary data you need and/or can have from regular survey? Please propose 1 question you would recommend to add to the COST comparative survey.

We need data acquired from a regular survey enabling forecasting improvements and camera inputs.

What is the acceptable level of personal data gathered?

7. Do you have any question to the other panel participants? Could you see collaboration among your methods and the others?

What are the methods being used to correlate location data of nodes between each other?

There is definitely possible cooperation based on social network applications and travel cards data including position information.