SOSTARK
CLOUD CONNECTED PRODUCTS

Singapore . Amst

LEIBNIZ-INSTITUT LIFIS

Leibniz Conference 2018

Positioning technologies for IoT, Telematics and Industrie 4.0

LOKALISIERUNGTECHNIKEN FÜR IoT, TELEMATIK UND INDUSTRIE 4.0

A “poor” mans locating method

From Locating 100k visitors at large events

To locating 100k visitors at large Smart Buildings

23 Nov 2018

Tomorrowland video

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https://www.youtube.com/watch?v=6amNmM1f77I&list=PLOj6Fj01OE8I2rHu9jOCAunezqZLSZ8PX

Some event issues to solve

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- Where are the visitors in case of a calamity?
  - weather, attack,
- When the event management can not proof they are in control, it is immediately shut down by local authorities - verification happens any time
- Where are specific individuals?
- Emergency Evacuation crowd control
- Improve positive visitor experience
- Value proof to sponsors (how many visitors, which location visited most, …)

Tomorrowland product

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- “Real time” location tracking of 250,000 visitors over 3 days
- Wristband is also used for light show, time-stamp notification, access and cash-less payments
- Acquired data is used for security, heat map, social features, and management

Rewarded

14/15

WEARABLE TECHNOLOGIES

INNOVATION WORLD CUP

powered by life.augmented

INNOVATOR OF THE YEAR

150k real time visitor locations

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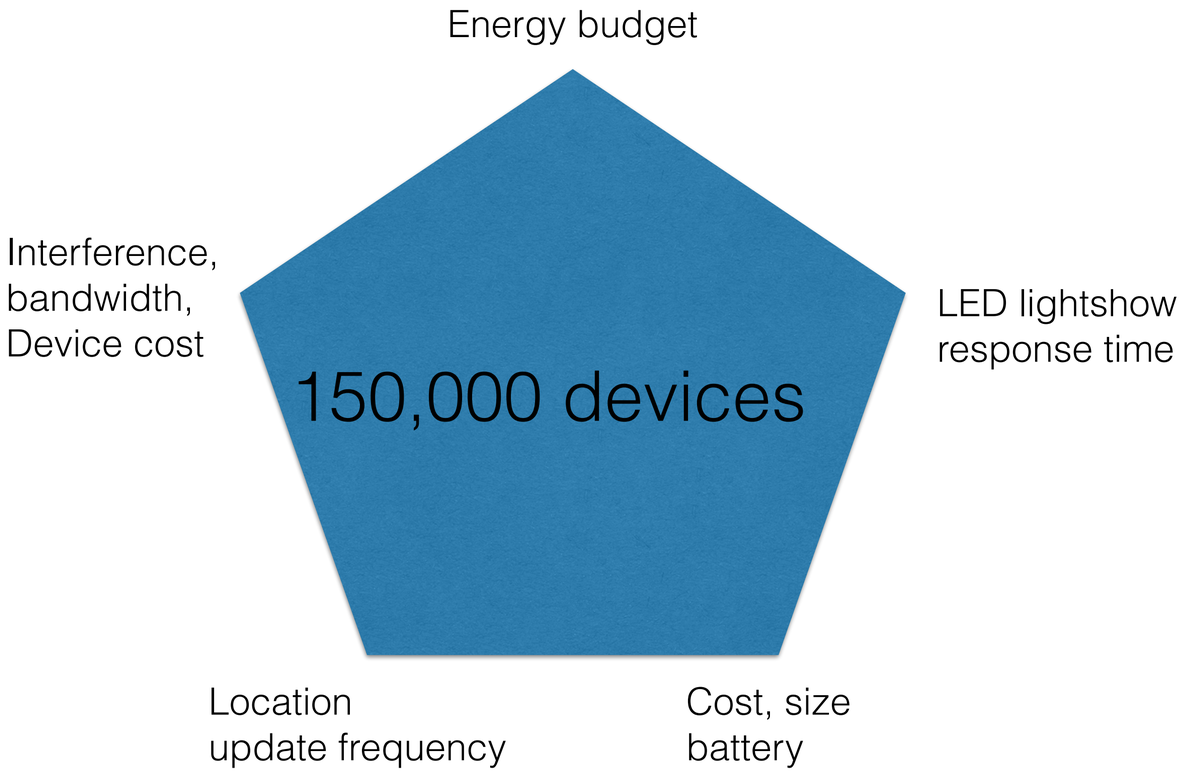
Location of each Visitor every few minutes
Density
Heatmap, indicating movements
Location of individuals: Who is still where after the event?

Major challenges

- 150,000 devices in one system makes everything difficult (and interesting)
- Energy budget for 3 days: Tx, Rx, LED
- Minimum amount of energy to detect and calculate the location
- Link from Wristband to Server (for both data and location)
- Response time LEDs, during lightshow
- RF interference, interference, and interference



Locating Methods and limitations

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Method	Technique	Pro	Con	Accuracy	Range
ToA	UWB	accurate, low power beacon	no good low cost chips available; bi-directional is power hungry	10 cm	30 m
Phase	RF versions as discussed in this conference	accuracy and range	slow, energy	1m	1km
RSSI	GFSK RF	fast, low cost, low power, long range and accurate enough	not very accurate	10 - 30 m	100 - 300 m
AoA	4 antenna array	improves accuracy to 10m; low cost wearable	large antenna system and complex base station	10 m	100 - 300 m
Beacon	BLE	RSSI BT is cheap	Too much interference and not reliable	1 - 10m	30m

Why RSSI method?

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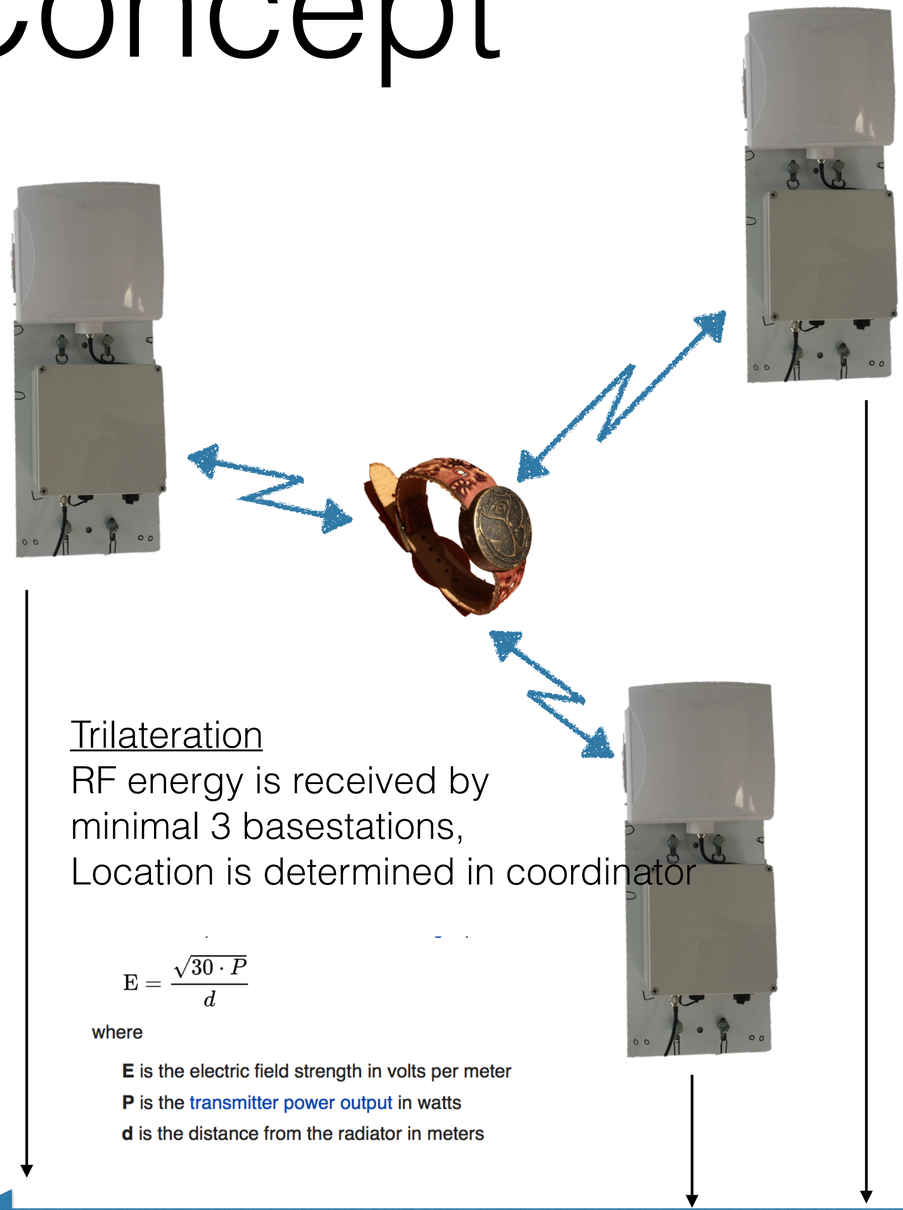
- Good enough accuracy
- Good range to cover the large areas; High enough RF power output at 868MHz
- 10m with AoA without adding any cost to the wristband
- Low cost (<$5), low power (1uA/10mA), low latency response (<25ms)
- Widely available radio components
- Good and low cost antenna design (on the wrist and >100m)
- 802.15.4 based propriety protocol: synchrone, small time slots, multiple bands, space diversity

Concept



Trilateration
RF energy is received by minimal 3 basestations,
Location is determined in coordinator

$$E = \frac{\sqrt{30 \cdot P}}{d}$$

where

E is the electric field strength in volts per meter
P is the transmitter power output in watts
d is the distance from the radiator in meters

PoE

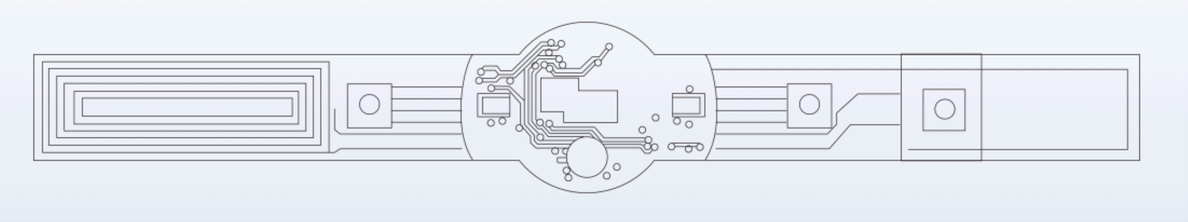
-Management tools
-Security and staff data
-Visitors counts and crowd control
-Friends finding ,
-Social features

What is in the Wristband?

NFC antenna

868MHz chip

Push button



RGB LED

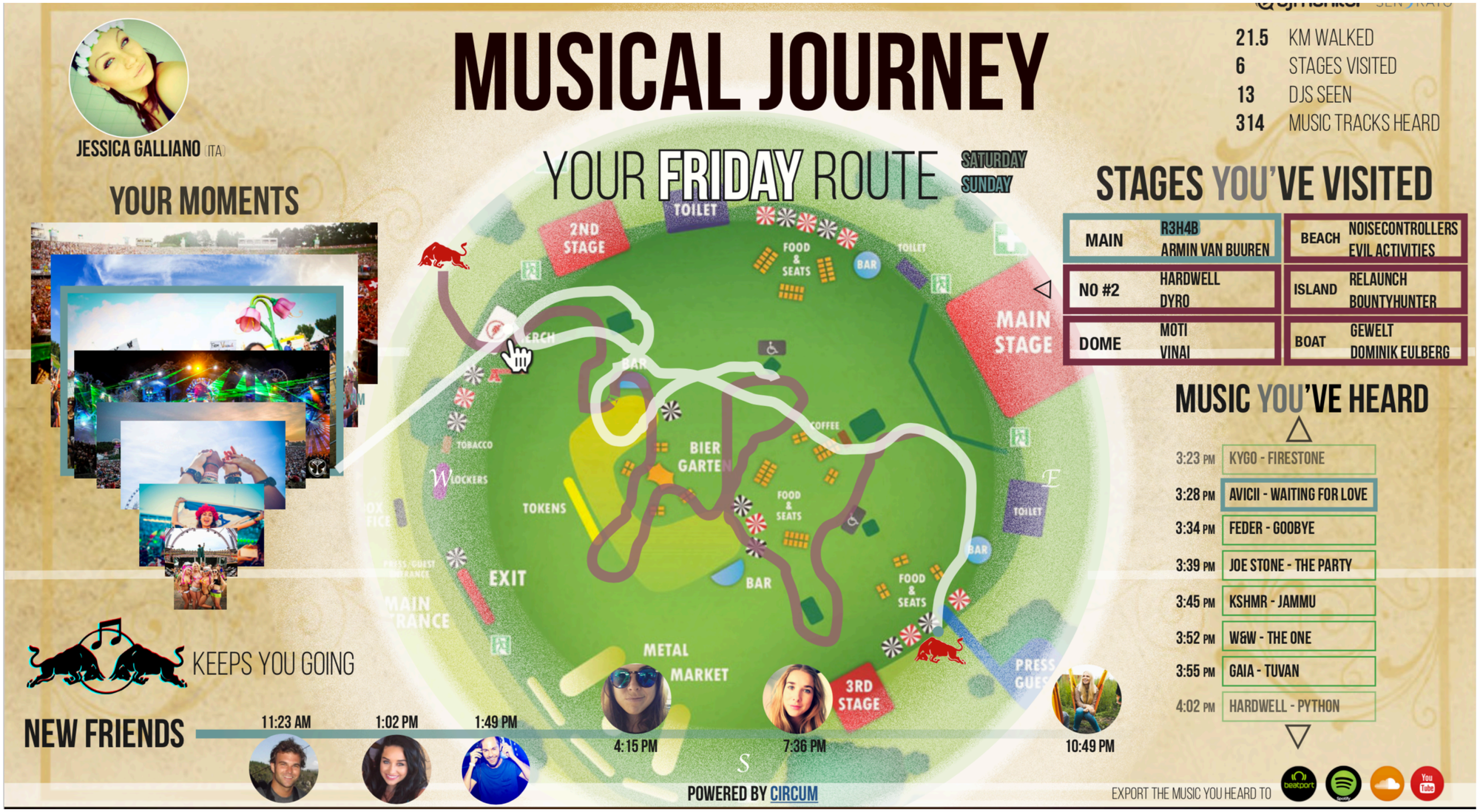
RGB LED

RF Antenna

Infra structure

- For Tomorrowland we required 70 base stations
- This required two weeks setup time

Example result



The next steps

- Can we use this method for tracking in (large) Smart Buildings?

example: World Trade Center Delhi

WTC building Delhi:

- Floorspace 500,000 m2
- 20,000 visitors and 30,000 workers per day
- 8 towers
- parking garages
- 100,000 wireless networked sensors

Example: Apple Park

Apple Park In Early 2017 Apple finished construction on their new massive office building: Apple Campus 2.

It will house 12,000 workers in the 260,000sqm building.

The Apple Campus 2, is the worlds largest (and also green) work space

Smart Buildings

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- A smart building is like a personal assistant
- It knows what you want and provides the right conditions to work, sleep, meet, drink coffee etc
- More comfort for users, predictive maintenance, security, safety
- This requires plenty sensor data and determining the location of each visitor and employee

Smart Buildings

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- Thousands of sensors in a building
- Sensor network standards based on 802.15.4 technology (Thread, ZigBee, IP500, Propriety, BLE)
- Major issue for management decision is support and sensors and actuators reliability over 10 year time span

Requirements

- Location 10m and in-room
- Use by visitors and employees should be made intuitive and automatic
- Very low cost technology; products must be CE, VdS certified
- Proof of reliability and support system for long term

Practical verification with 2k visitors

Acquired Conference Parameters:
- occupancy per area over time
- number of total visitors
- number of person-to-person contact
- flow over time

Success:
Installation of RF access points
Network infra structure
Data processing
Convincing Presentation to management

Smart Building Tech Lab

- New Initiative
- Verifying of the operation of many OEM products
- Combining existing standards with our location technology and processing software in order to real time locate many people
- 50,000 m2 test space + 2 level garage

Thank you

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