InPercept

Make prisons safe again!

researchXchange - presentation

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01.10.2021

How it all began

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Armin Schmidt

- BSc Electrical Engineering (Embedded Systems and Management)
- MSc in Engineering (ICT)

Thousands of illegal cell phones every year

State of the Art

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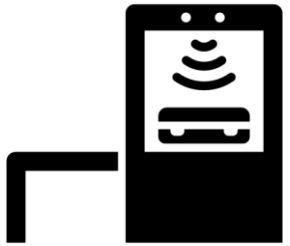

Personal searches at the prison entrance **or recurrent searches of inmate cells**

- Extremely time consuming and therefore costly
- Can’t uncover all cell phones
- Problem of corruption

Jamming of mobile communication **or Fake Base-Stations**

- Neighborhood is effected too
- Problematic due to needed concessions

Detection sensors in each inmate cell

- Expensive
- Problematic due to vandalism

Problem Statement

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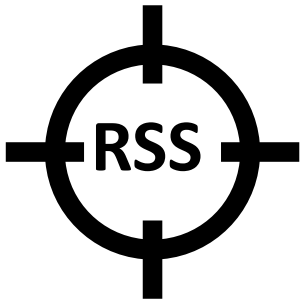
- **A feasible solution** has to be
  - As **automated** as possible
  - Central logging to **prevent corruption**
  - Should **not disturb** the neighborhood
  - Using as **few sensors** as possible

- Our institute is developing since 2012 a **system for indoor localization**
  - Is based on fingerprinting using RSS
  - Supports 2G, 3G, 4G and 5G communication standard on all currently used mobile frequency-bands



Our Solution

Based on protected IP's

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- Based only on received signal-strength
- No signal decoding necessary
- No active transmission of signals
- Small number of sensors
- Published at IEEE Conference: IPIN in Pisa 2019

IPIN 2019
TENTH INTERNATIONAL CONFERENCE ON
INDOOR POSITIONING
AND INDOOR NAVIGATION
30 September - 3 October 2019, Pisa, Italy

The approach is a novelty in literature and there are no third-party patents restricting us.

Our Solution

Fingerprinting-Algorithm based on RSS

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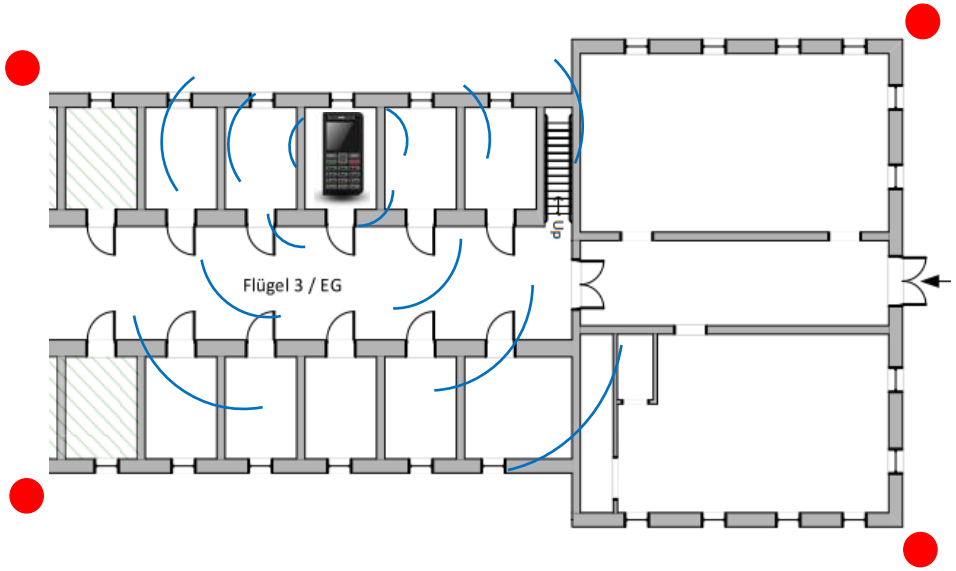
- **Problem:**
  - **No direct access** to the mobile-communication signal and therefore no RSS estimates

- **Solution:**
  - **Multiple antennas** are placed around the building
  - RSS of a specific cellphone is estimated from all sensed antenna signals



Our Solution

Coverage of all Frequency Bands

- **Problem:**
  - Hardware has **limited Bandwidth**
  - Provider bands range from 700MHz to 2.6GHz
  - Antennas have **limited view on building**

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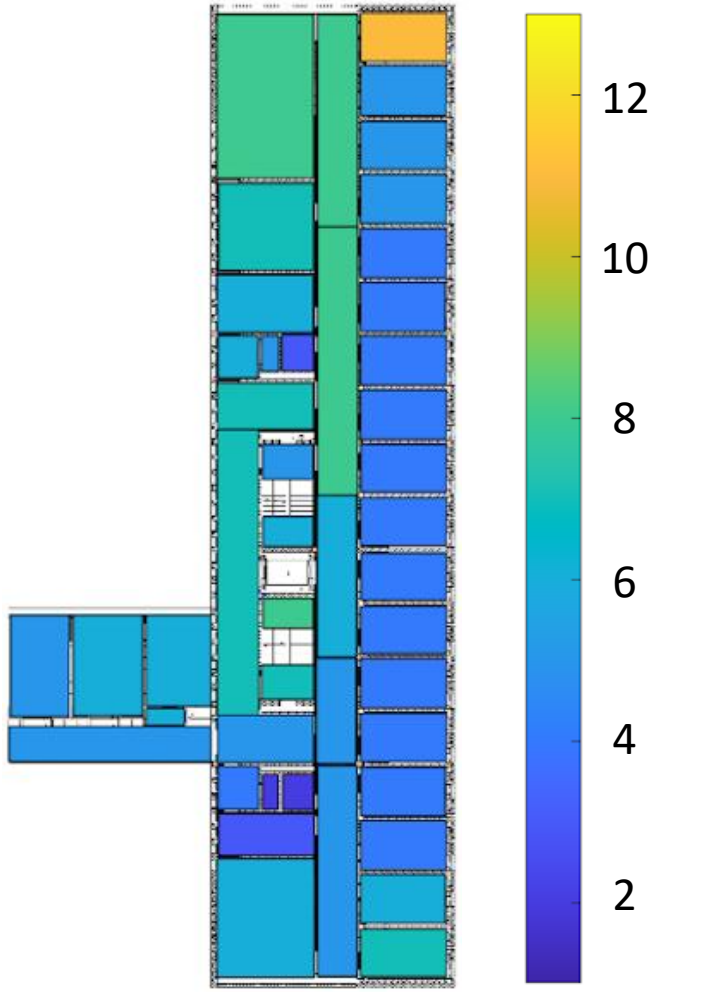

Our Solution

Coverage of all Frequency Bands

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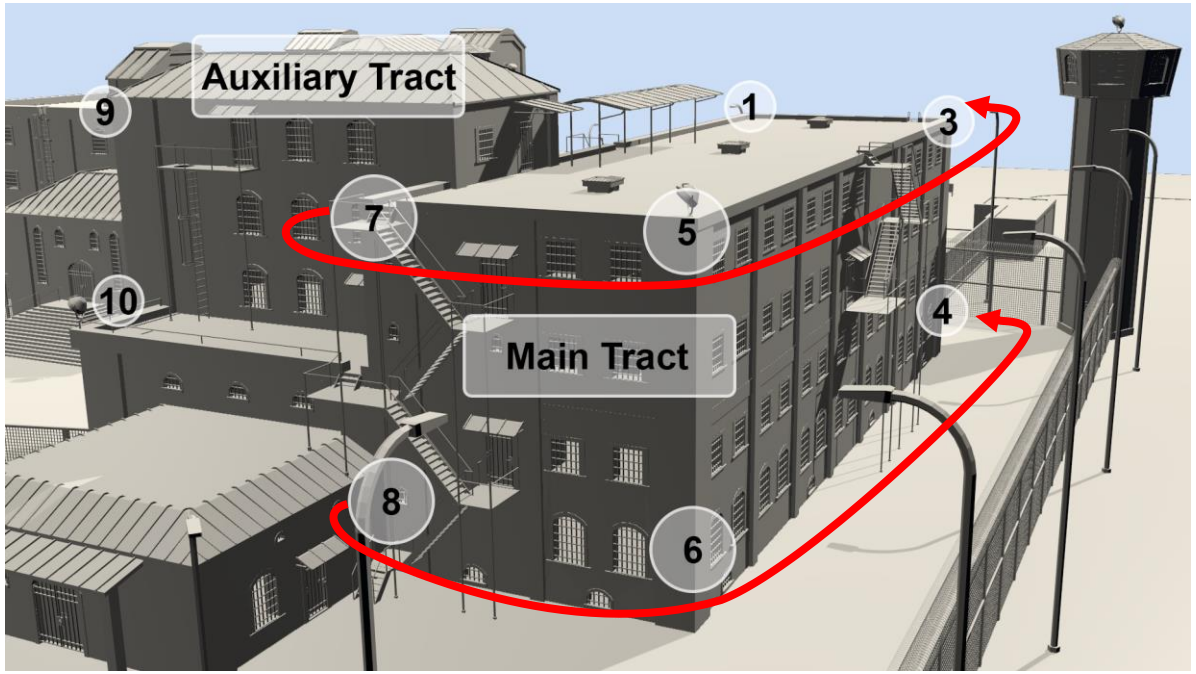
- **Solution:**
  - **Two mode operation** (Scanning/Localization)
  - Frequency **band rotation**



Our Solution

High cell phone activity in the vicinity

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- **Problem:**
  - High cell phone activity in the vicinity due to penitentiary staff
  - Leads to unwanted detections
  - … and **partial blindness** on other frequency bands

Our Solution

High cell phone activity in the vicinity

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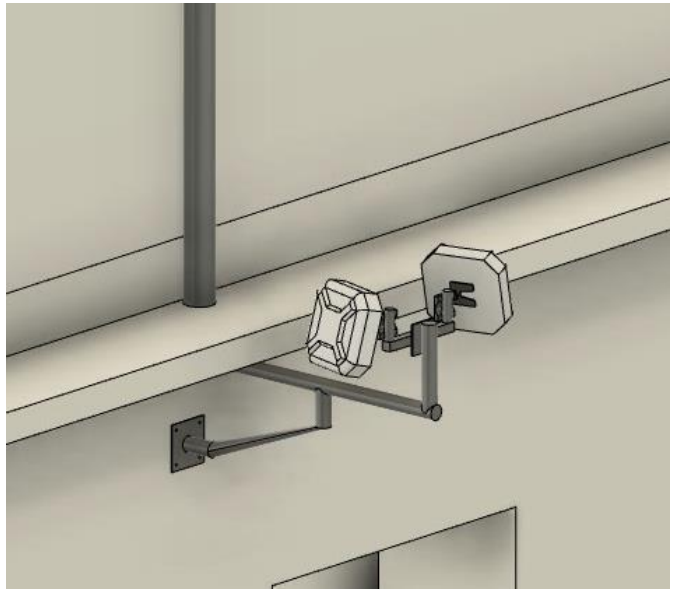
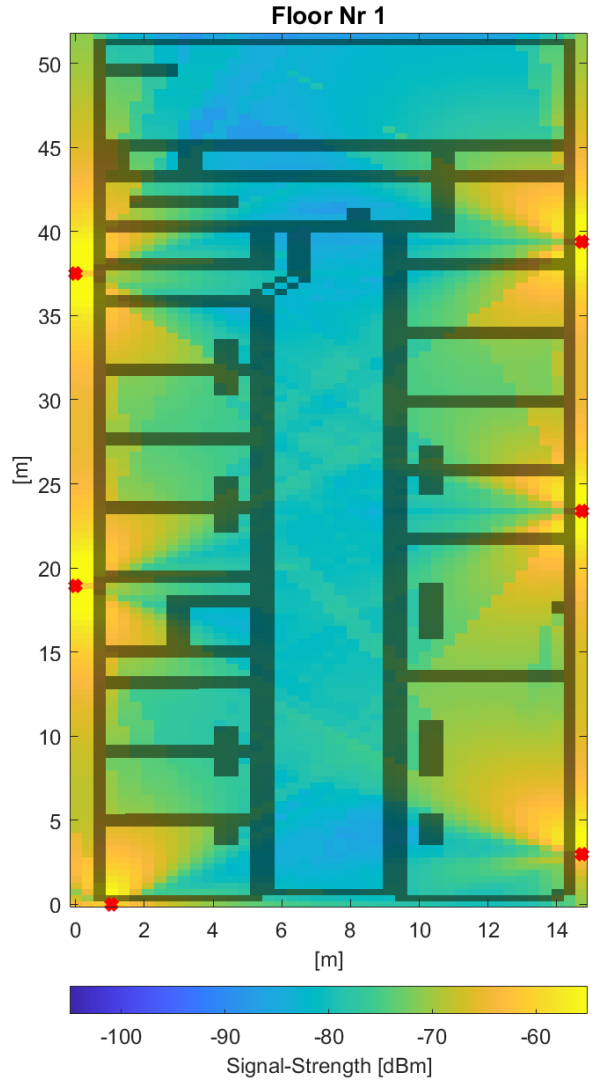
- **Solution:**
  - **Directional** Antennas





Our Solution

High cell phone activity in the vicinity

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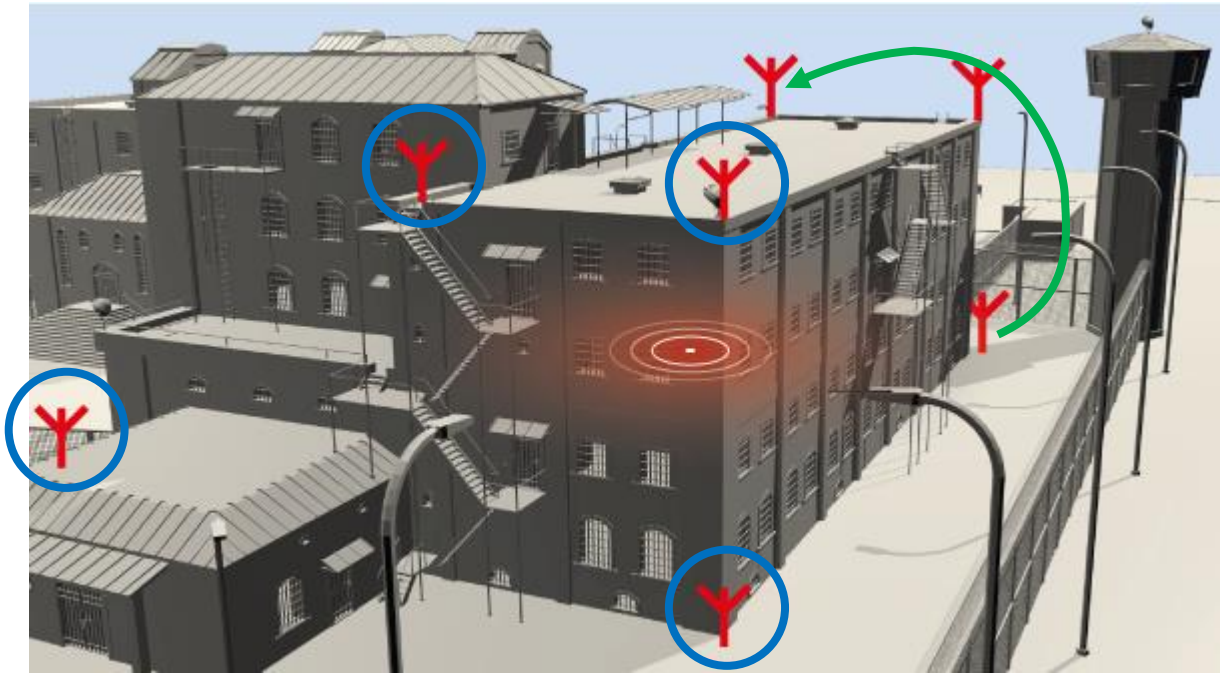
- **Solution:**
  - **Directional** Antennas
  - **Parallelization** of Scanning and Localization
  - **Subspace Approach**



Our Solution

Based on extensive validations

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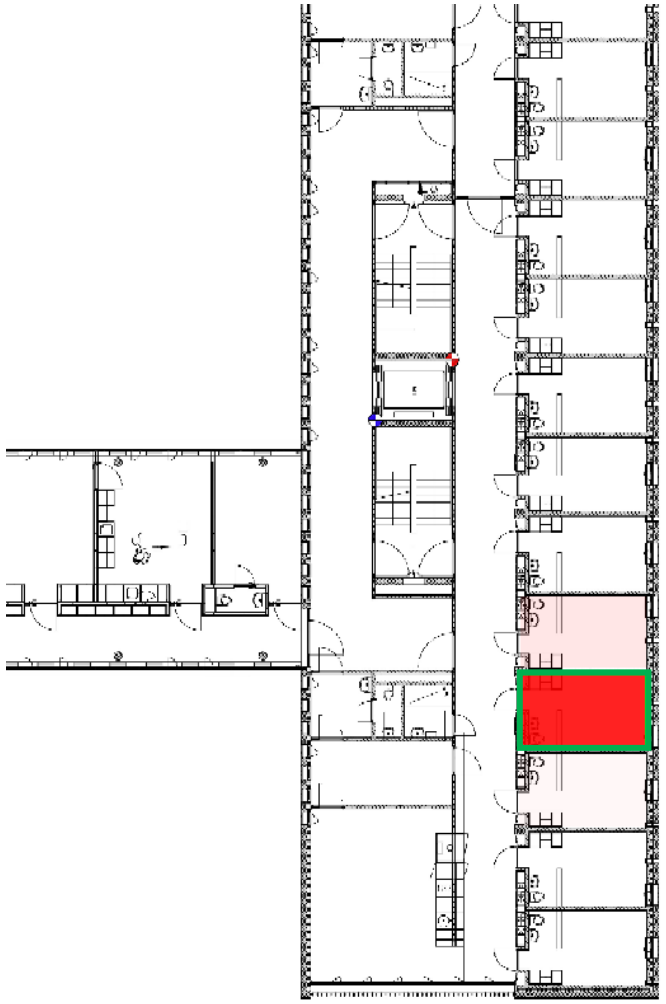
- **Validation-Setup:**
  - First prototypes were tested in Prison **Lenzburg** and **Bellechasse**
  - **Current demonstrator** is installed in a large Swiss prison with **two buildings** (four and five storeys respectively with over 200 cells/areas per building)
  - **Offline-Validation**
    - On 800MHz, 2100MHz and 2600MHz
    - 20’000 recordings per frequency band in over 200 cells/areas per building
  - **Field Tests**
    - Randomly selected inmate cells
    - Dispatch SMS



Our Solution

Offline Validation

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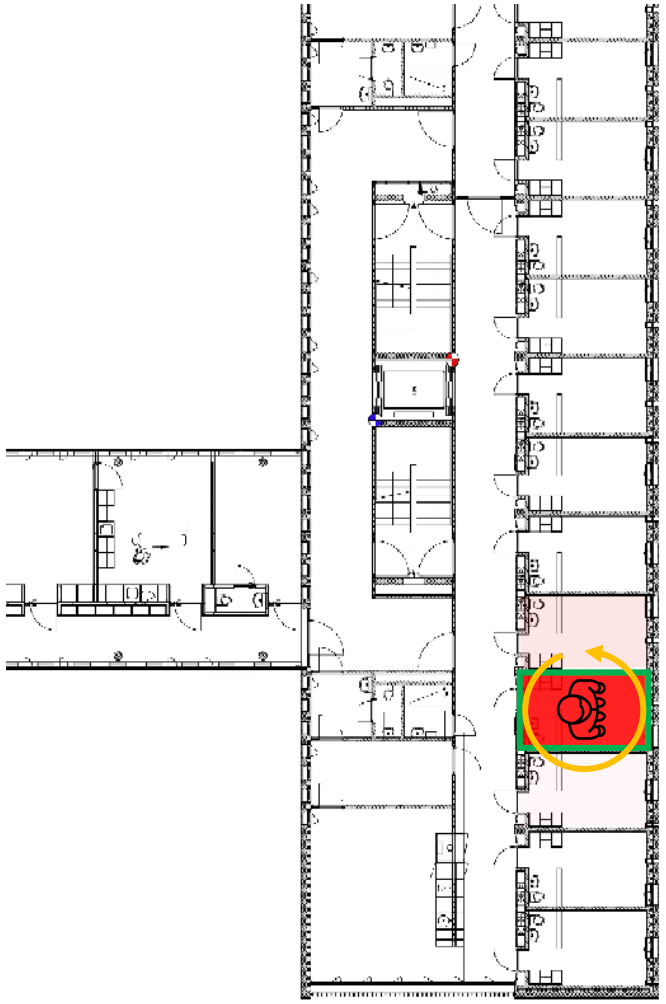
- **Results Building A**
  - Cell Accuracy: **51%**
  - Dispersion (< 1 cell): **95%**
  - Error-Distance (i70, i80, i90):
    0.38m, 0.7m, 1.4m

- **Results Building B**
  - Cell Accuracy: **71%**
  - Dispersion (< 1 cell): **95%**
  - Error-Distance (i70, i80, i90):
    0.06m, 0.3m, 1.3m



Our Solution

Field Tests

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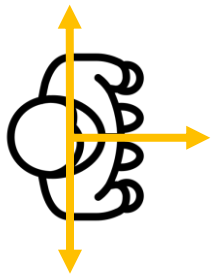
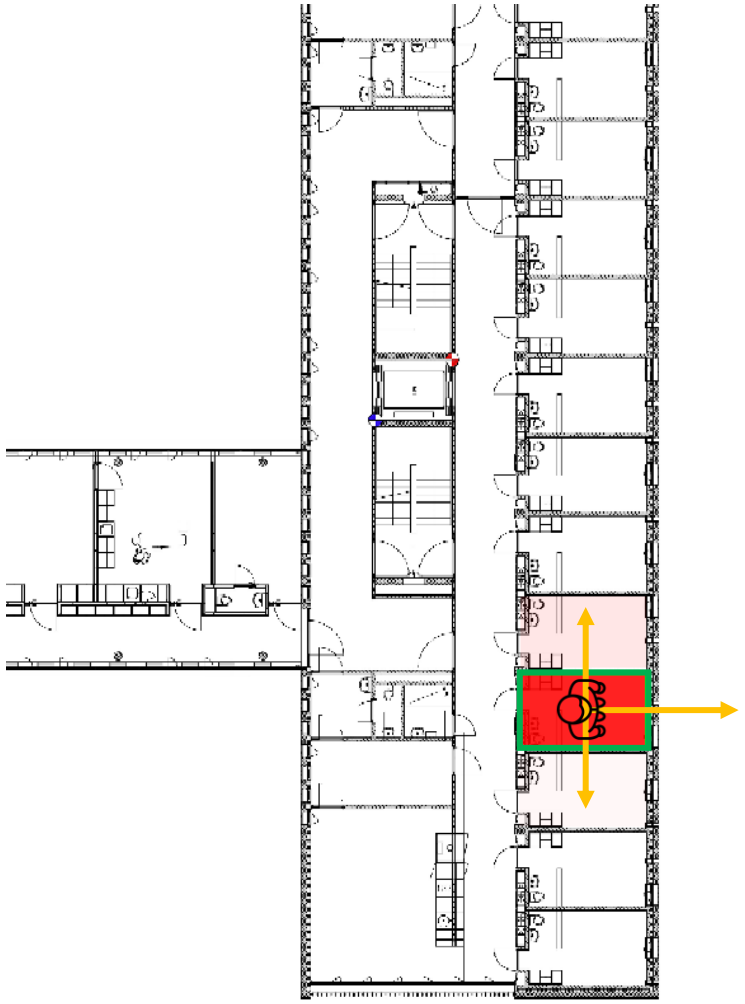
- **Results** for building B so far:
  - Detection sensitivity: **98.4%**
  - Similar results in localization-performance like in offline-validation, when following same test-protocol
  - Orientation of Test Person has a large effect on localization





Customer Segments

… and Market Potential

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Total Indoor Localization Market:

- Global Indoor Location Market 2018 - 2023: $58 Billion, CAGR 42%
  - Intrusion-Detection
  - Monitor employees in hazardous environ.
  - Logistics (Industry 4.0)
  - Navigation / Marketing

Our Focus on Correctional Facilities :

- Estimated market penetration of 20%
- Switzerland and neighboring countries: 600 up to 900 salable Systems
- 60 sold Systems in the first 5 years: CHF 5 Mio.

Our Valuepropositions

… and our Findings

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High localization precision ?

In 95% of all cases error lower than one room-size, but orientation of test-person can have large effect on precision

24-7 and comprehencive ✓

System searches and localizes around the clock and in the complete building under surveillance

No regulatory barriers ✓

Due to the passive approach of our system and since the received signals need not be decoded, no legal permits are required.

Due to the minimal intervention in the building structure, even listed objects can be equipped

Easy to use technology ✓

Easy user interface with live and retrospective analysis for forensics

Concealed operation ✓

Sensors are mounted outside of the monitored area and vandalism/shielding is therefore no issue

Cost effective installation and usage ✗ ✓

Easy Facade mount and no vandalism-protection needed

Due to centralistic data-processing, easy upgradable to new mobile communication standards

Business Model

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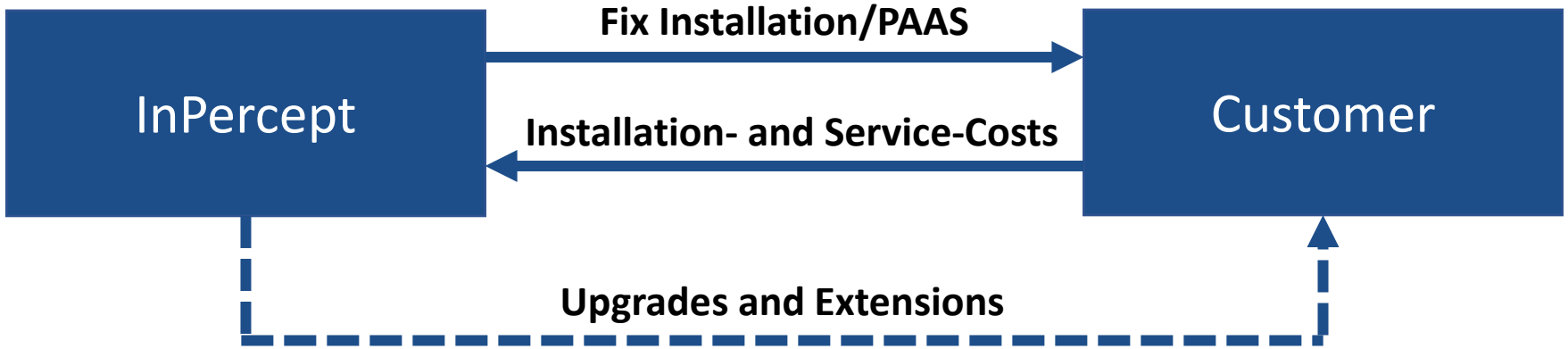

Fix Installation:
Antennas and processing unit is installed and sold as a package (directly or over partners)

Product as a Service (PAAS) Installation:
Antennas are installed permanently, processing unit is shared between different locations.

Customer Aquisition Costs: CHF 5000

Livetime Service/Product: 10 - 20 years

Roadmap

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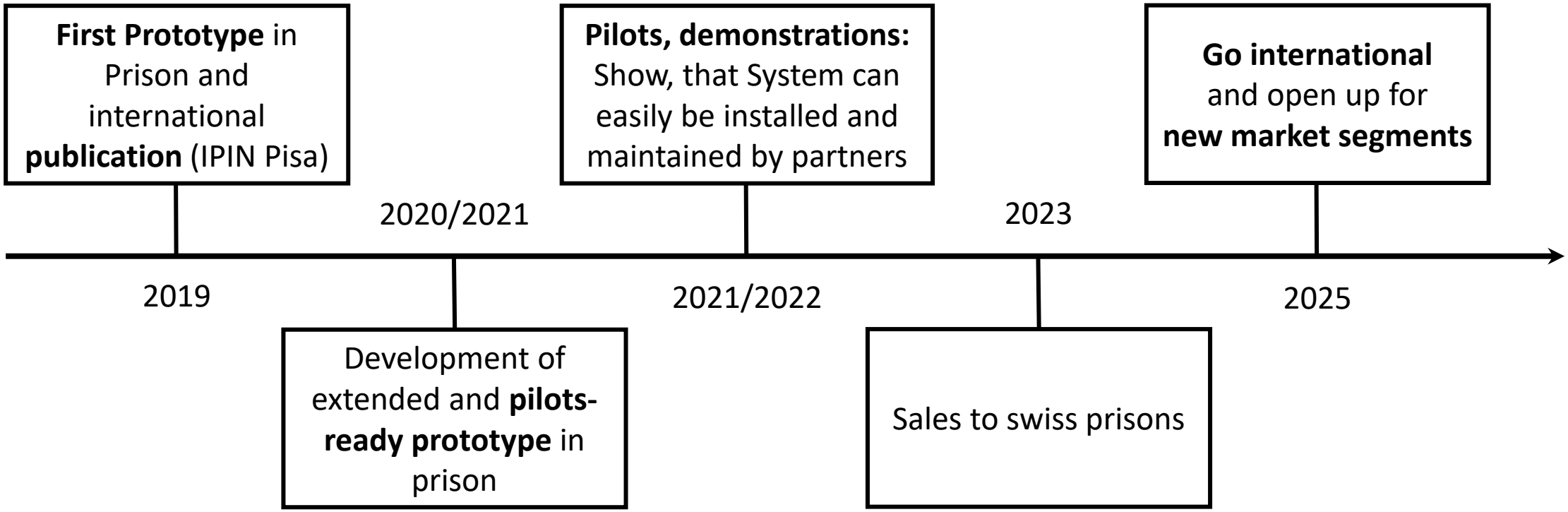

Our Conclusion & Learnings

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+ High localization-accuracy
+ Value proposition is working
+ Urgent need confirmed
+ Upgrade- and service-contract important
+ Trustful cooperation with international company

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– Human body has larger effect on localization-performance than expected
– More activity in/around penitentiary than expected
– Construction costs are higher than expected
– Electrical installation-skills needed

Give illegal cell phones no chance…

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Questions?