PSCR 2020:

THE DIGITAL EXPERIENCE

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LMR Data Collection For Traffic Modeling

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*** Please note, unless mentioned in reference to a NIST Publication, all information and data presented is preliminary/in-progress and subject to change**

Contents

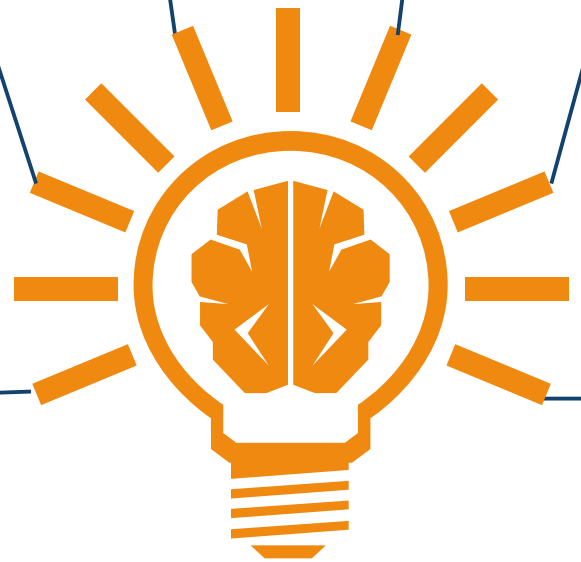
- Why do we need LMR call data?
- What data is useful?
- How is PSCR collecting the data?
- What can we learn from the data?
- What does success look like?

Why Do We Need LMR Call Data?

How are the different modes (i.e., infrastructure-based and direct) used?

Comparison of LMR to LTE (PSCR-wide focus).

How do we implement Mission critical voice on other technologies (e.g., LTE and 5G)?



What does mission critical voice look like?

Lack of publicly available MCV data/models.

Development of standards, equipment, and network.

What Data Is Useful?

LMR Radio User Location

Call Time/Duration

Calling User ID

Called User/Group ID

How Is PSCR Collecting The Data?

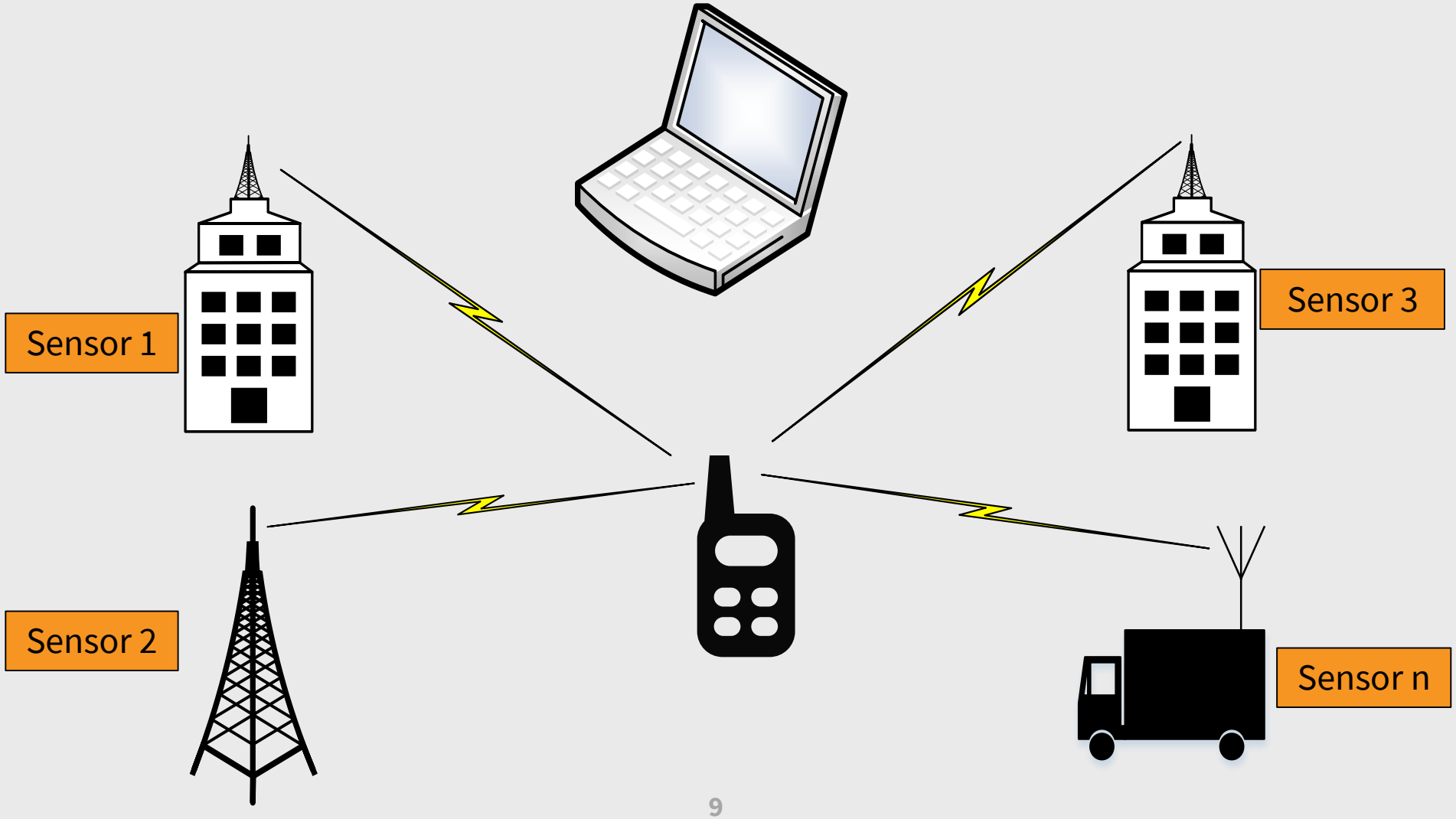
- LMR Equipment Geolocation
  - Commercial solution with custom RF equipment
  - Measure user location when transmitting
  - Multiple sensors placed around measurement area (3 minimum)
  - User location estimated from hybrid of signal time difference of arrival (TDOA) and received signal strength (RSS)
- LMR Decoding
  - If available
    - P25, Analog Digitally Coded Squelch (DCS), Motorola Data Communications
  - Software defined radio (SDR) equipment
  - Decode user and group IDs

Sensor Site Components

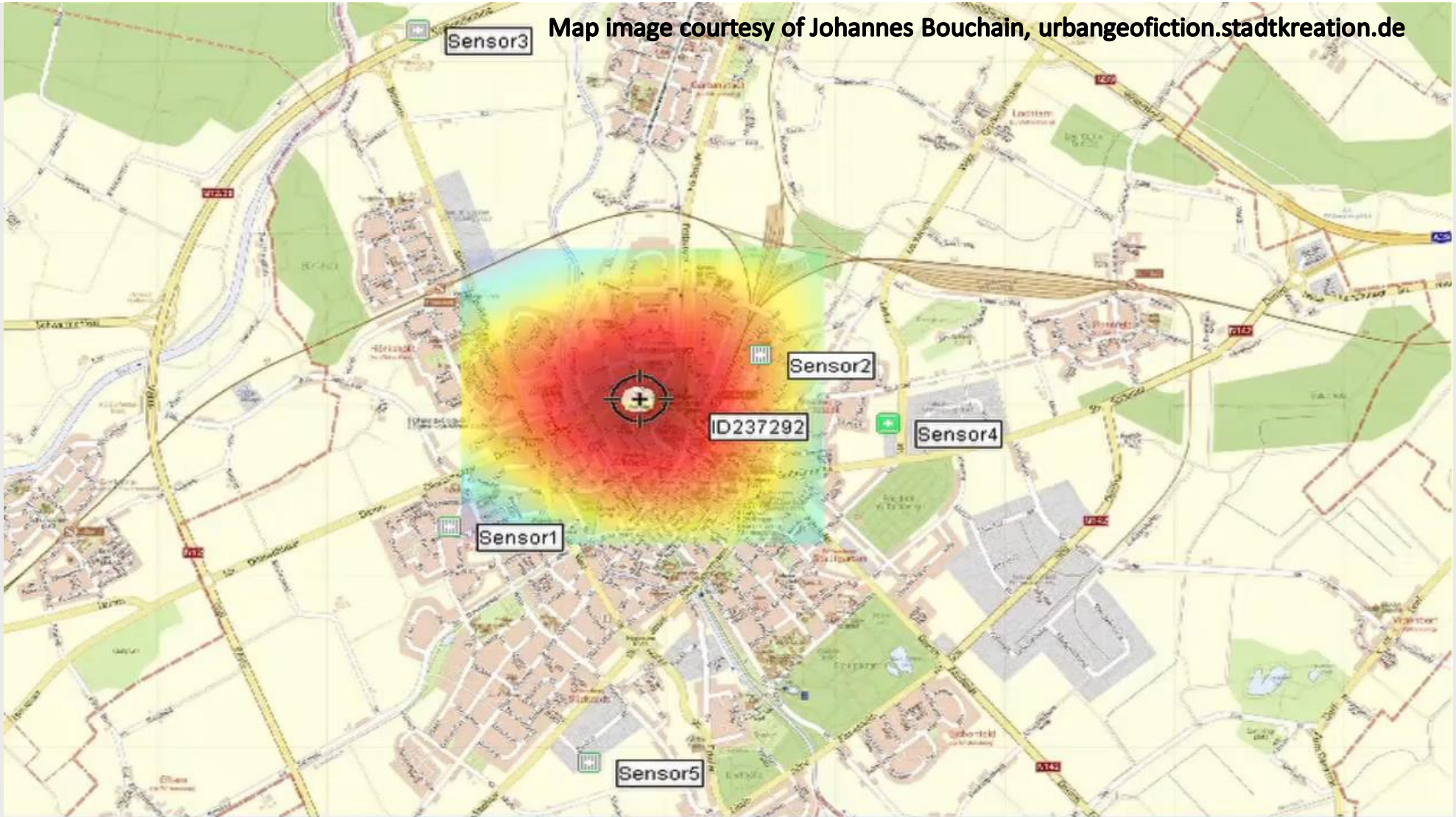
- RF Sensor
- Bandpass Filter
- Low-Noise Amplifier
- Antennas
- Linear Power Supply
- Wireless Backhaul

Sensor System

Multi-Sensor Setup



Geolocation Results



Map image courtesy of Johannes Bouchain, urbangeofiction.stadtkreation.de

What Can We Learn From The Data?

Approach:

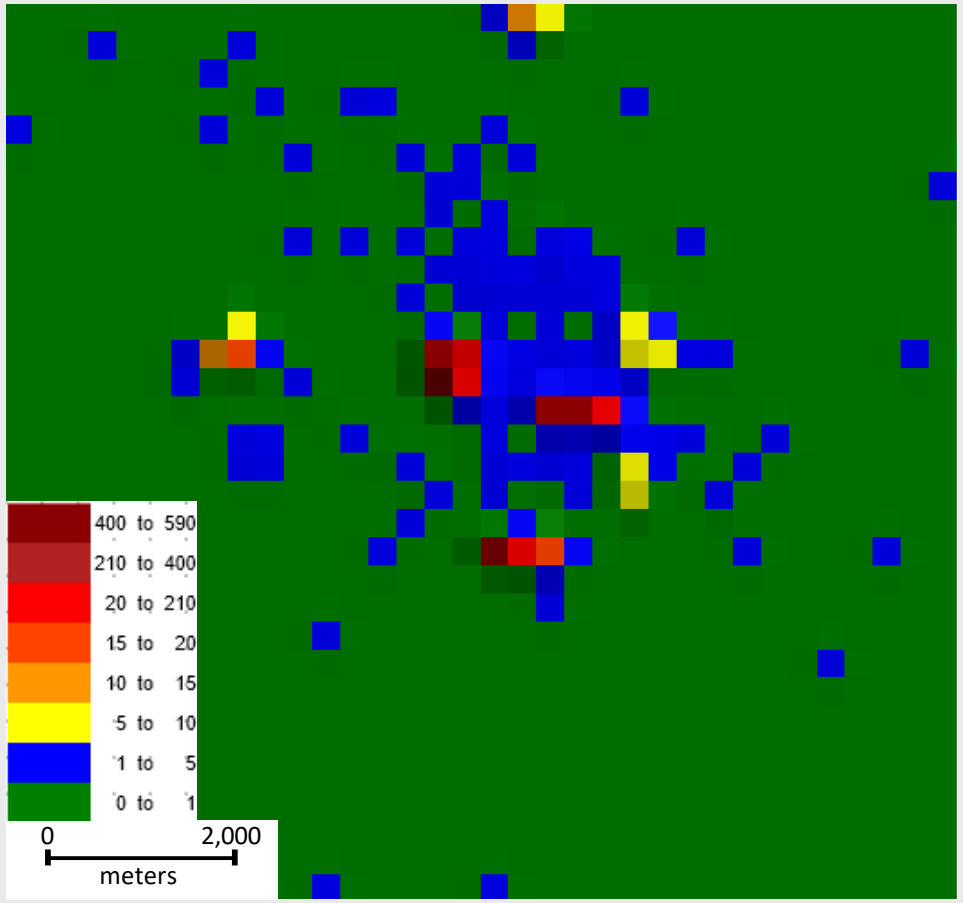
- Call analysis and modeling based on geolocation data logs

Objectives:

- Gain a better understanding of MCV call statistics, both spatially and temporally
- Analyze information and propose models (next steps) on several aspects of public safety users' behavior which may be independent of the underlying network infrastructure (e.g., LMR, LTE, 5G)
- Collect group specific call statistics

Call Density Map

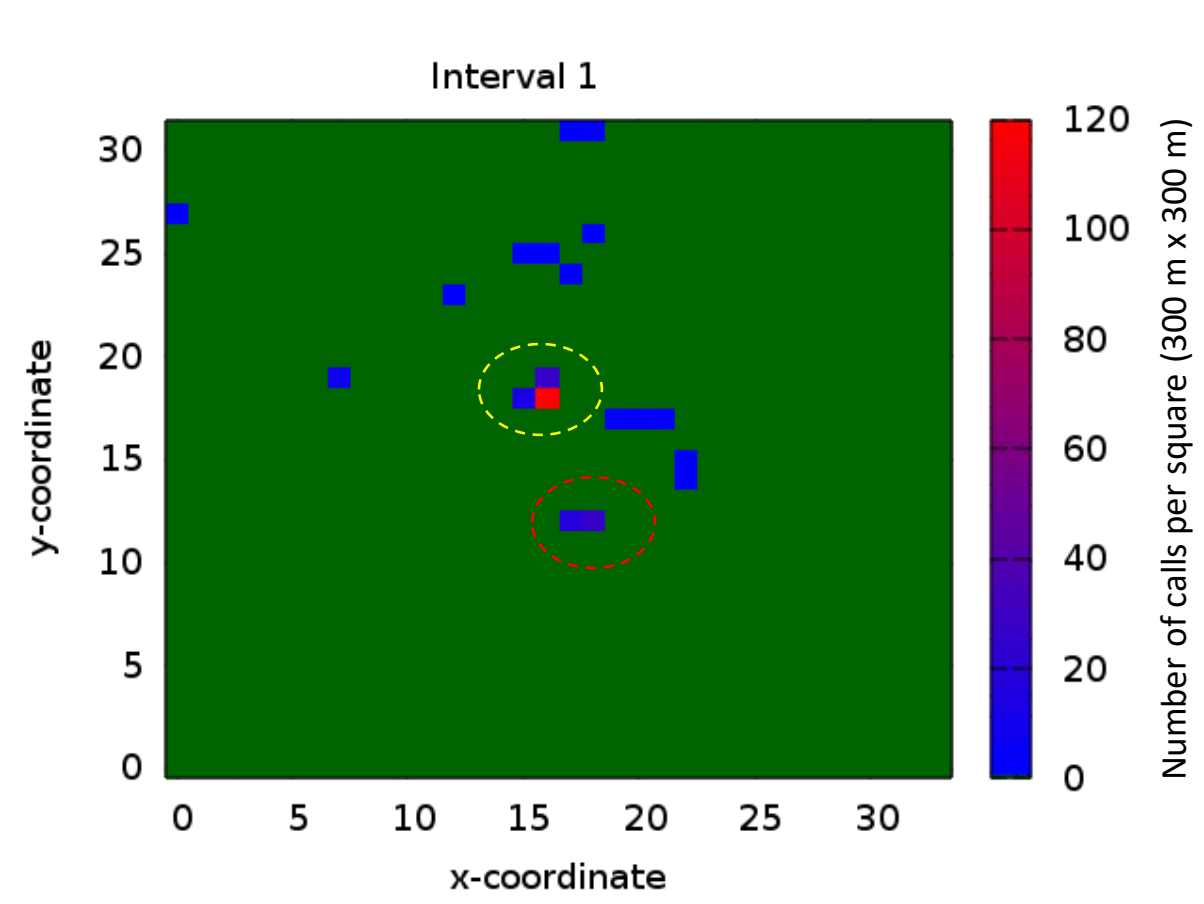
Number of Calls Per Square (300 m x 300 m)



- The color of a square on the map shows the number of MCV calls per square (300 m x 300 m) over a 24 h duration
- Analyzed by Matlab, illustrated by Planet
- Similar analysis can be done for other square sizes or durations

Call density map may be used to assist network provisioning, base station deployment, etc.

Call Density Map Over Time

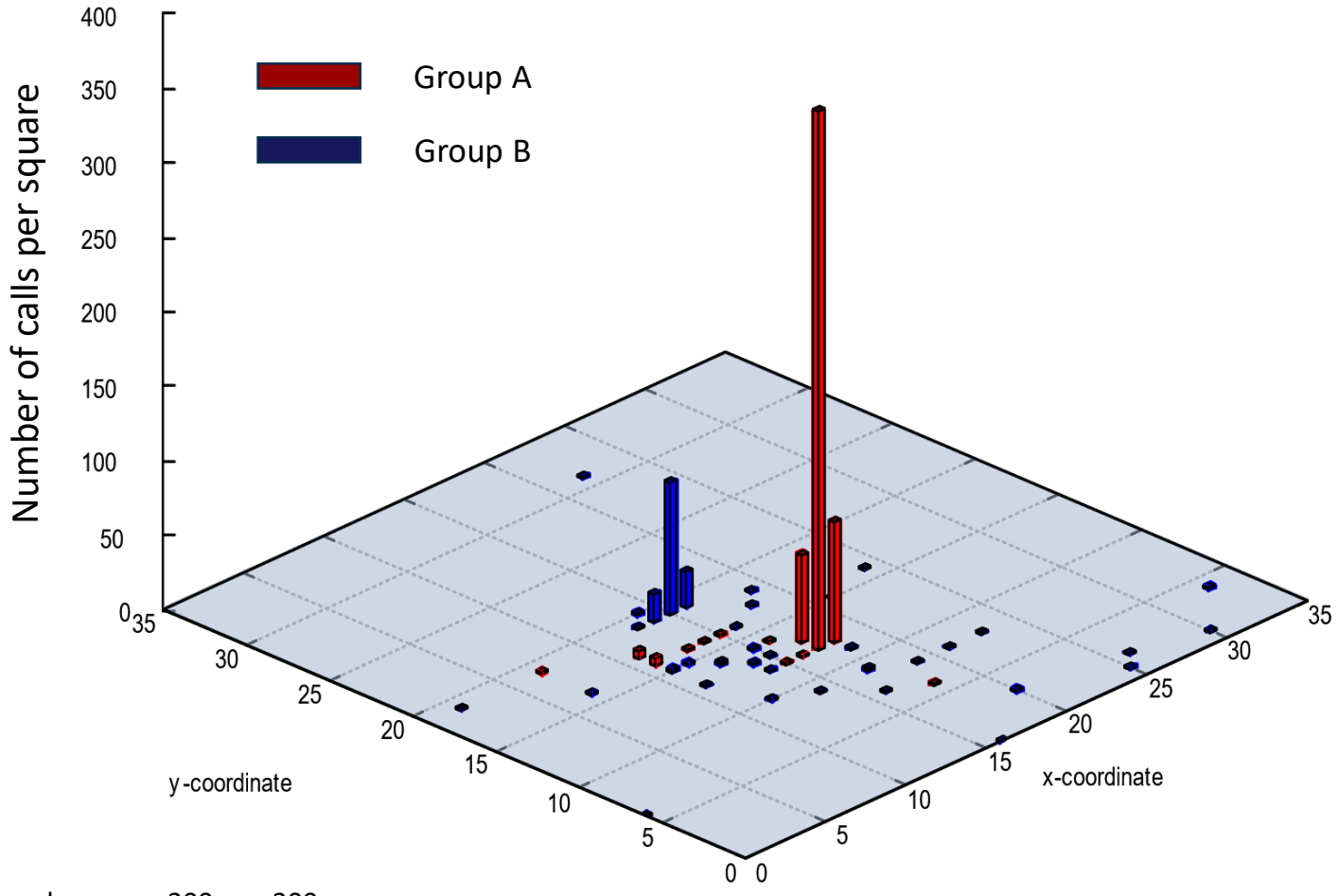


- Each snapshot shows the number of MCV calls per square (300 m x 300 m) over a 3 h interval. The 8 snapshots correspond to an entire duration of 24 h, starting from 6pm

- Observations: calls in different areas reach peak hours at different times throughout the 24 h duration and show distinct characteristics

MCV calls distribution needs to be modeled both temporally and spatially

Group Specific Call Statistics

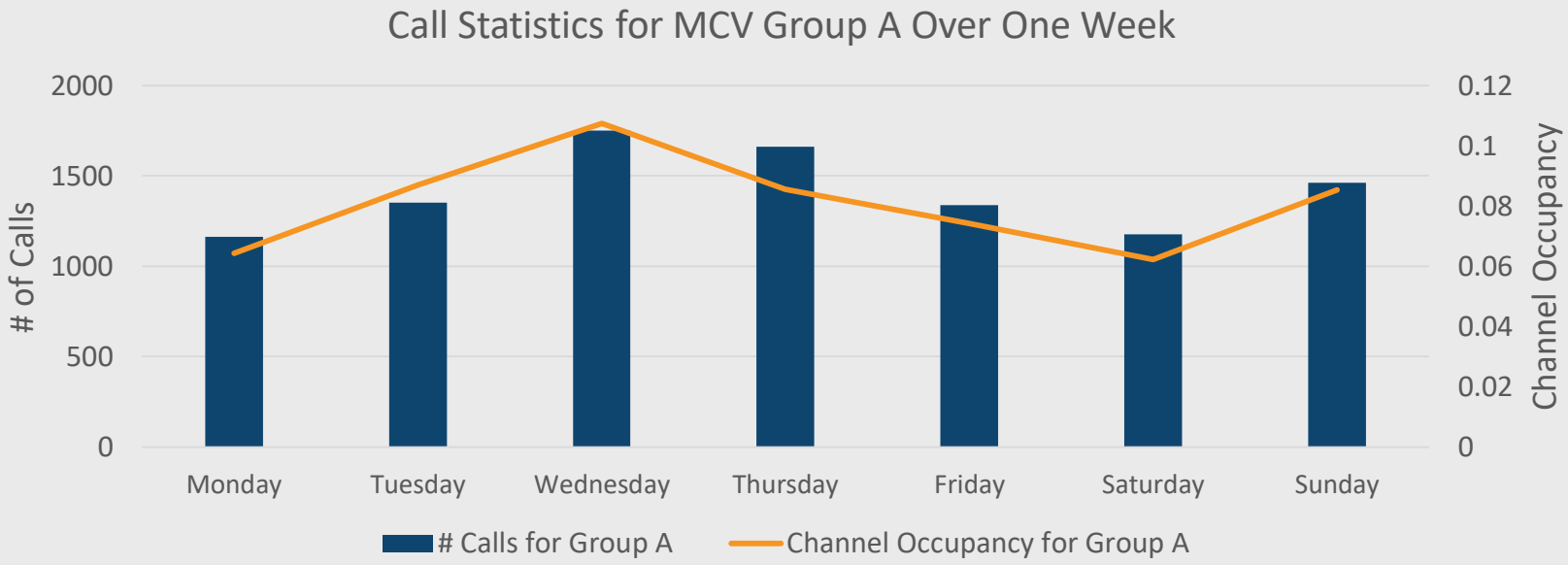


each square: 300 m x 300 m

- Observations: call statistics of different public safety groups may vary, e.g., call density map (left), call duration distribution, etc.

MCV calls may be analyzed or modeled according to each individual group. Group specific call statistics may assist resource allocation and frequency coordination

Channel Occupancy & Number of Calls

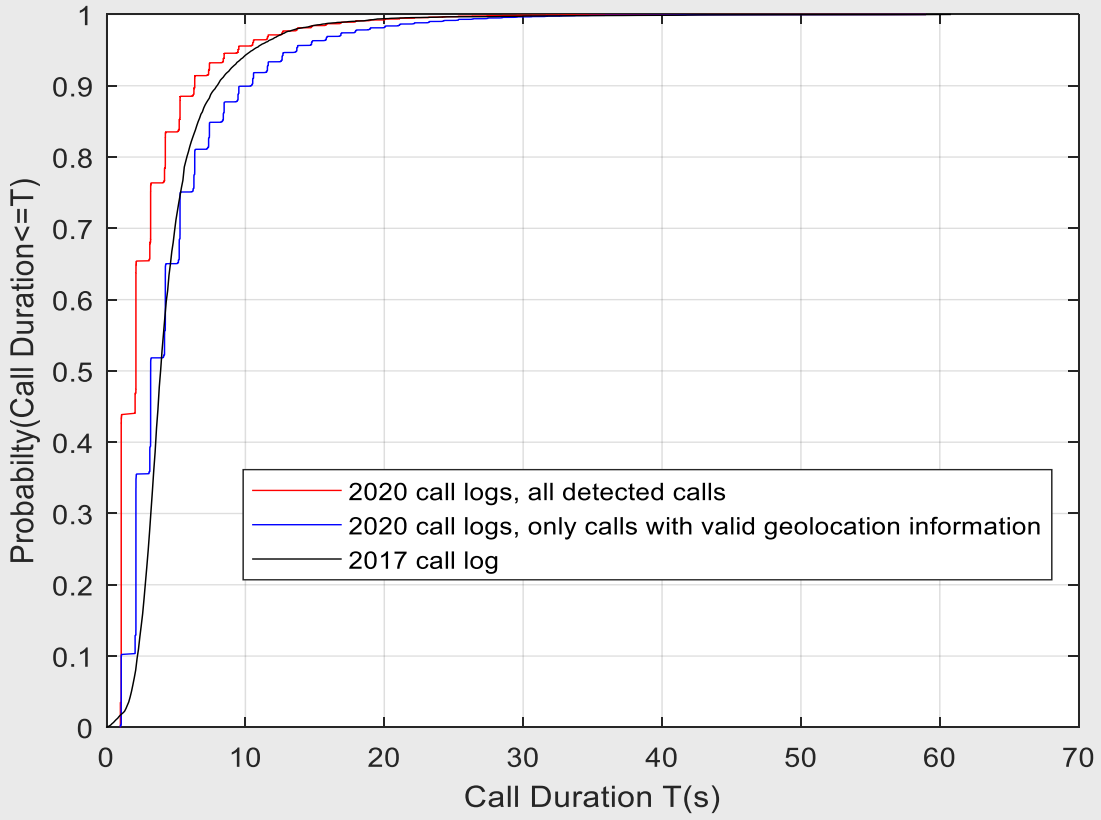


- Observations: the trend of channel occupancy versus the number of calls are similar for the same group, but not fully proportional

Information about channel occupancy and the number of calls may be helpful for carrier assignment and bandwidth adaptation

Call Duration Distribution

Cumulative Distribution Function (CDF) of Call Duration



- The CDFs of MCV calls shown on the left are based on call logs collected in 2017 and 2020, respectively. The curves are similar

The analysis/model of call duration distribution has the potential to provide the public safety community with knowledge that is not limited by the underlying network (e.g., LMR, LTE, 5G). This may be because the conversation scenarios and patterns of first responders tend to remain the same regardless of the device communication technology

What Does Success Look Like?

- Geolocation and Usage Data Sets for Multiple Localities
  - Infrastructure-based and direct mode
- Data Model(s)
  - Describe Public Safety users' use of MCV
  - Different models for different environments/scenarios
- Applications
  - Standards
  - Broadband equipment development and network deployment
    - Get it right the first time
  - Comparison of LMR to broadband

THANK YOU

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