

GOOGLE EXPOSURE NOTIFICATION API TESTING

FRAUNHOFER IIS

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System used to determine the Ground Truth

Reference system

- QualiSys – www.qualisys.com
- Motion-Tracking System consisting of a total of 30 fixed cameras
 - 28 Oqus 7+ cameras for motion tracking
 - 2 Miquis cameras for video recording 1080p@25Hz
- Sample rate 140 Hz tracking data, 25Hz video data
- Accuracy approx. 1 cm
- Synchronization with API by hand signals in video files



Test procedure – API-Daten

- The test runs have been performed with bucket border of 55 dB and 60 dB
- As a recommendation from Google, Pixel 4 devices were used as test devices. Since the device calibrations had not yet been rolled out at this point, we tested with changed bucket borders. We added the calibration offset of 18 dB to the buckets, so 73 dB and 78 dB were used as exposure buckets.
- The device differences were determined on a random basis in a further test. At this point, all devices used were already calibrated. Thus the buckets for Android devices are 55 dB and 60 dB.

Exposure duration and weighting

- The lower bucket border corresponds to a distance of 1.5 meters in non-shaded environments (specification of RKI Robert-Koch-Institute).
- So that typical shading scenarios are tolerated the upper bucket border was chosen somewhat higher.
- The calculation formula of Robert-Koch-Institute for generating the confusion matrices is:

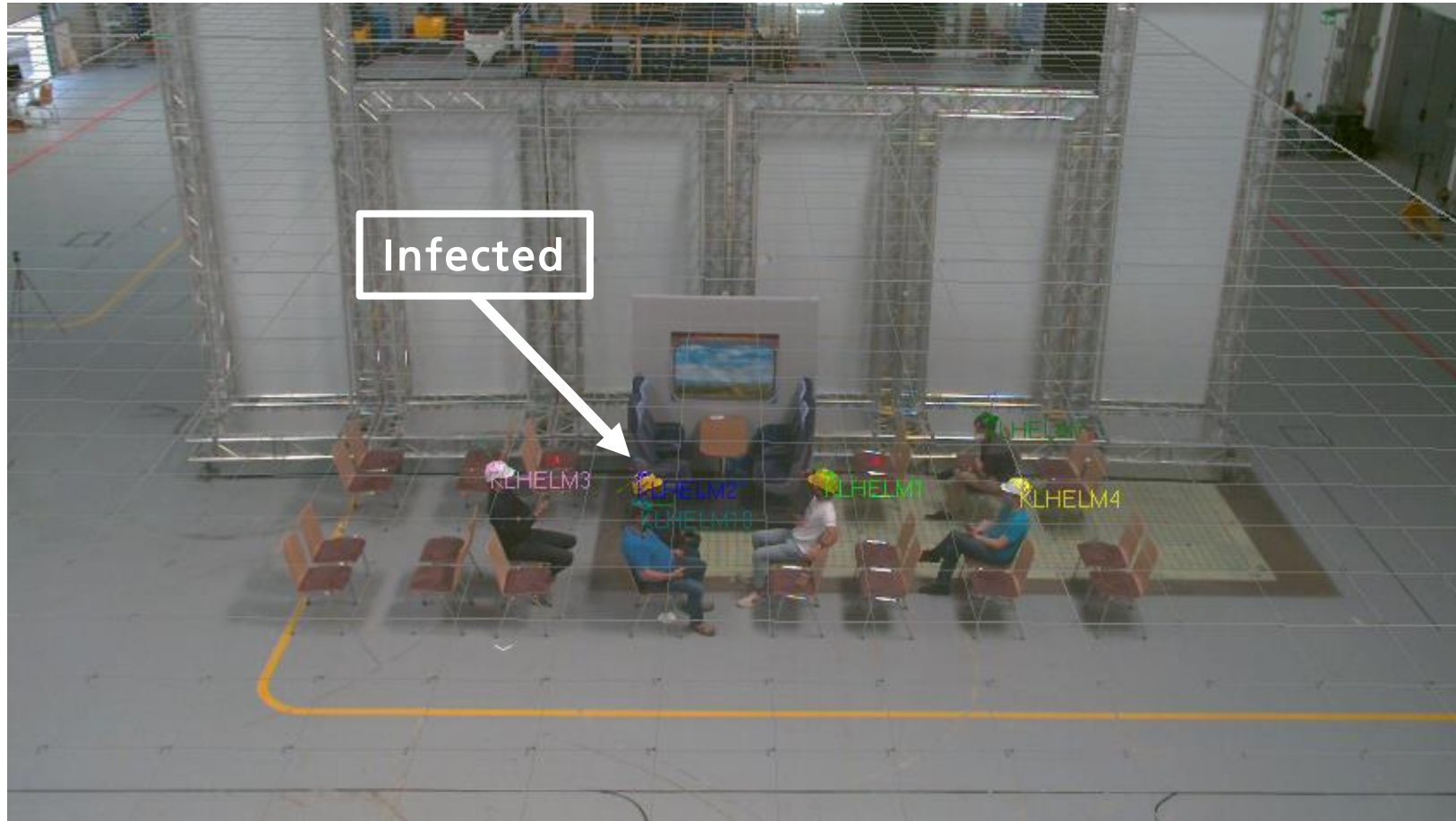
$$Exposure\ Time = w_1 * duration_{near} + w_2 * duration_{mid} + w_3 * duration_{far}$$

- A definition of exposure for **Weighted Confusion Matrix**
 - Detected exposure, if:

$$Exposure\ Time \geq 15\ minutes; w_1 = 1, w_2 = 0.5, w_3 = 0$$

- This definition refers to the API only (API / App attenuation)
 - z.B. $Bucket_{near} < 55\ dB \mid Bucket_{mid} = 55\ dB - 60\ dB \mid Bucket_{far} > 60\ dB$

Real-live Scenario 1 – ICE/train



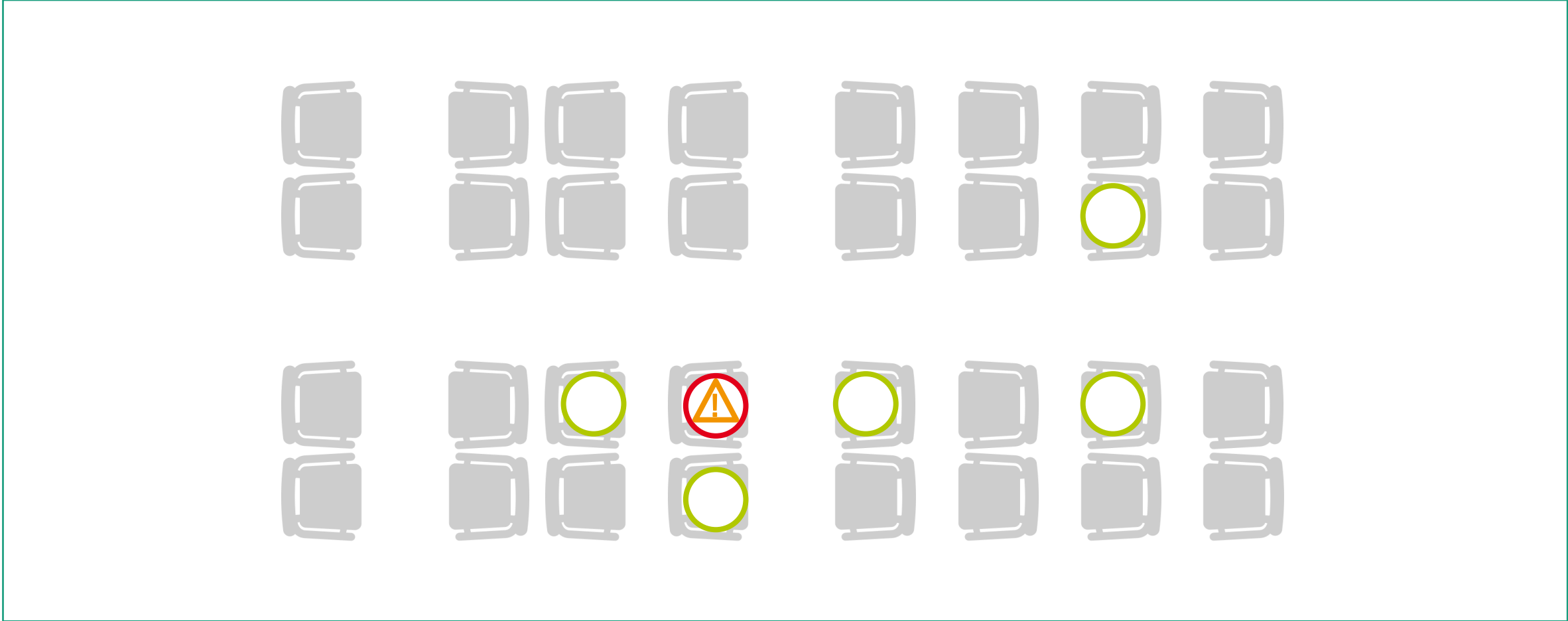
Real-live Scenario 1 – ICE/train

Test procedure

- 5 runs overall
 - Runs 1 to 3: Test subjects held phones in their hands
 - Runs 4 and 5: Two additional phones were carried in the pockets.
- Each run
 - Test subjects sat for 20 minutes
 - The positions have not been changed
 - Devices could be moved in the hands

Real-live Scenario 1 – ICE/train

Test procedure



Real-live Scenario 2 – Queue



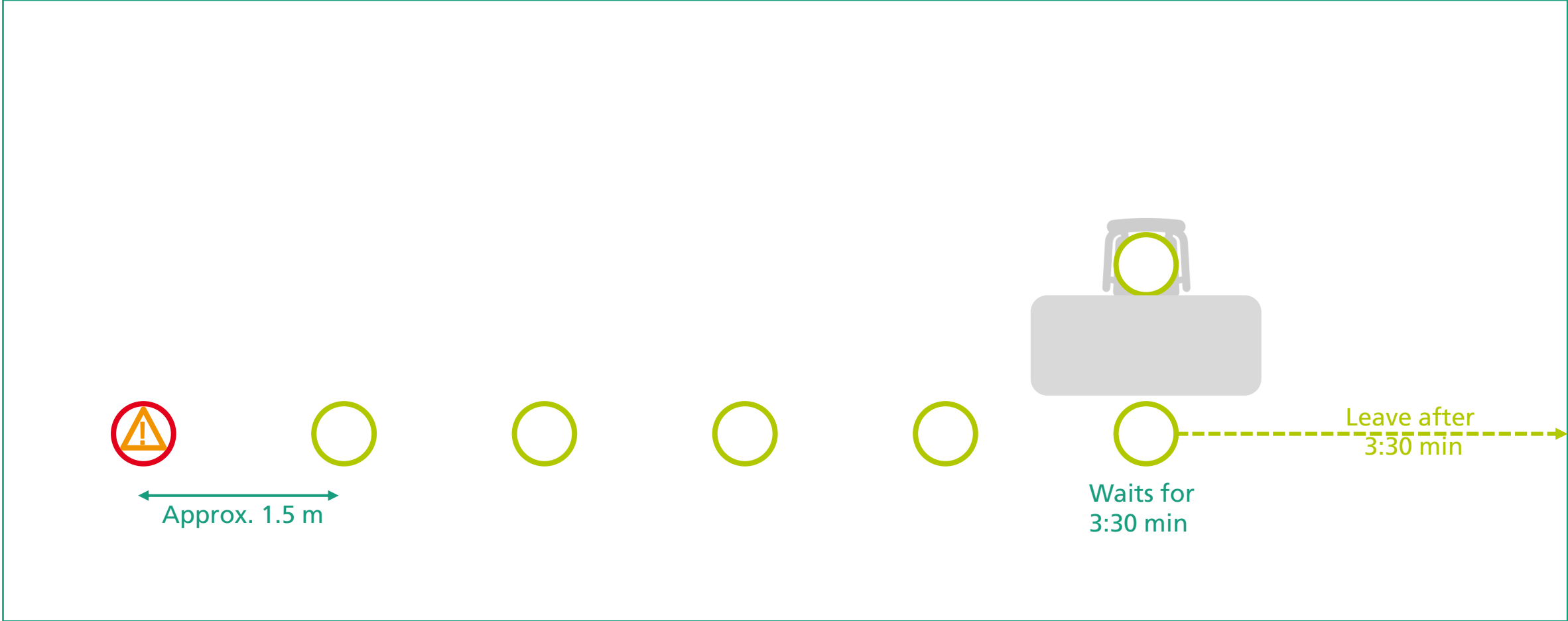
Real-live Scenario 2 – Queue

Test procedure

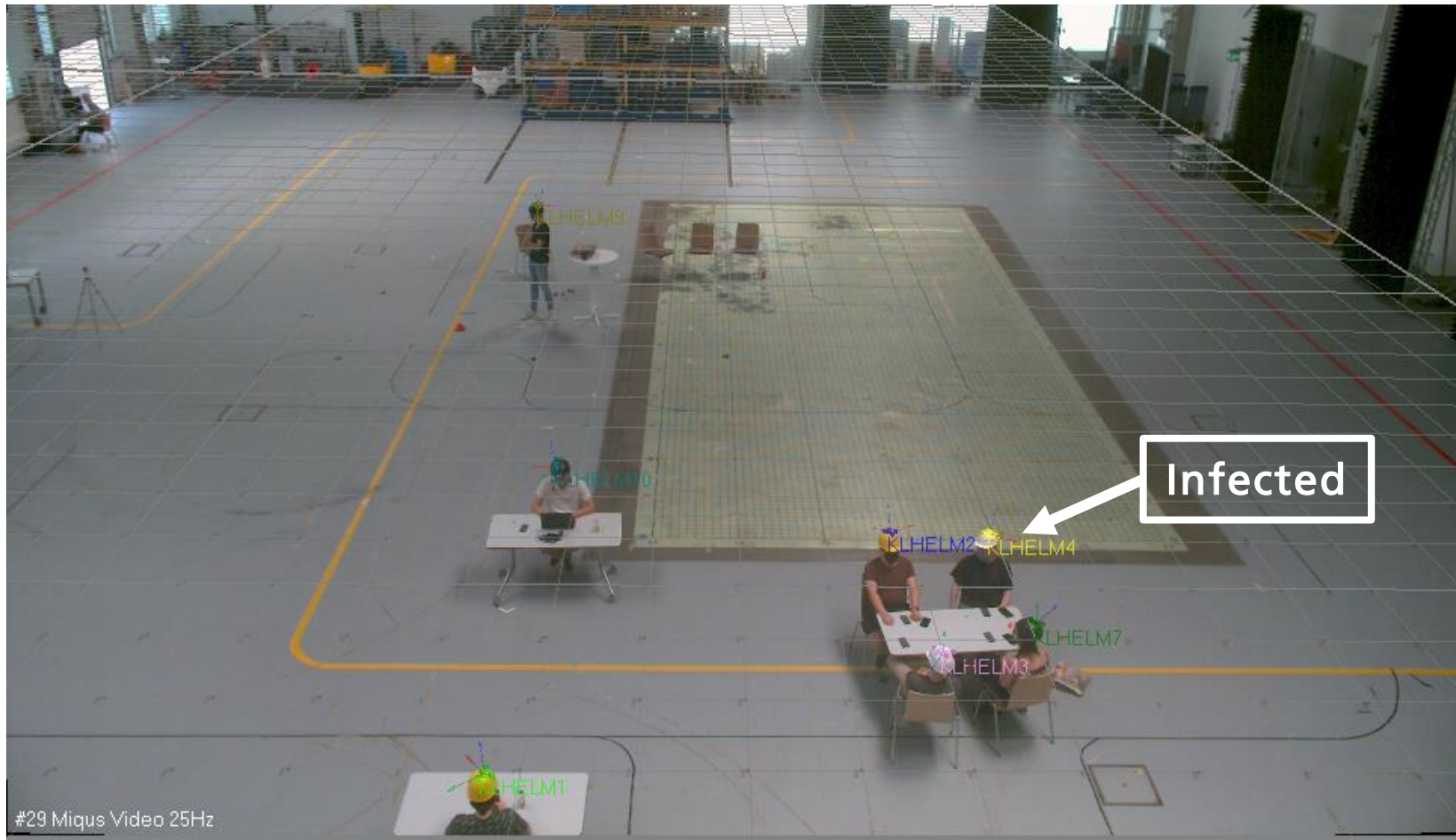
- 5 runs overall
 - Runs 1 to 3: Test subjects held phones in their hands. Devices could be moved in the hands
 - Runs 4 and 5: The test subjects had carried the devices in their pockets
- Each run
 - Each person stood in line and waited for the checkout
 - Each person stood in front of the cashier for 3.5 minutes to check out
 - After the checkout the person left the queue and others moved up
- Infected test subject:
 - The last person in the line

Real-live Scenario 2 – Queue

Test procedure



Real-live Scenario 3 – Restaurant



Real-live Scenario 3 – Restaurant

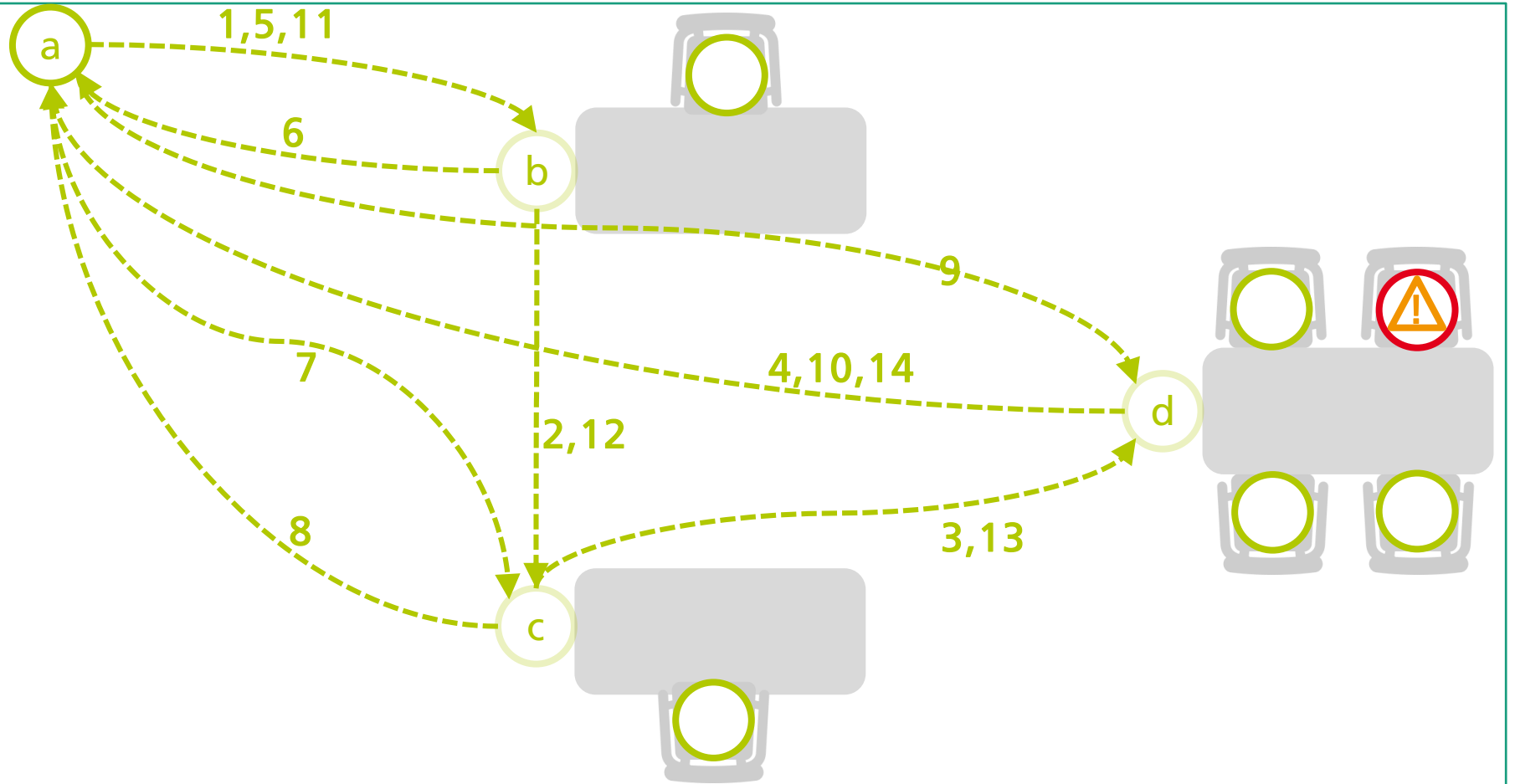
Test procedure

- 5 runs overall
 - Runs 1 to 3: Test subjects held phones in their hands or put it on the table. Devices could be moved in the hands
 - Runs 4 and 5: The test subjects had carried the devices in their pockets
- Each run
 - All guest were sitting all the time
 - The waiter followed the procedure:
1 minute in the kitchen → 2 minutes at each table → 0.5 minutes in the kitchen → 0.5 minutes at the table 1 → 0.5 minutes in the kitchen → 0.5 minutes at the table 2 → 0.5 minutes in the kitchen → 0.5 minutes at the table 3 → 3 minutes at each table → 1 minute in the kitchen
- Infected test subject:
 - The person at the table with 4 guys

Real-live Scenario 3 – Restaurant

Test procedure

Action	Time@target
0	1 min@a
1	2 min@b
2	2 min@c
3	2 min@d
4	0.5 min@a
5	0.5 min@b
6	0.5 min@a
7	0.5 min@c
8	0.5 min@a
9	0.5 min@d
10	0.5 min@a
11	3 min@a
12	3 min@b
13	3 min@c
14	1 min@a



Real-live Scenario 4 – Cocktail-Party



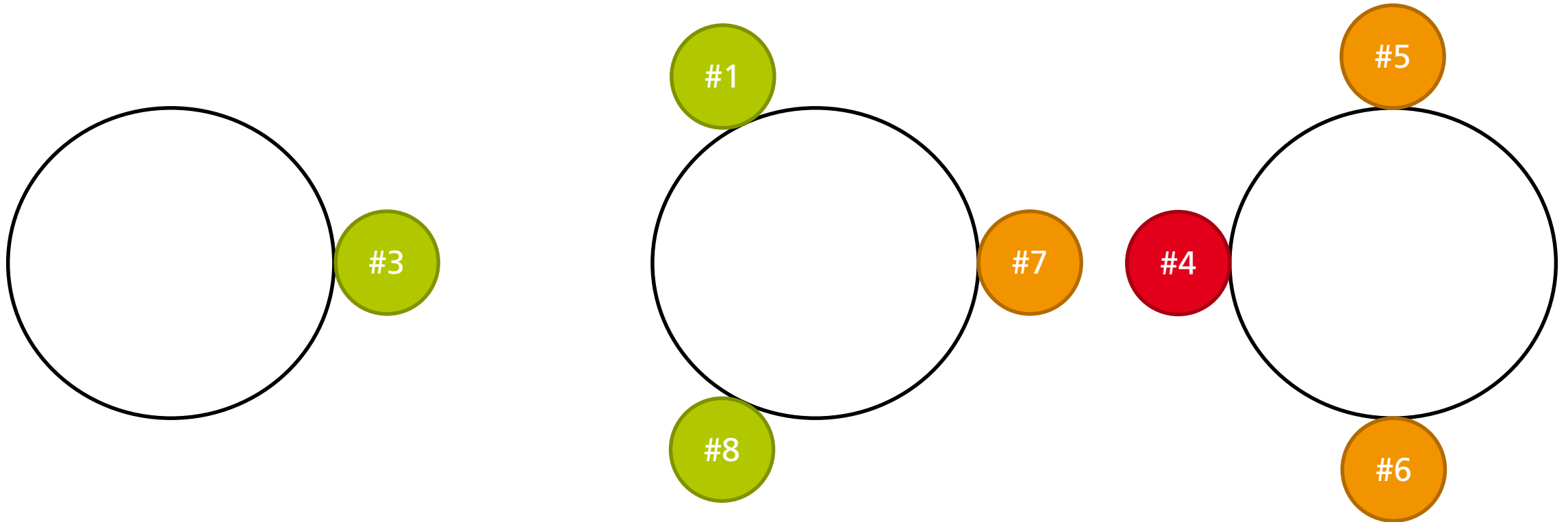
Real-live Scenario 4 – Cocktail-Party

Test procedure

- 5 runs overall
 - Runs 1 to 3: Test subjects held phones in their hands or put it on the table. Devices could be moved in the hands
 - Runs 4 and 5: The test subjects had carried the devices in their pockets
- Each run
 - The test subjects stood at tables and talked
 - After 10 minutes some persons changed their position (see following slides)
- Infected test subject:
 - The person #4 (following slides)

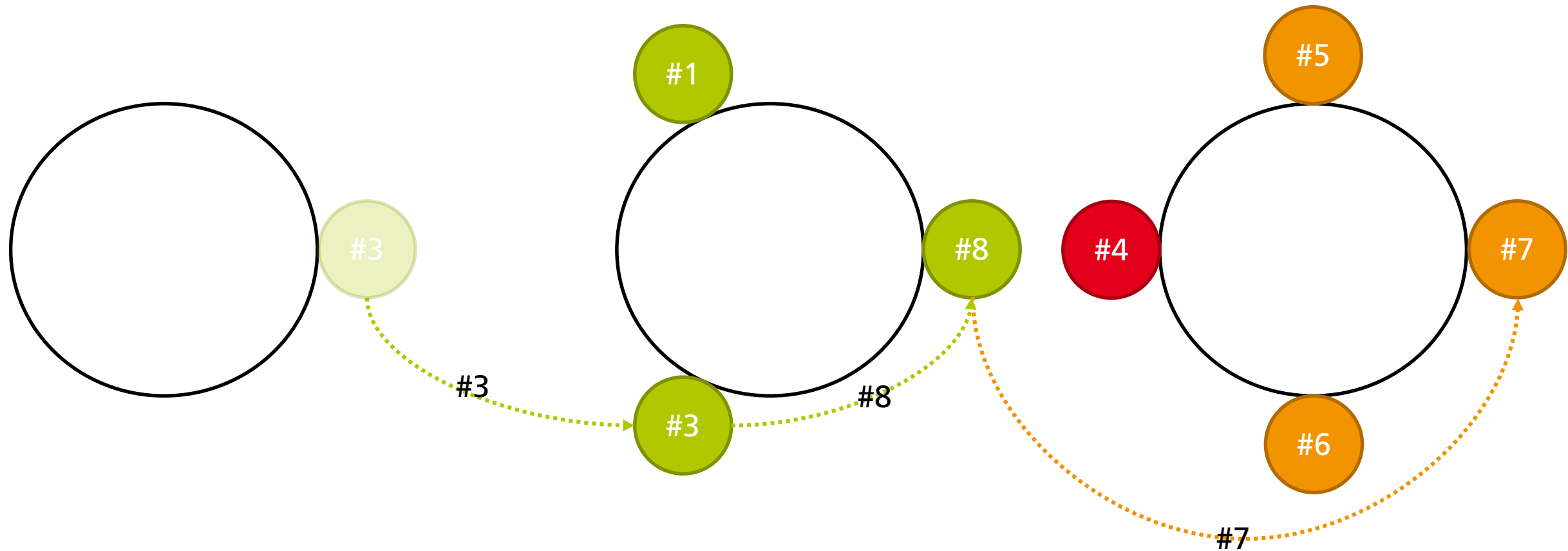
Real-live Scenario 4 – Cocktail-Party

Test procedure – start position at tables

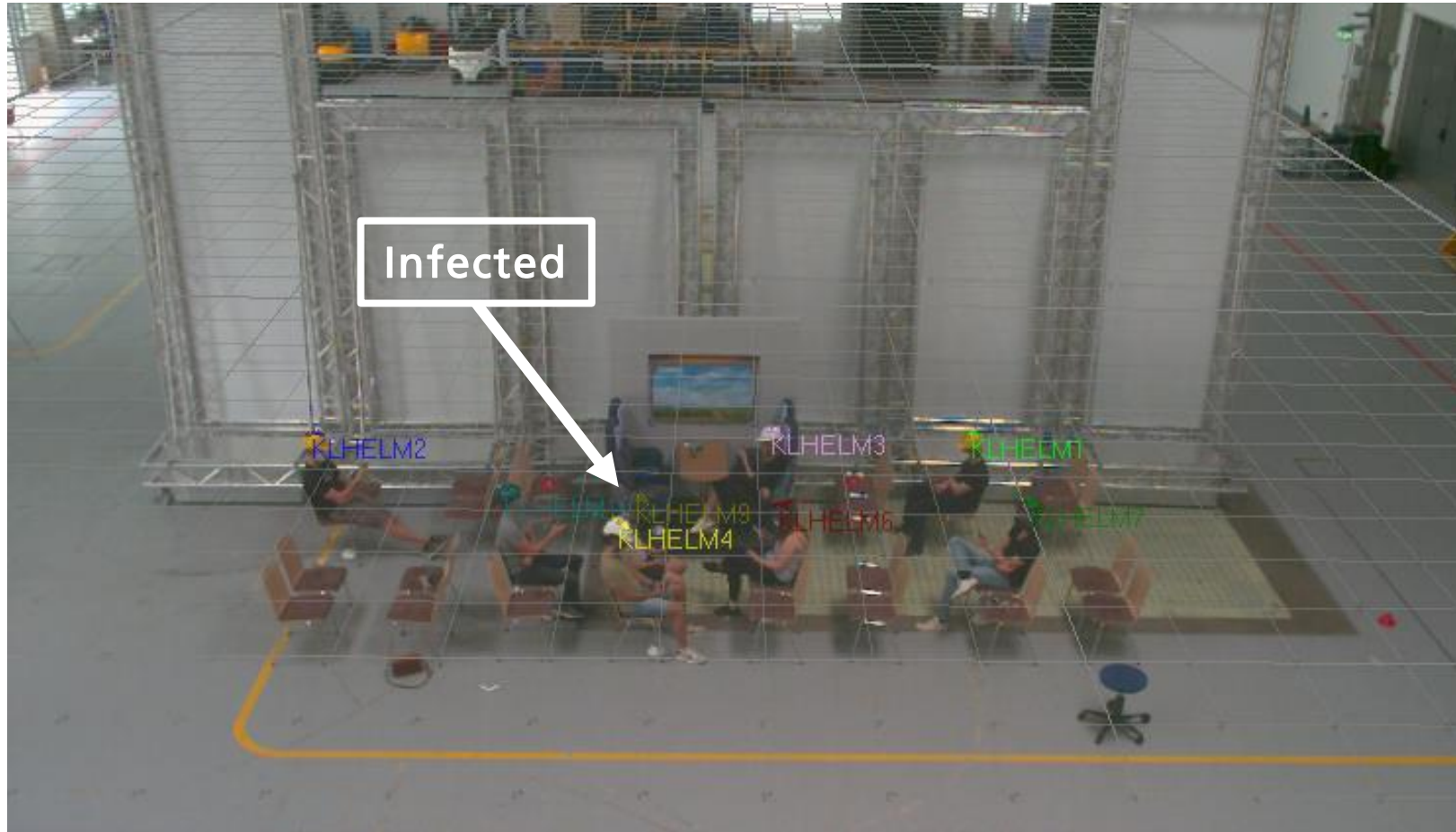


Real-live Scenario 4 – Cocktail-Party

Test procedure – changing the position after 10 minutes



Real-live Scenario 5 – ICE/train, first scenario with different devices



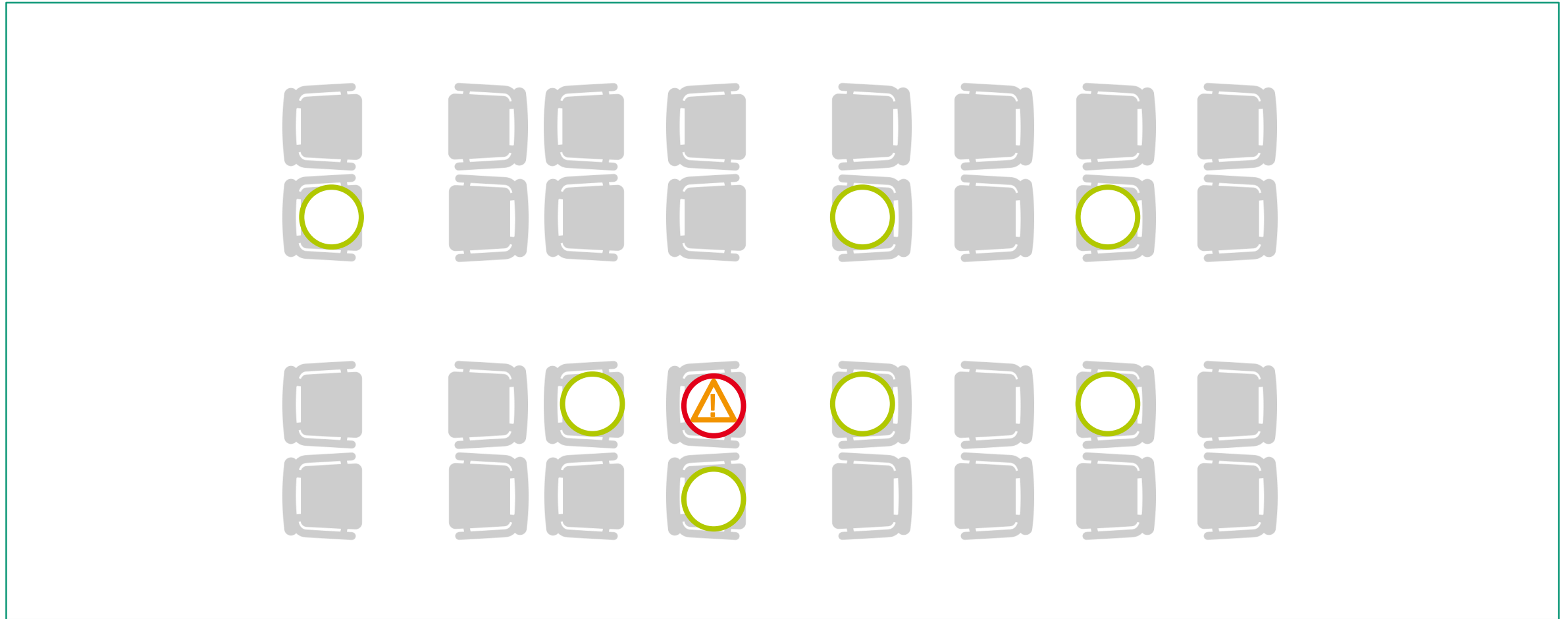
Real-live Scenario 5 – ICE/train, first scenario with different devices

Test procedure

- 3 runs overall
 - Runs 1 to 3: Test subjects held phones in their hands. Devices could be moved in the hands
- Each run
 - Test subjects sat for 20 minutes
 - The positions have not been changed

Real-live Scenario 5 – ICE/train, first scenario with different devices

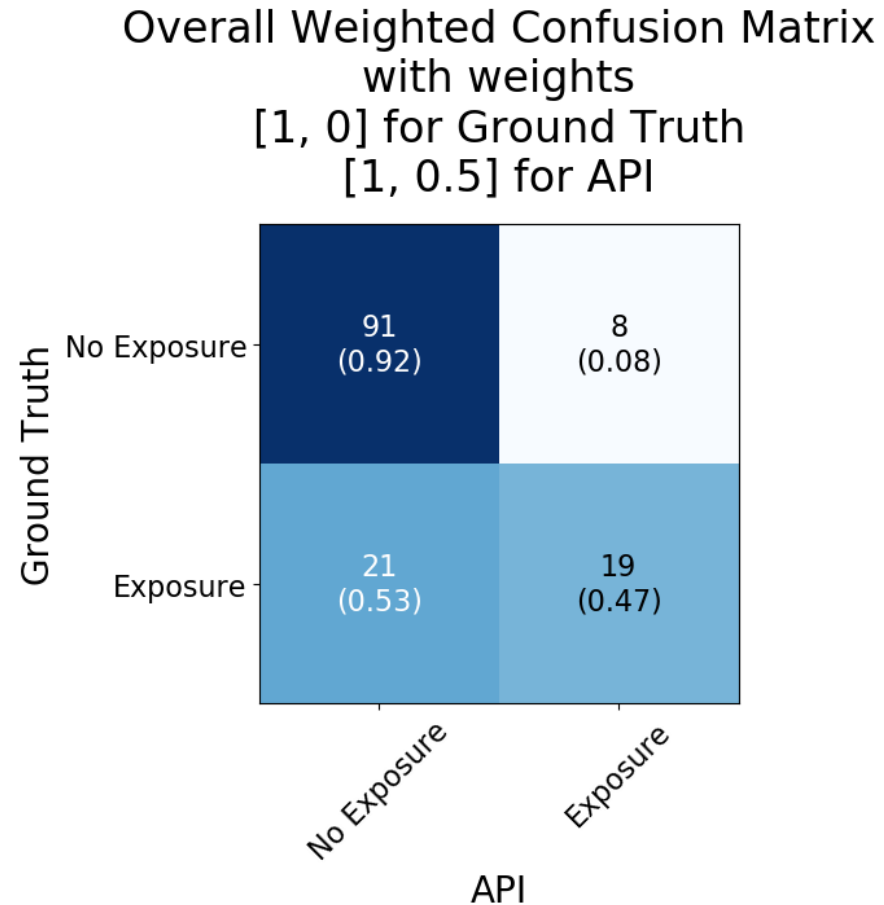
Test procedure



Summary 1

Results – Confusion matrices over all scenarios

- All scenarios 139 tests
 - True negatives: 95
 - True positives: 19
 - False negatives: 21
 - False positives: 8
- Precision = 70%
- Recall = 47 %
- Accuracy = 79 %



Summary 2

Bucket borders

- RKI and Fraunhofer have decided on the bucket borders of 55 dB and 63 dB.