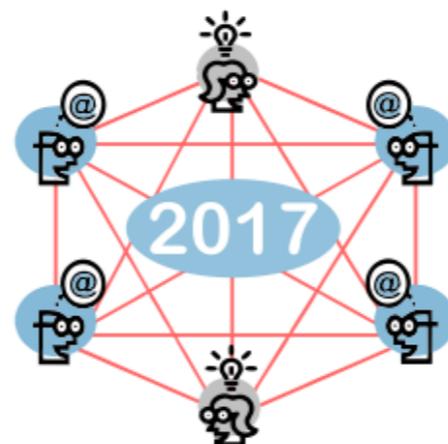


Evaluating the Utility of UDG Using OMNeT++

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OMNeT++ Community Summit 2017

University of Bremen, Bremen, Germany

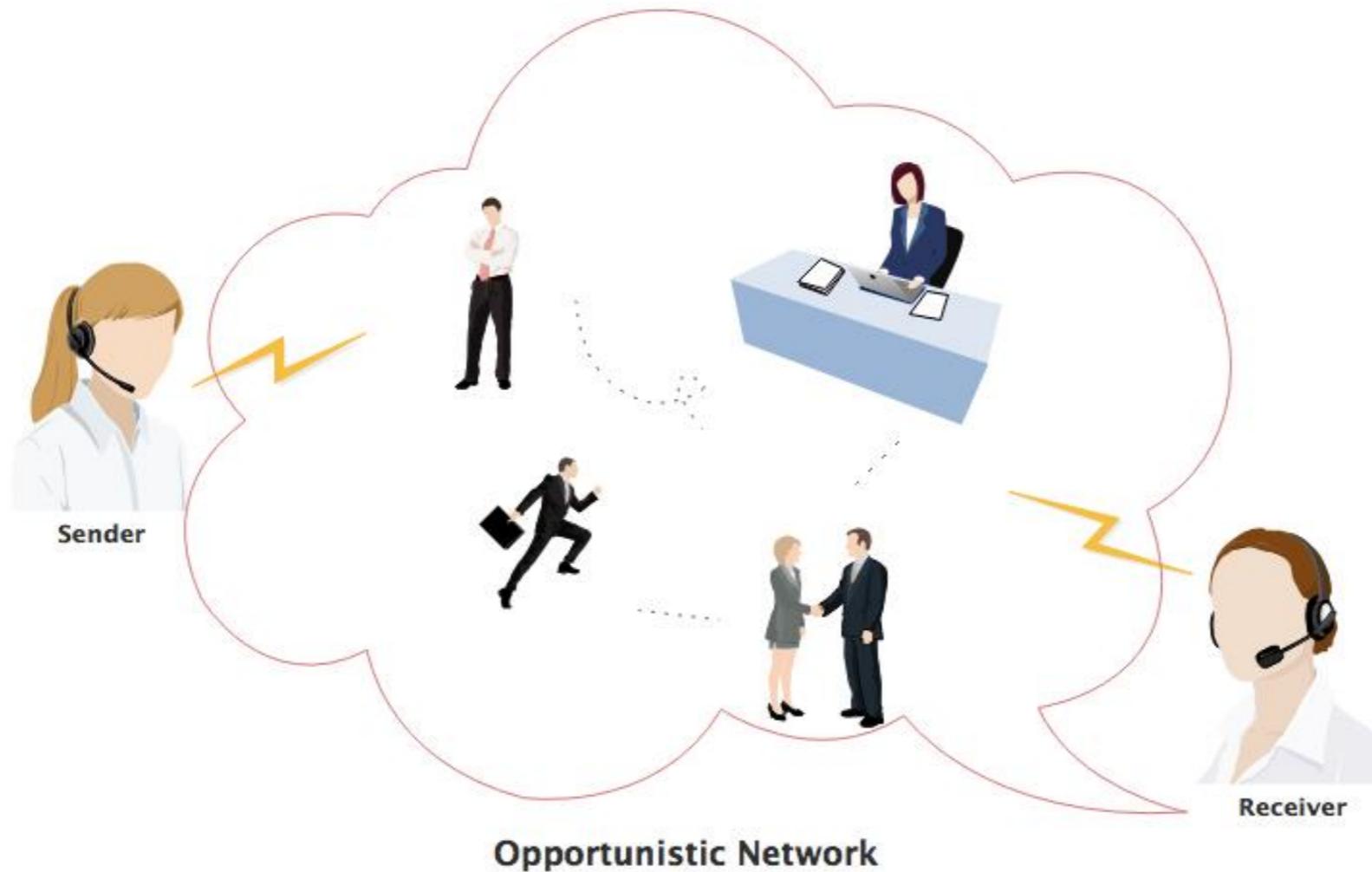
September 07 – 08, 2017

Outline



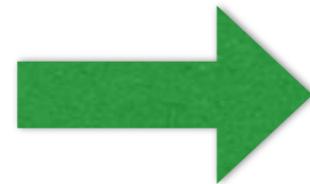
- Background
- Motivation
- Implementation
 - Data Collection
 - Trace based Mobility Model
 - UDG Model
- Simulation Results
- Conclusion

→ Opportunistic Networks



Contact Time Traces???

Mobility Model + Connectivity Model



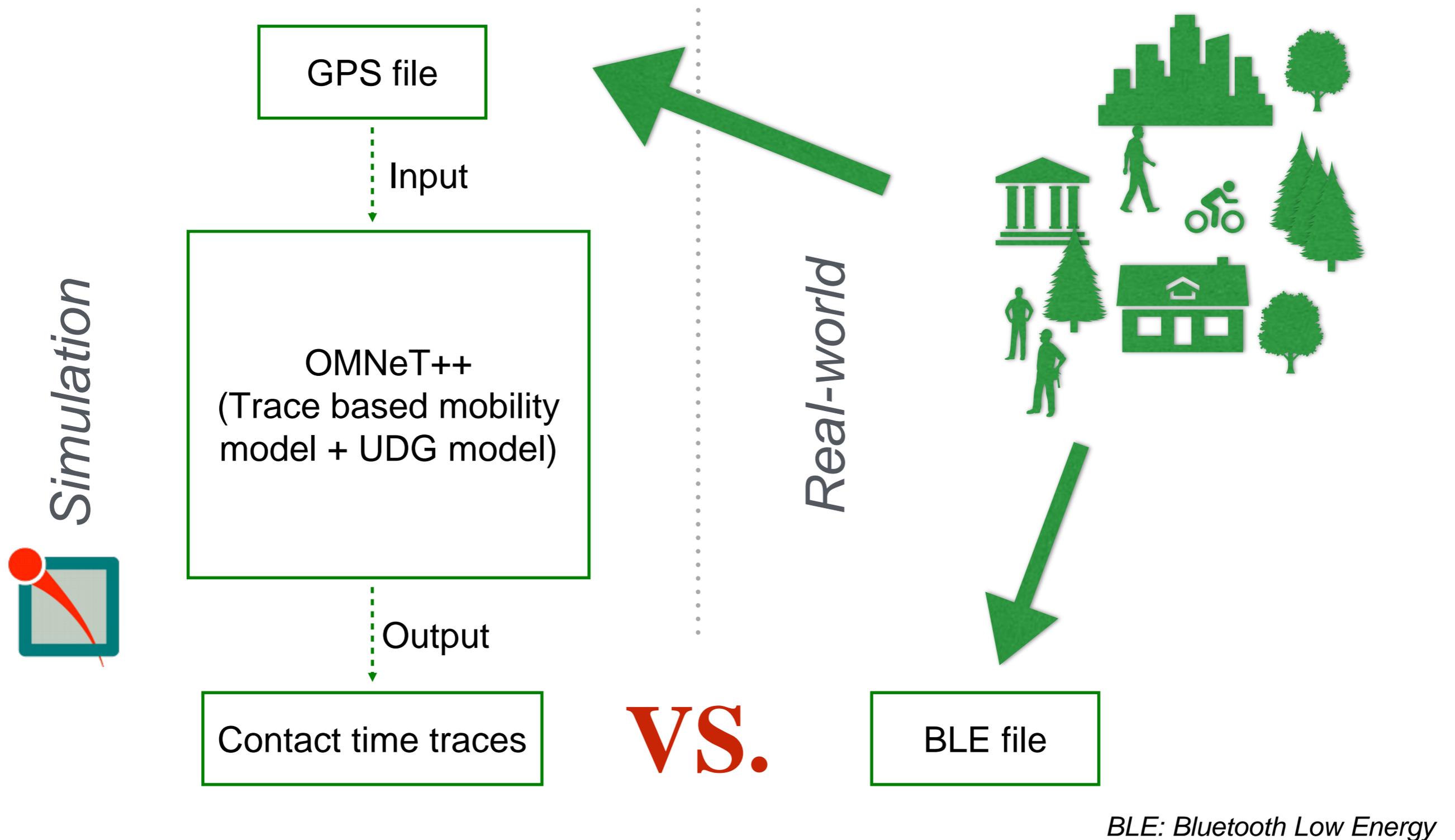
Contact Time Traces

- Trace Based Mobility Model
 - More realistic | GPS based
- UDG Connectivity Model
 - Simplest
 - Used by simulators (*ONE*, *Adyton*)

UDG: Unit Disk Graph

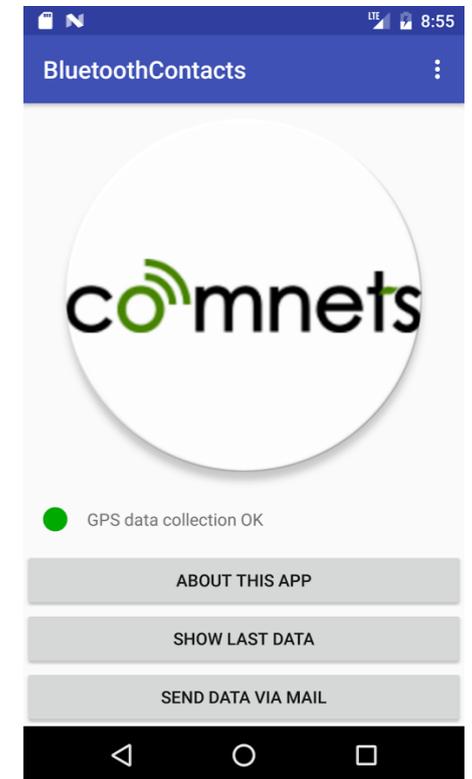
Is UDG model realistic???

Main Idea



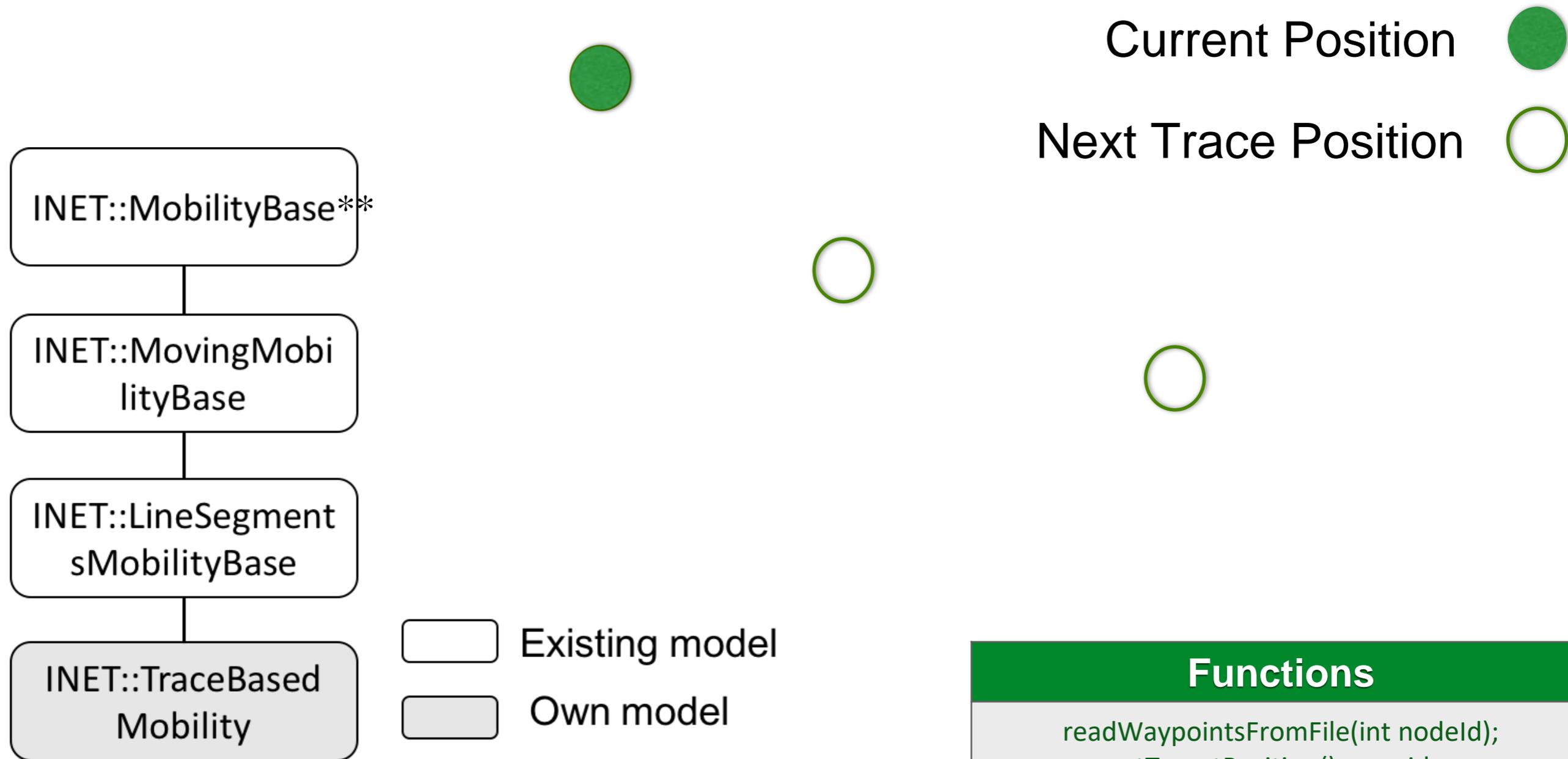
BLE: Bluetooth Low Energy

- Android Application: **BluetoothContacts***
- 22 users, 6 weeks
- GPS file
 - GPS coordinates | Interval 10 mins
 - *Gauss - Krüger map projection*
 - Convert: Cartesian coordinates
- BLE file
 - *Received beacons* / Interval 22 secs (unfixed)
 - Threshold = 90 secs
 - Convert: Contact times



*BluetoothContacts: developed by Jens Dede and Sarmad Ghafoor, ComNets, Uni-Bremen, Germany. <https://play.google.com/store/apps/details?id=de.uni-bremen.comnets.BluetoothContacts>,

Trace based Mobility Model



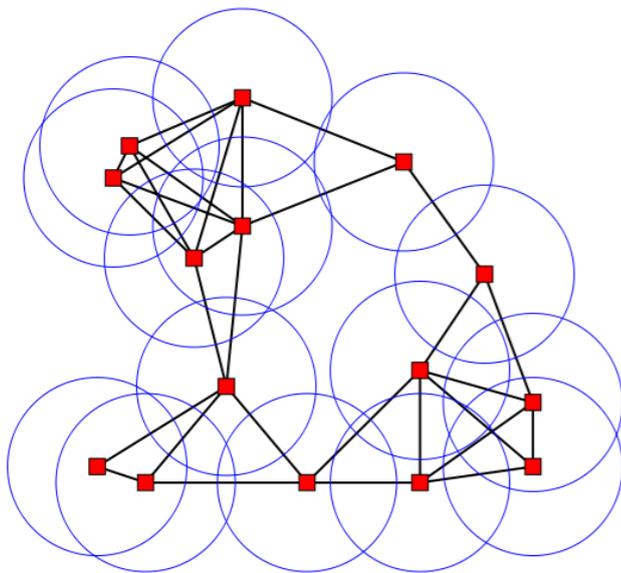
Functions
<pre> readWaypointsFromFile(int nodeId); setTargetPosition() override; setInitialPosition() override; </pre>

TraceBasedMobility Model Inheritance Diagram in INET

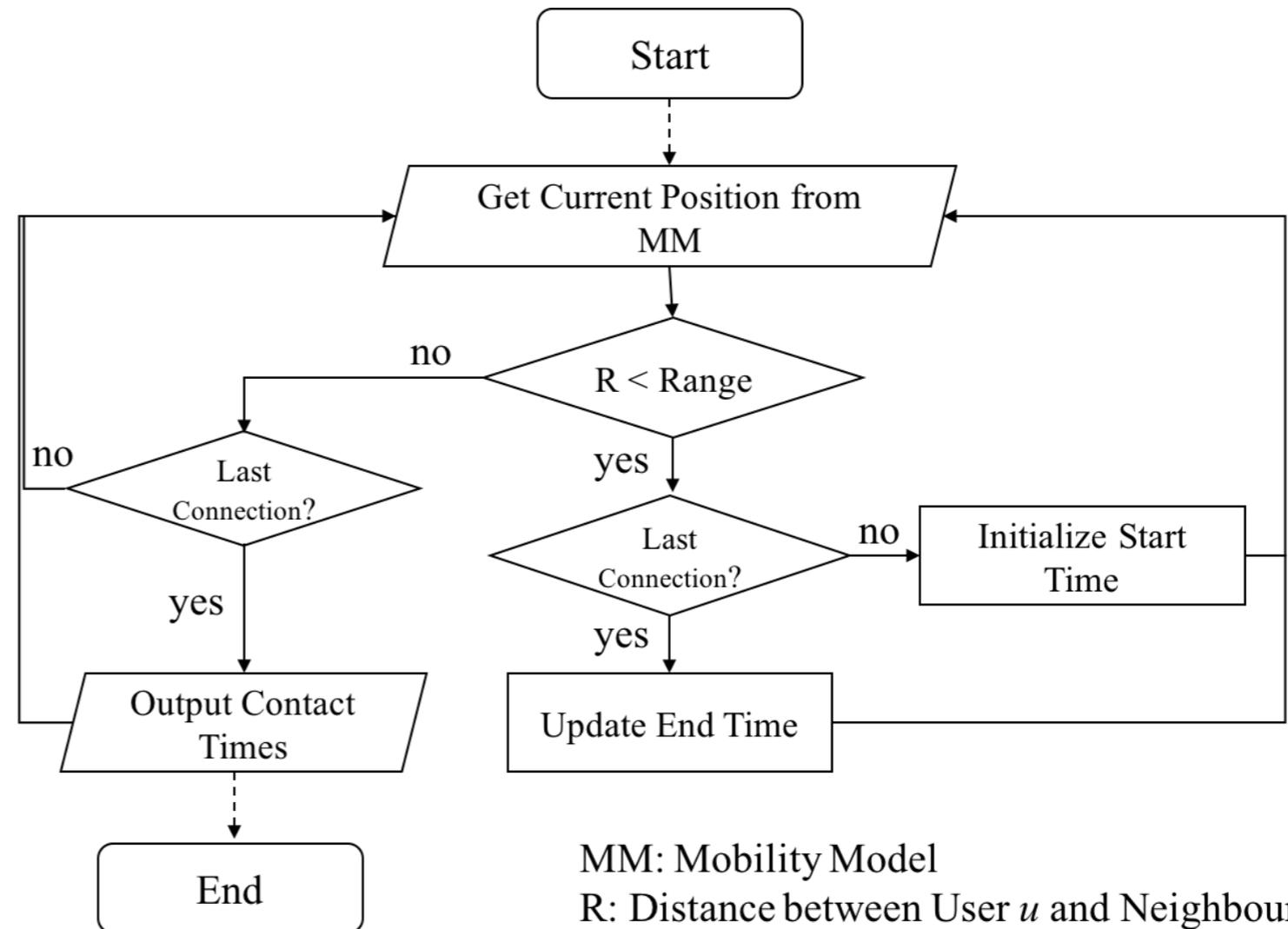
** INET framework is the library in OMNeT++ that includes all the protocols from physical layer to application layer.

UDG Model

- Users contact within wireless range
- Only depend on wireless range



Unit Disk Graph



MM: Mobility Model
R: Distance between User u and Neighbour n_i
Range: Wireless Range

Scenario Setting



- Network: **5 users, 1 weeks.**
- Colleagues
- Every day lunch time for 2 hours;
- Saturday/Sunday no work

Table 1. Network Parameters

Parameters	Purpose	Value
numHosts	The number of users in network	5
wirelessRange	Maximum wireless range for obtaining contact times	selected between 1 and 120 meters
neighbourScanInterval	Time interval used to check the update of neighbours	90 seconds
nodeId	The ID of user, -1 represents automatically obtaining user ID	-1
mobilityType	The type of mobility model	traceBasedMobility
is3D	The coordinates are 3 dimension	false
traceFile	The name of trace file	CartesianTraces.txt

Neighbour Availability Situations

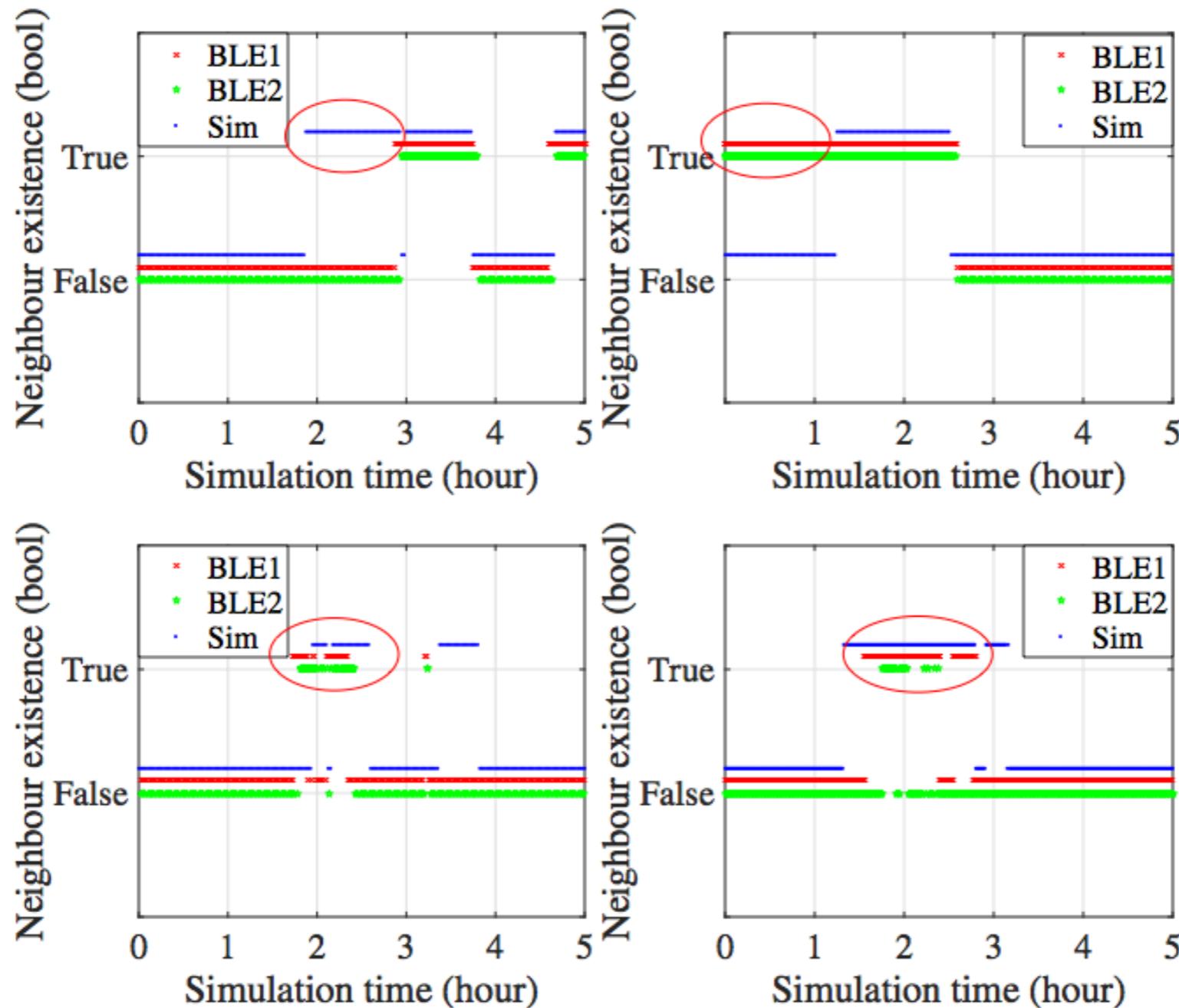
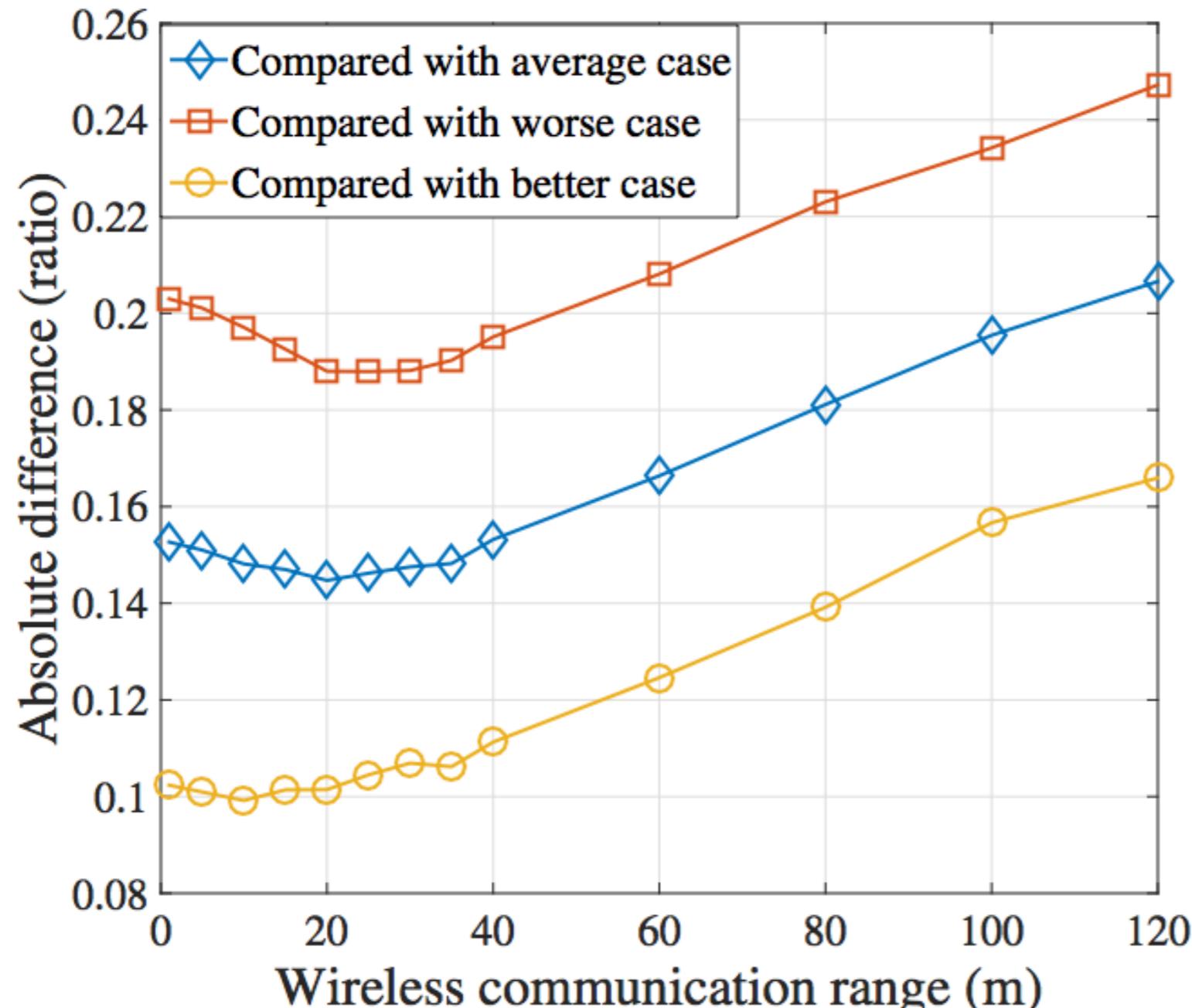


Fig. 2 Four Different Neighbour Availability Situations between Two Users - based on BLE and Simulations (with GPS Traces)

Absolute Difference of Contact Times



$$AbsD = \frac{1}{NK} \sum_{i=1}^N \sum_{j=1}^K \frac{|T_{S_{ij}} - T_{B_{ij}}|}{T_{ij}}$$

N - users

K - parts of simulation

T_S - contact time of sim

T_B - contact time of BLE

T - simulation time

Fig. 3 Absolute Difference of Contact Times against Wireless Range.

Average Contact Times per Hour

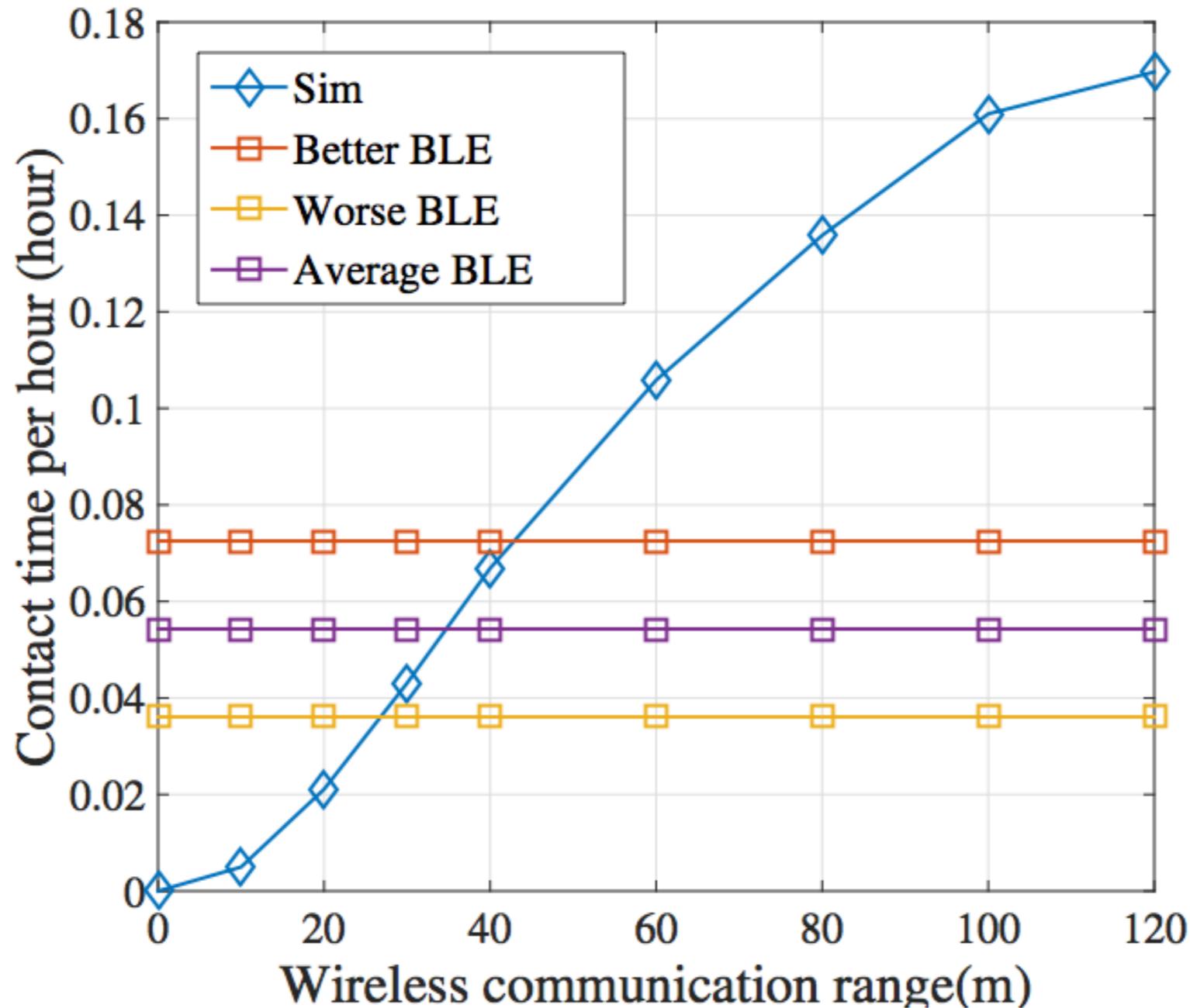


Fig. 4 Average Contact Times per Hour against Wireless Range.

Histogram of Contact Times

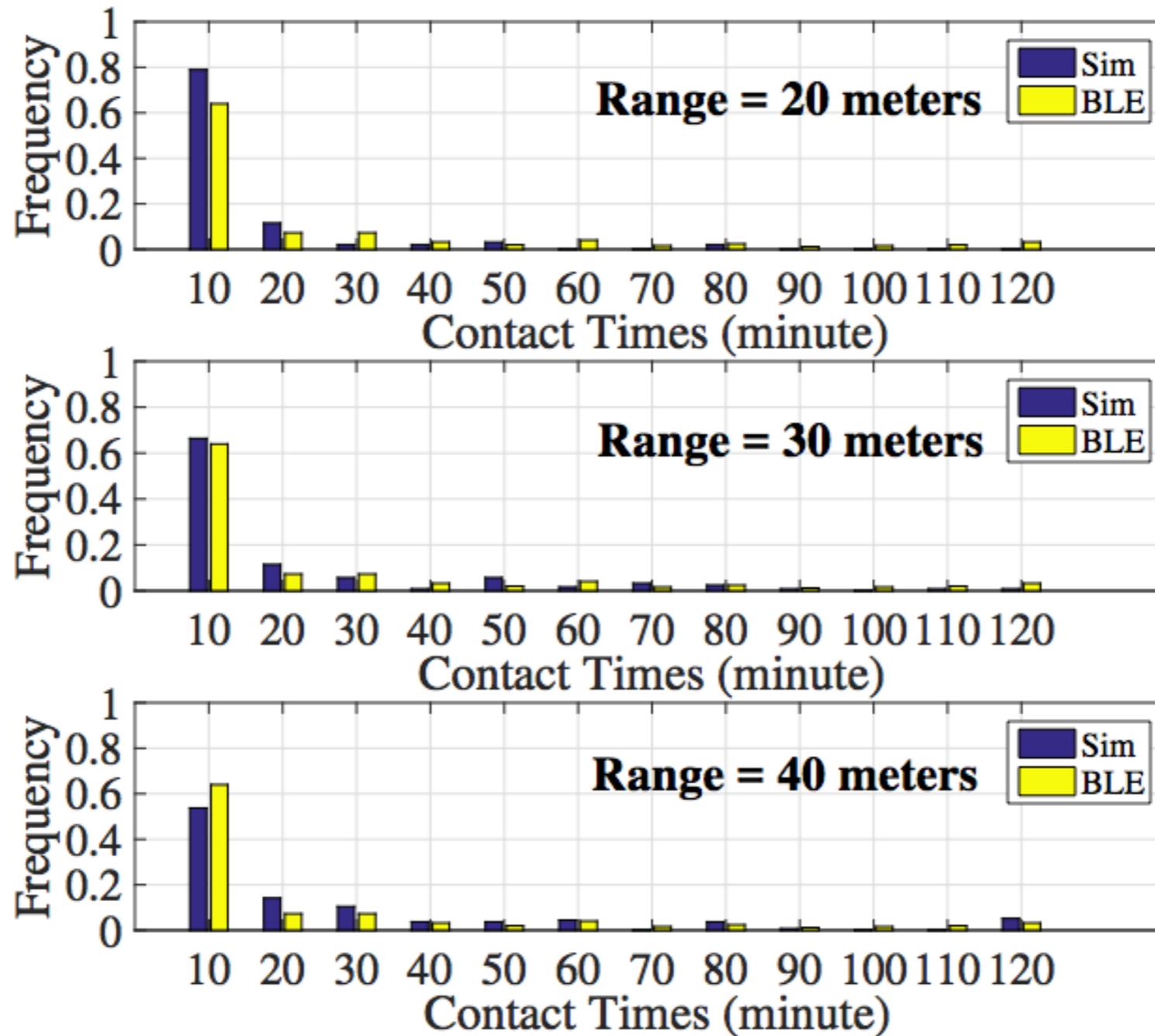


Fig. 5 Histogram of Contact Times. (Range = 20 m, 30 m and 40 m)

Conclusion



- Contact times from simulation based on UDG model follow the same pattern as contact times from Bluetooth traces.
- UDG should be effective as a connectivity model and thus, is suitable to extract contact times from GPS traces in simulations.



Thank you