

DiscoveryTree

Relative Localization Based on Multi-hop BLE Beacons

h e p i a

Haute école du paysage, d'ingénierie
et d'architecture de Genève

heig-vd

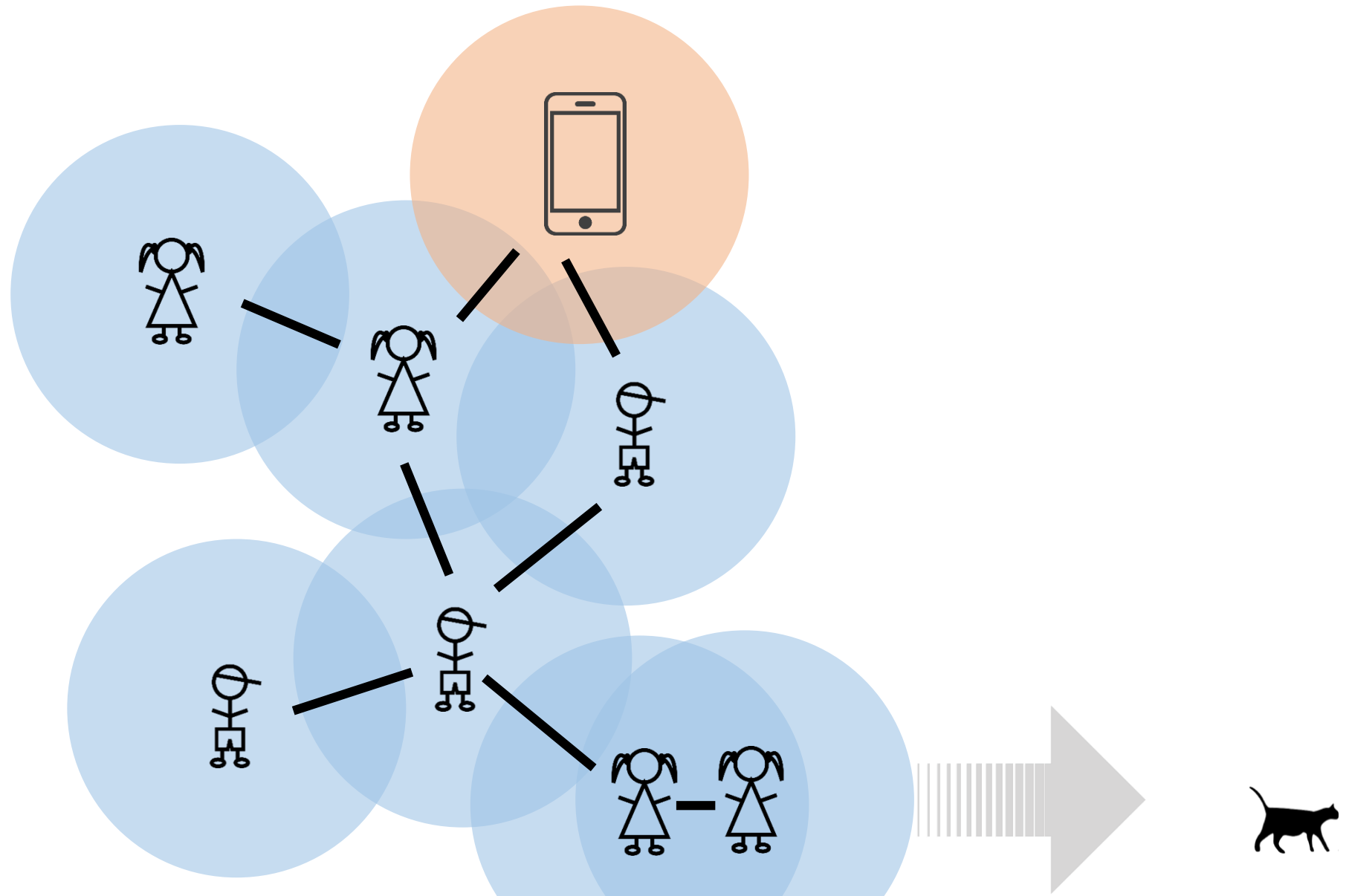
Haute Ecole d'Ingénierie et de Gestion
du Canton de Vaud

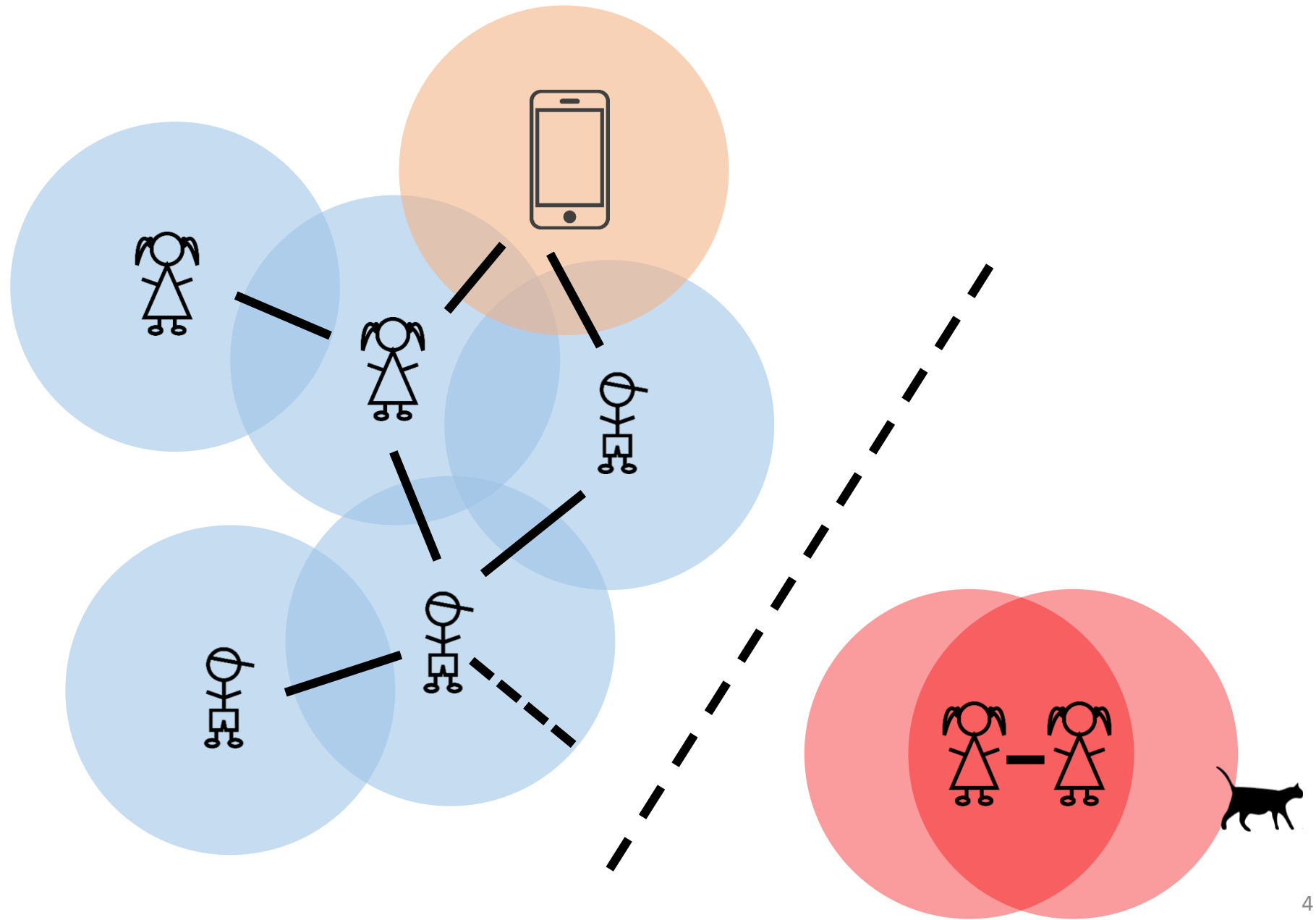
Hes·SO

Haute Ecole Spécialisée
de Suisse occidentale

Weazard – Wearables for preventing hazards

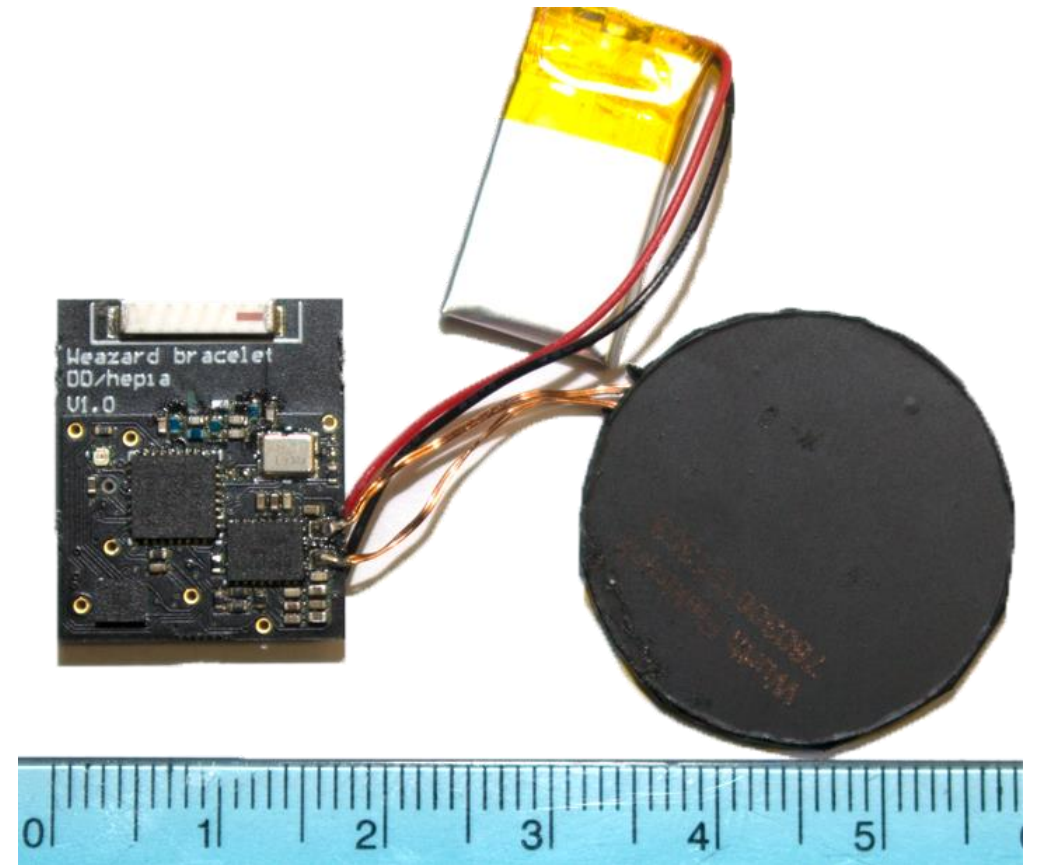
- Financed by HES-SO// iNuit
- Wristbands that prevent children from being missing
- Get a relative position for each node





Hardware solution

- Size factor (wristband)
- Low energy consumption
- Bluetooth LE
- Qi Rechargeable battery
- GSR Sensor, Accelerometer

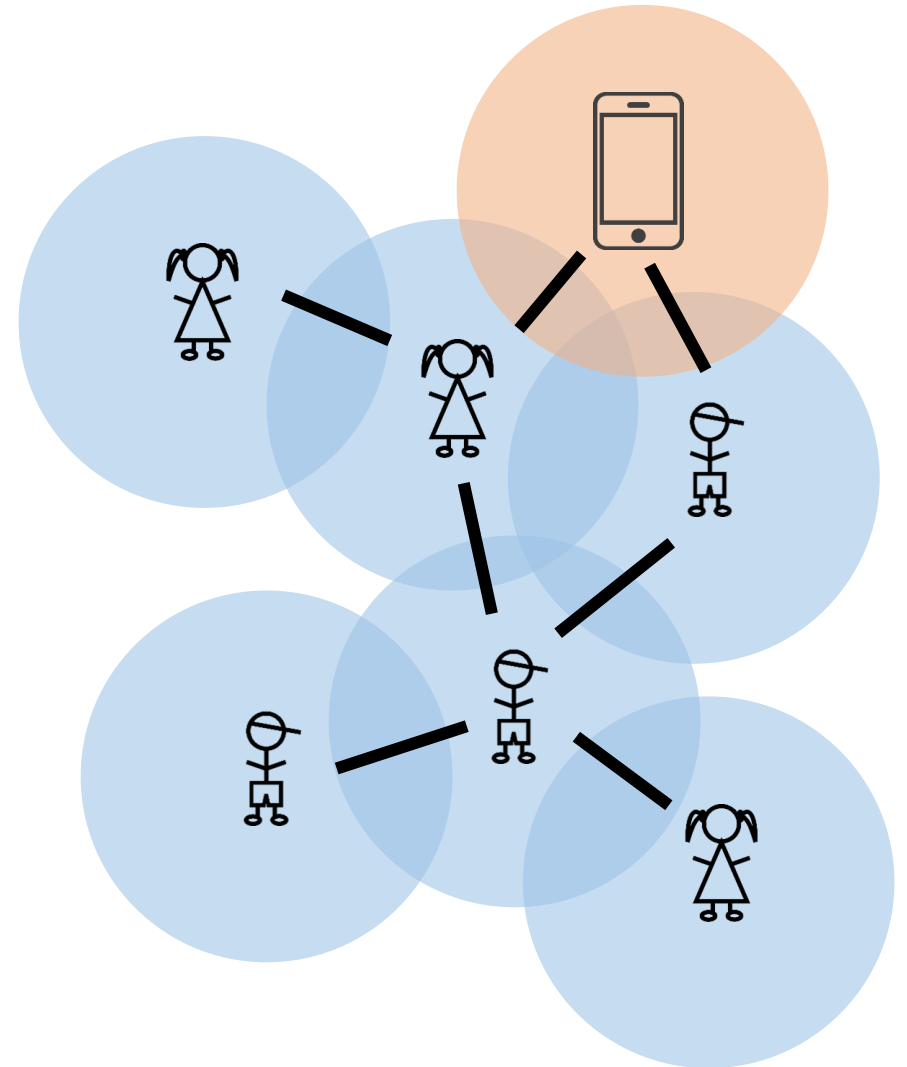


Algorithm principles

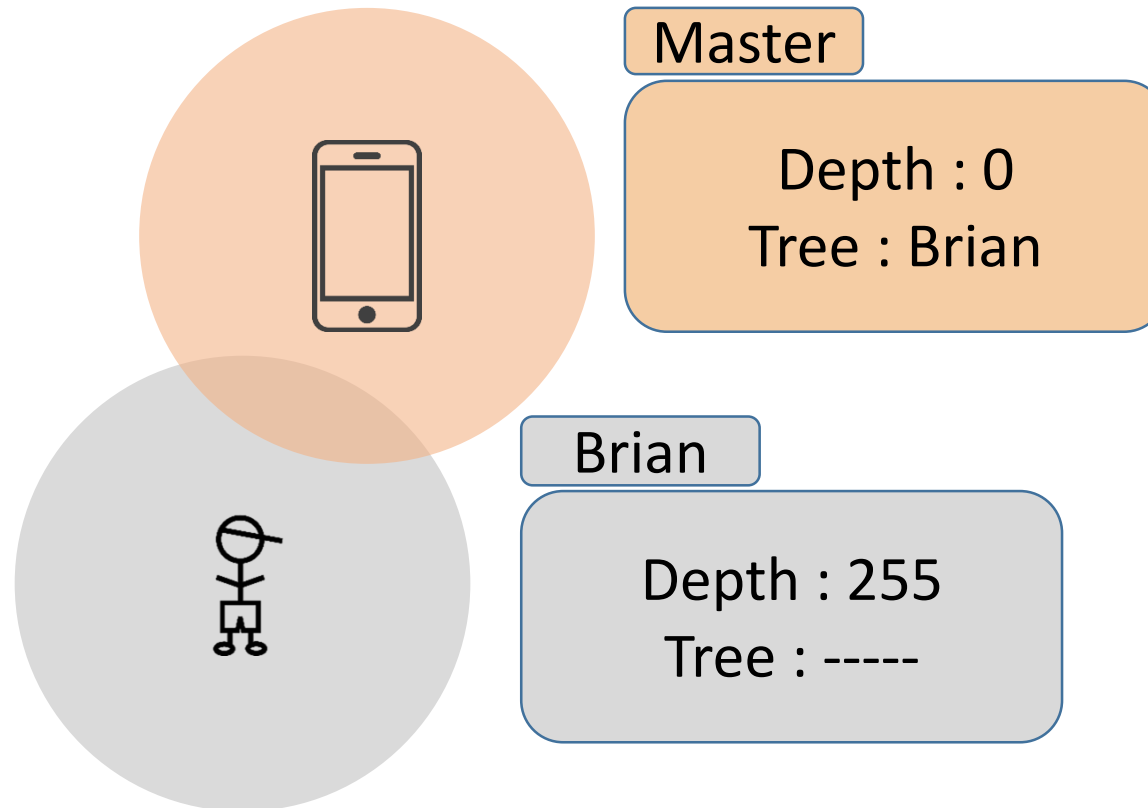
- **Depth** : *how many hops a device must do in order to reach the master*

Rules:

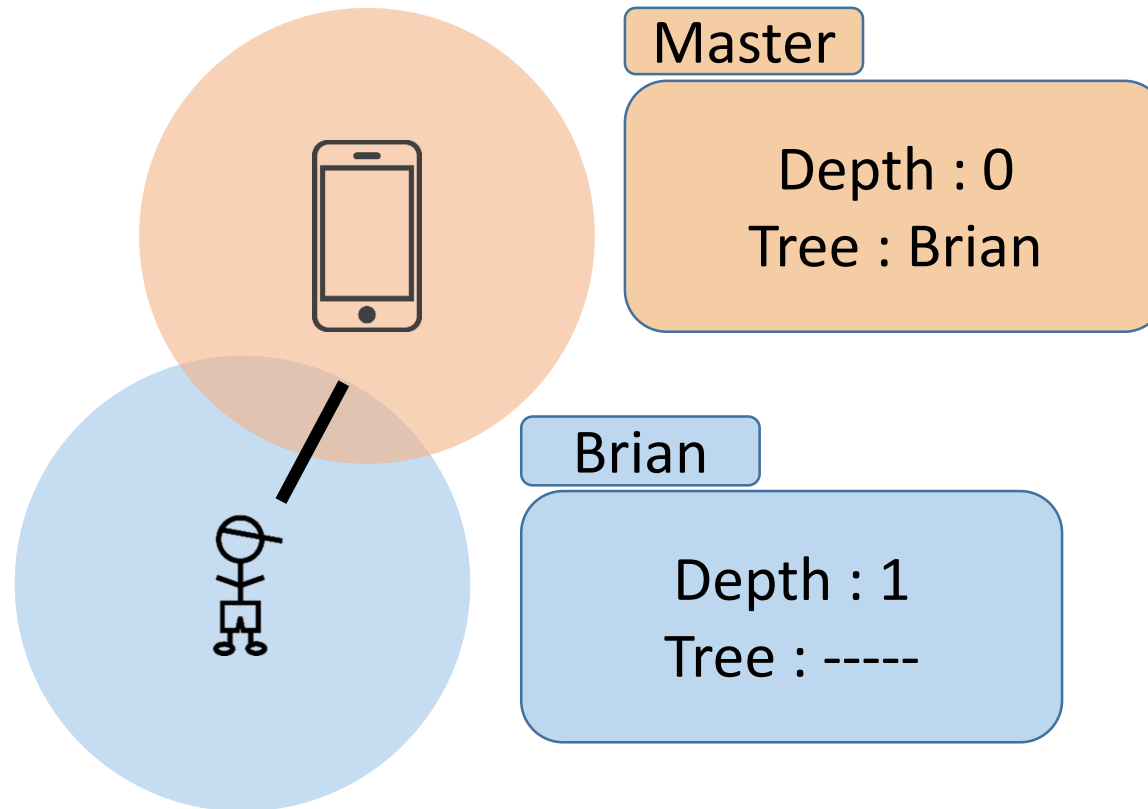
- A node will report any node that has their depth higher than itself
- A node updates its depth value when it sees itself mentioned by another device.



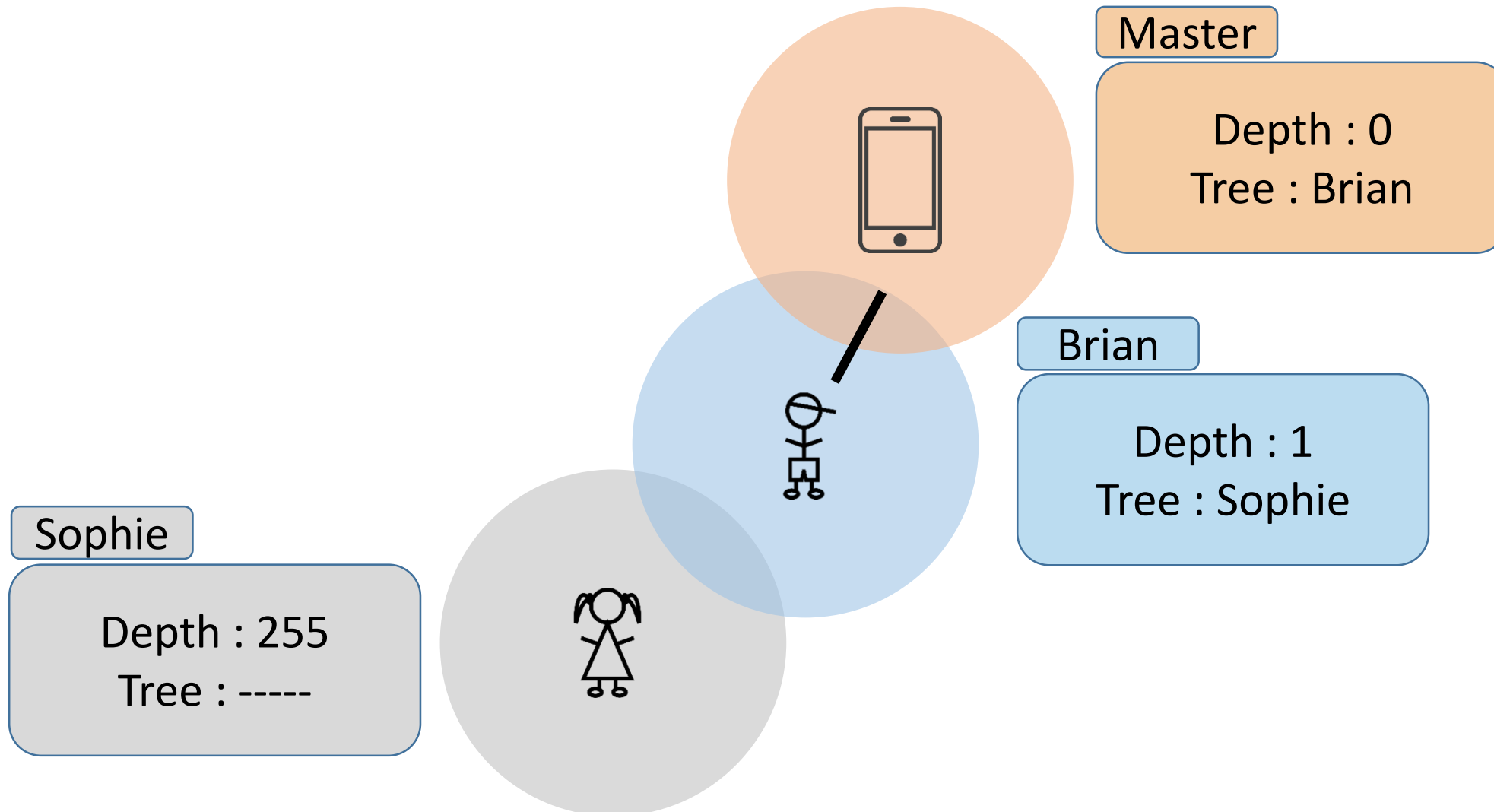
DiscoverTree – How does it work ?



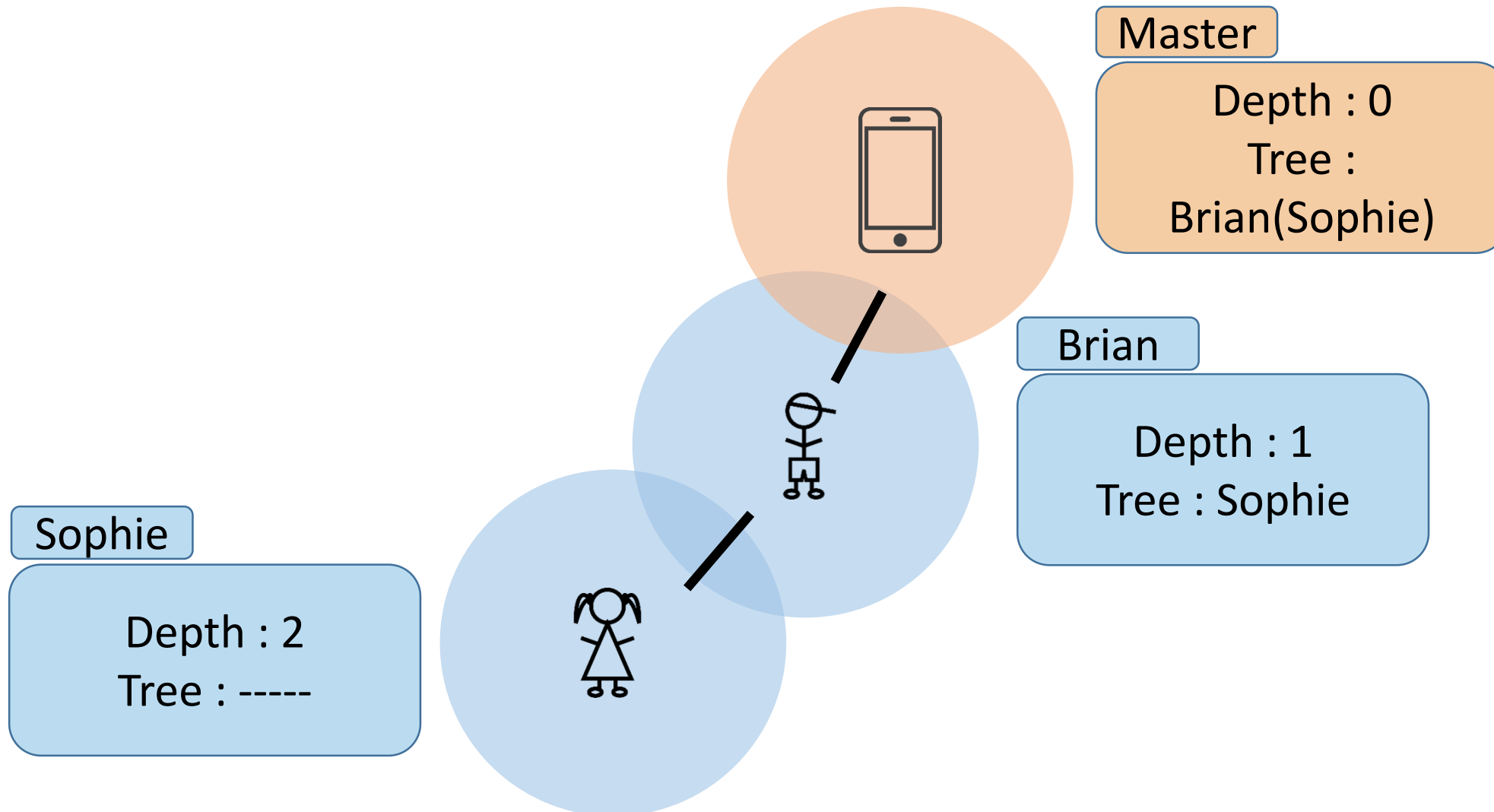
DiscoverTree – How does it work ?



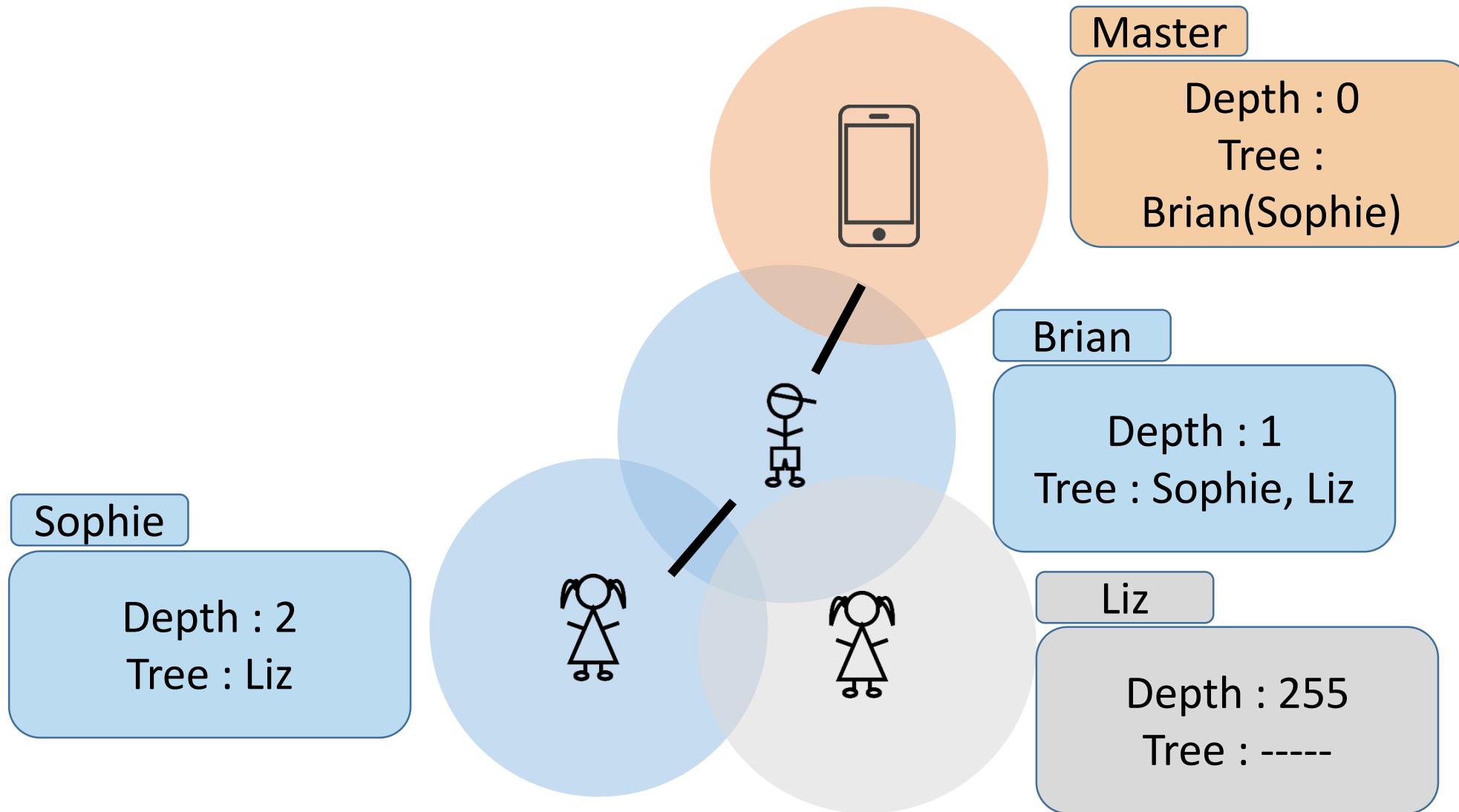
DiscoverTree – How does it work ?



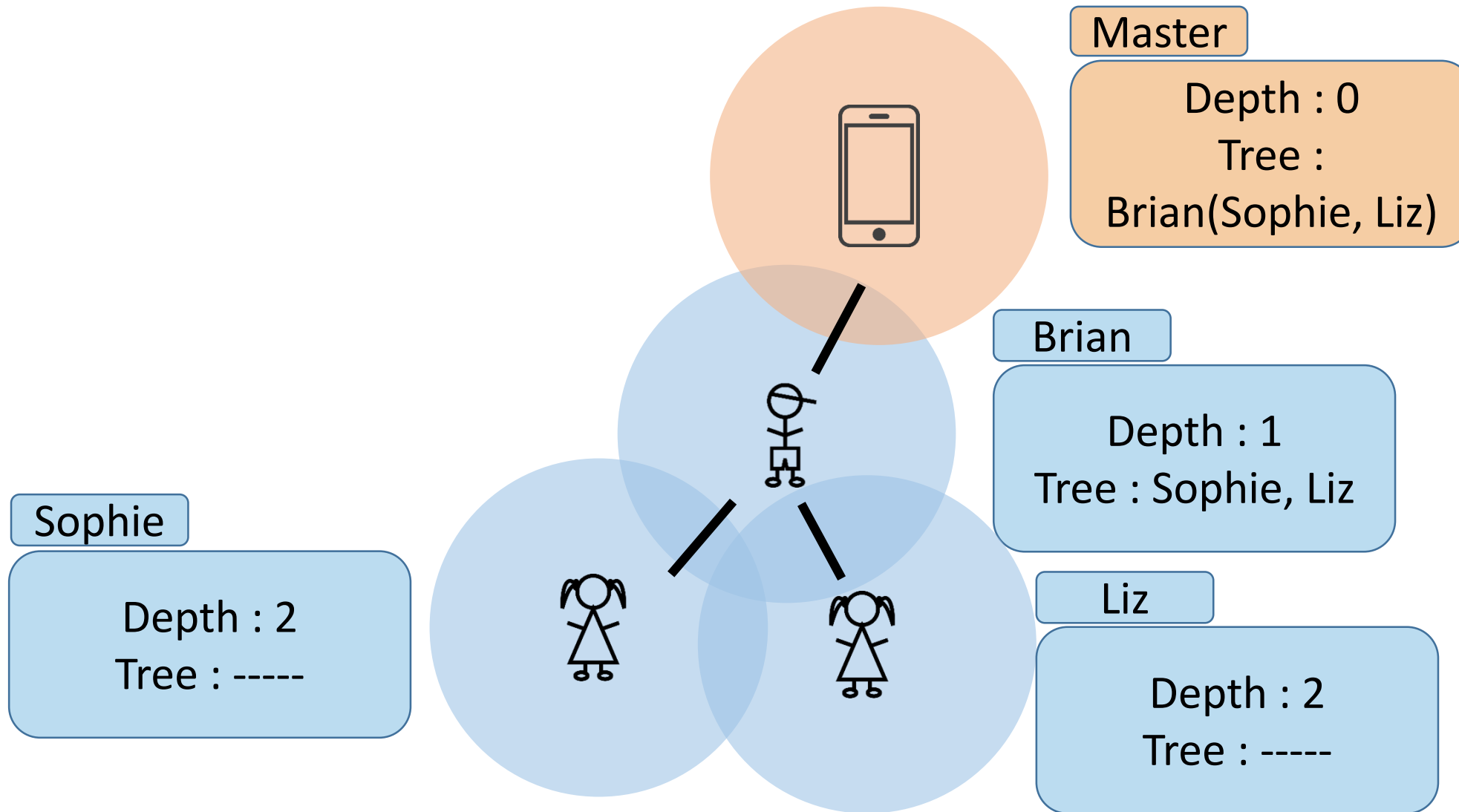
DiscoverTree – How does it work ?



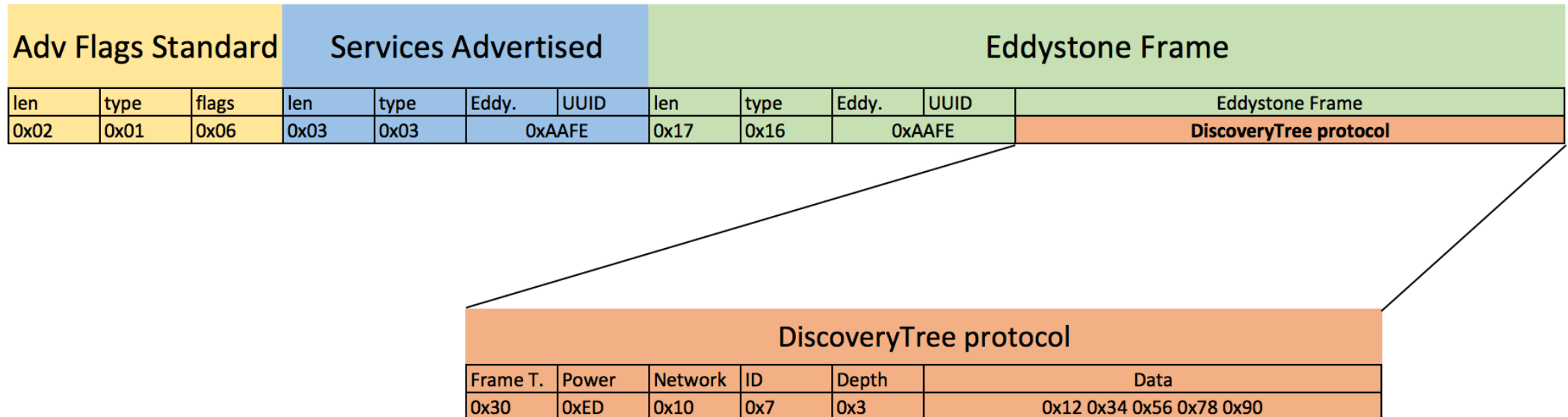
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Protocol description – Advertising Frame



Protocol description – Advertising Frame

- Frame type: 0x30 : DiscoverTree
- Tx power: Transmitting power
- Network : 0x00 – 0xFF
- Device ID (5 bits)
- Depth: How far is the node from the master

DiscoveryTree protocol					
Frame T.	Power	Network	ID	Depth	Data
0x30	0xED	0x10	0x7	0x3	0x12 0x34 0x56 0x78 0x90

Tree representation

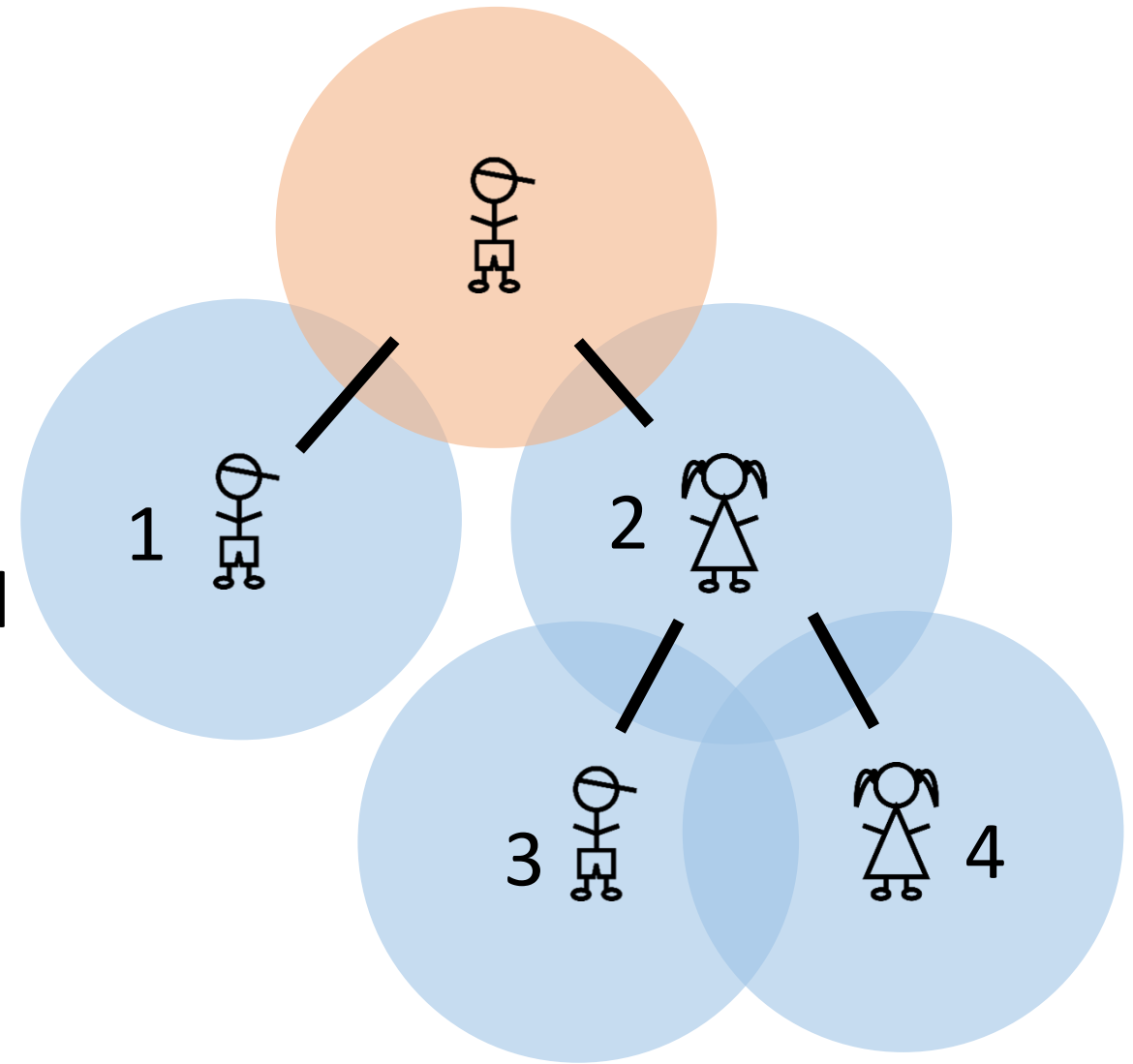
1. Serialisation: 12(34)

2. Compression:

- 5 bits IDs (0 – 31) 6 bits padded
- 2 bits separators (11 and 10)

• **12(34)** becomes :

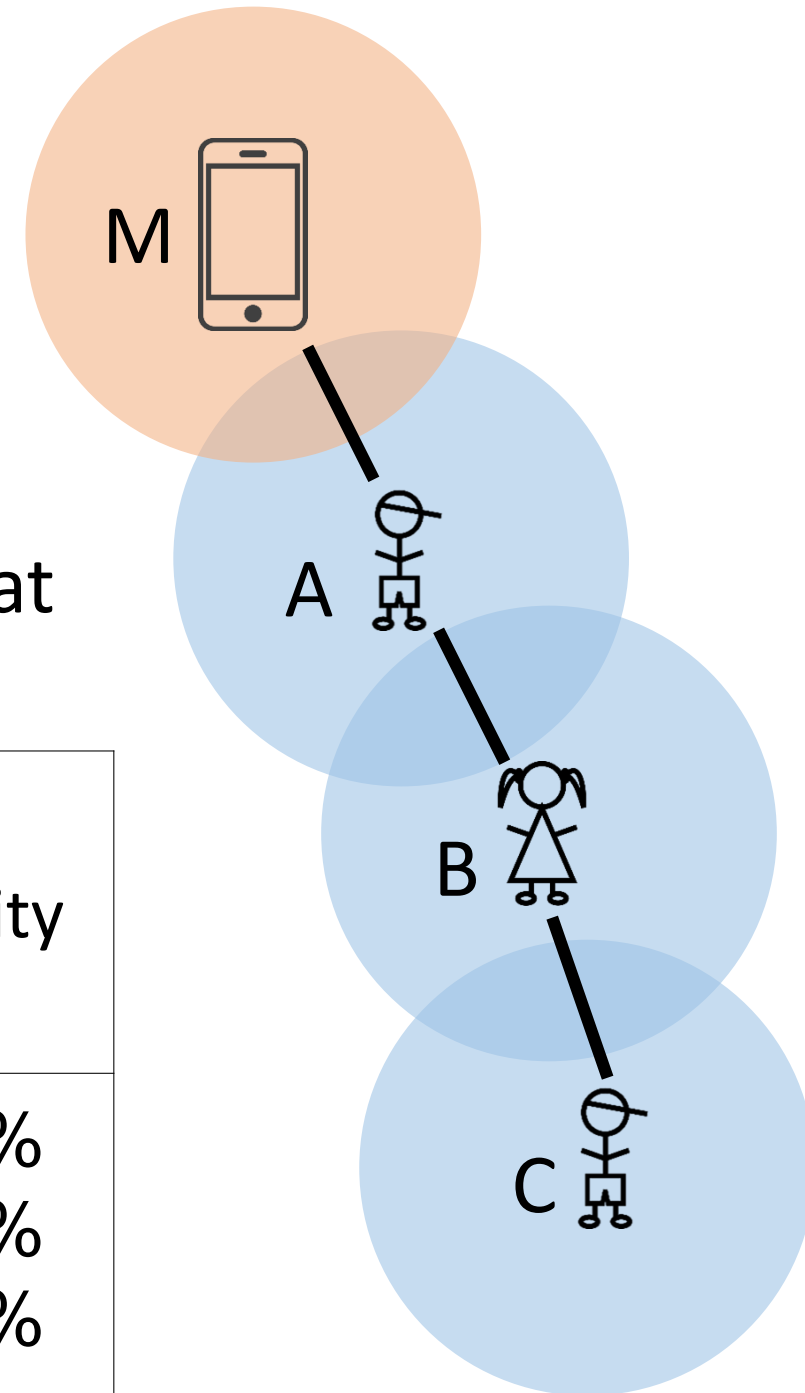
- 000001 000010 **11** 000011 000100 **10**



Experimental setup

- Scan for 8 seconds
 - During this window a device must be seen at least once

Visibility from M	samples lost	total samples	reliability
A	6	342	98.24%
B	17	342	95.02%
C	21	342	93.85%



Conclusion

- DiscoveryTree can currently handle 15 devices per network
- Other relative localisation algorithms based on gossip protocols on the works
- For a demo, visit us at the HES-SO stand in the Exhibition area