Resilient Networking for Emergency Scenarios

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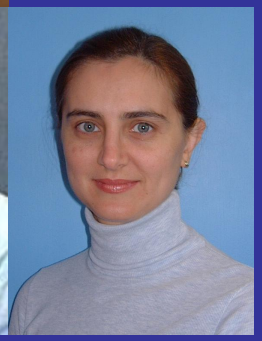

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IU-ATC

- India-UK Advanced Technology Centre
  - St. Andrews, Cambridge, Lancaster, Surrey, UCL, Southampton, Bristol, Ulster, BT
  - Several Indian partners

BIS
Department for Business Innovation & Skills

सत्यमेव जयते
Department of Science and Technology
Government of India

EPSRC
Pioneering research and skills

IU-ATC

- Ind gy Centre
  - ncaster, Surrey,
  - Several Indian p

Part of UK-India Education and Research Initiative

BIS
Department for Business Innovation & Skills

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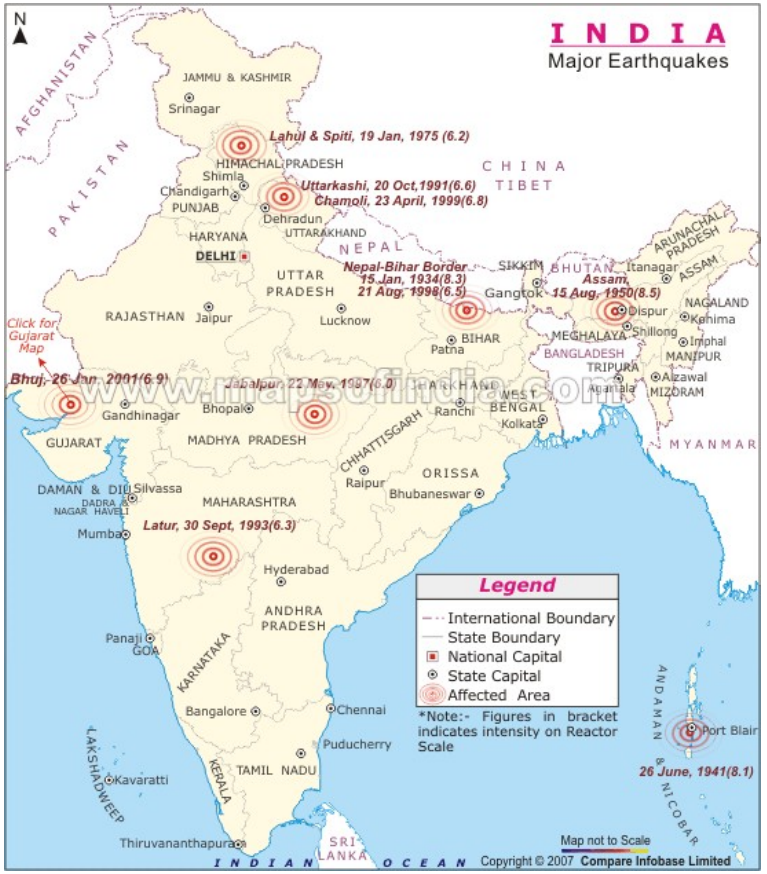
Department of Science and Technology
Government of India

IU-ATC

- A key work package on management of emergency situations
- A critical challenge in India
  - E.g. earthquakes



IU-ATC

- A key work package on manageme situations
- A critical ch
  - E.g. e

What is the most important thing in emergency management?

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communications

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Emergency Scenarios

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- Flooding

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- Fire

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- Fire
- Volcanoes

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- Collapsed building
- Terrorist attacks

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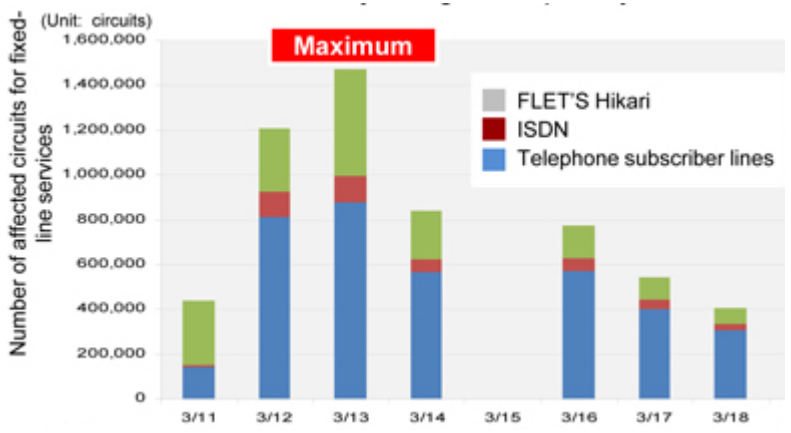
Events that lead to significant human risks

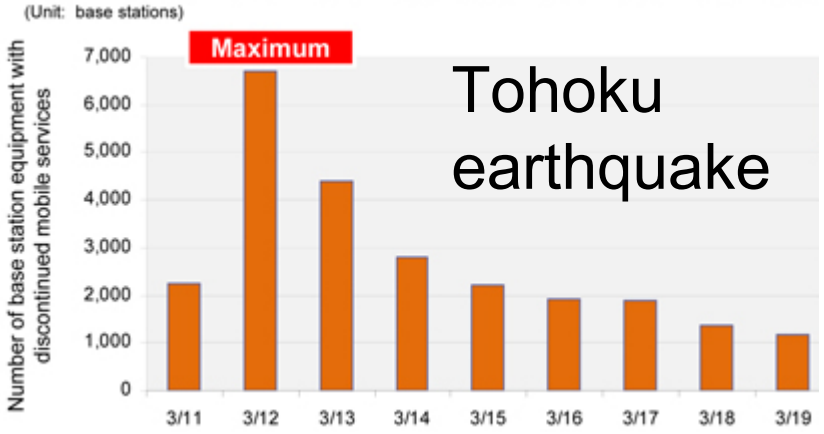
Emergency scenarios can lead to network collapse

Infrastructural issues

- Base stations/APs
  - Physically damaged
  - Overloaded
  - Not present
- Network cabling
  - Physical vs logical topologies
- Internet exchange points
  - Heavily co-located infrastructure

Infrastructural issues





Tohoku earthquake

Severed cabling

What is an emergency network?

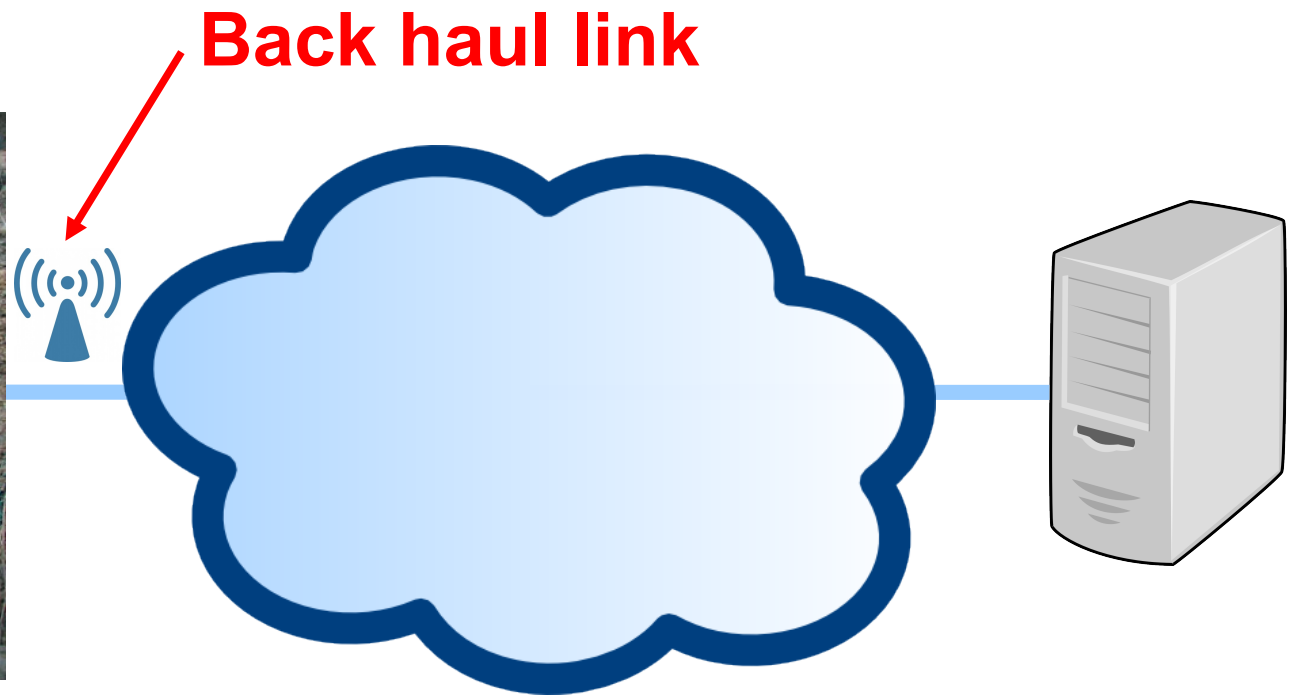
What is an emergency network?

A network designed to survive and facilitate recovery during an emergency

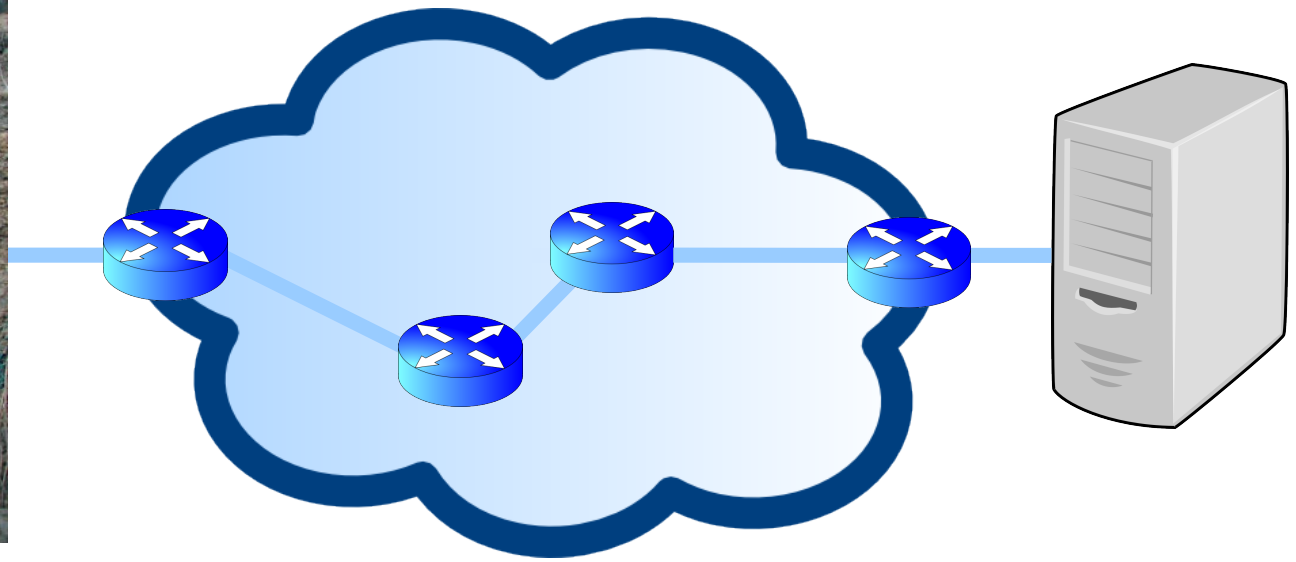
What is an emergency network?

Disaster zone

What is an emergency network?



What is an emergency network?



Network Core

What is an emergency network?

What does an emergency network need?

What does an emergency network need?

Resilience

What does an emergency network need?

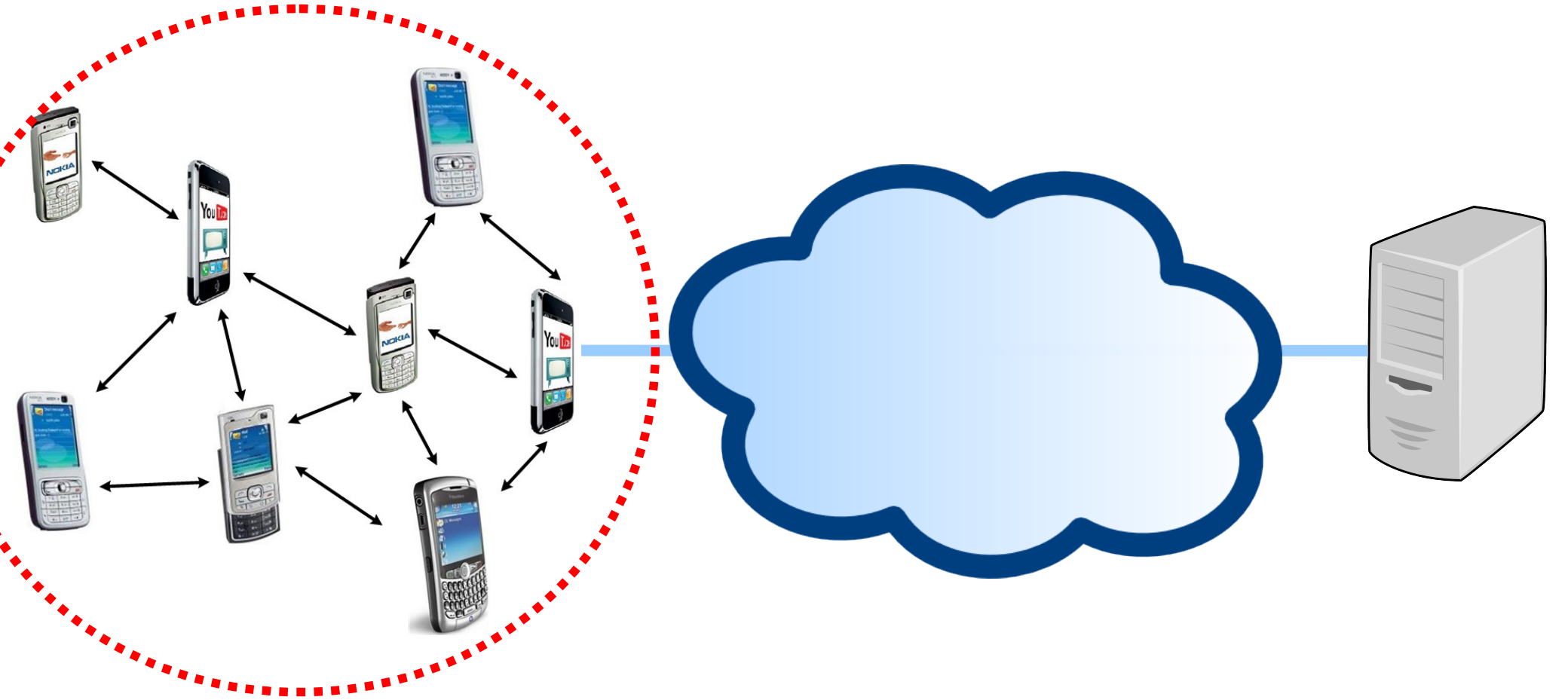
Resilience

At every component in the network

IU-ATC's approach

- Paradigm choices
  - Delay tolerant infrastructure
  - Message-oriented abstraction
    - Nodes can publish/subscribe
- Implementation choices
  - Hastily deployed infrastructure
  - Resilient back-end
  - Doesn't require resilience core

Hastily formed network



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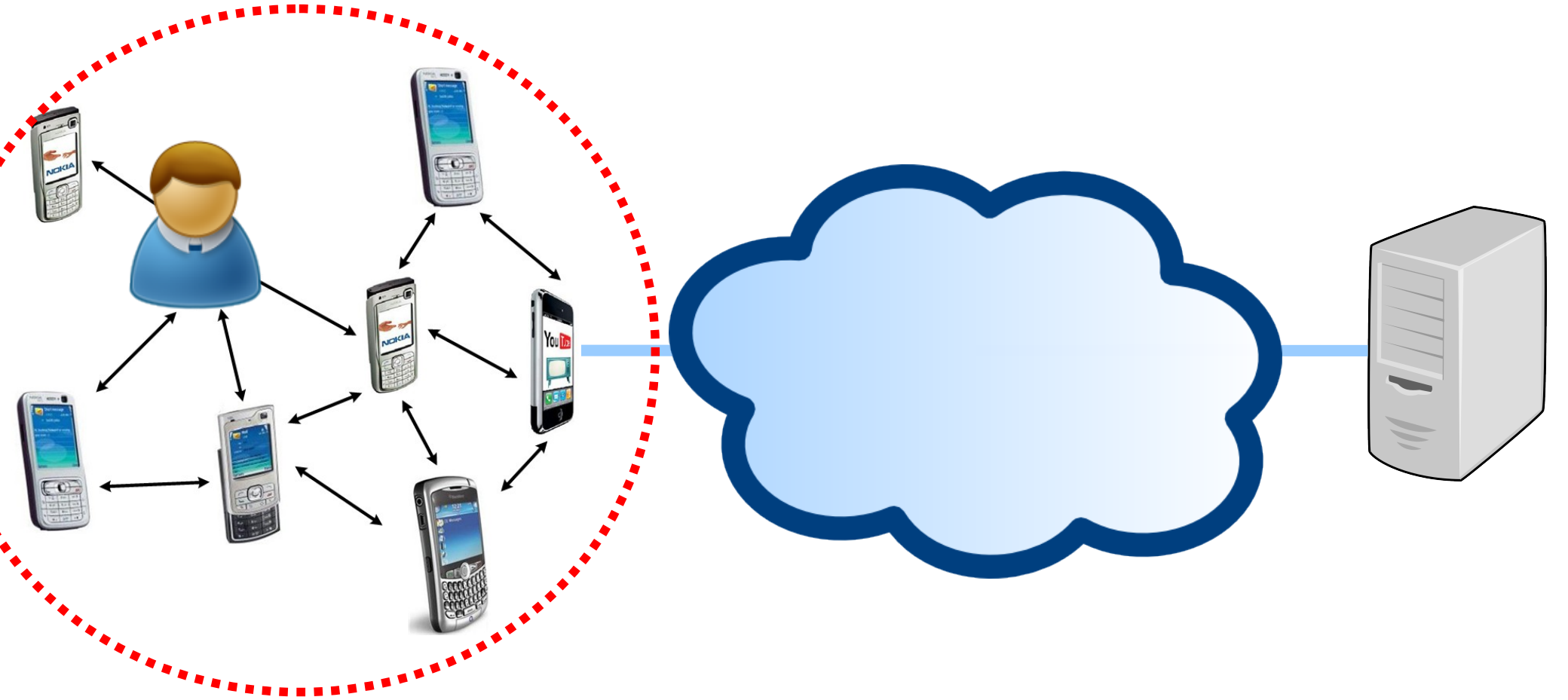

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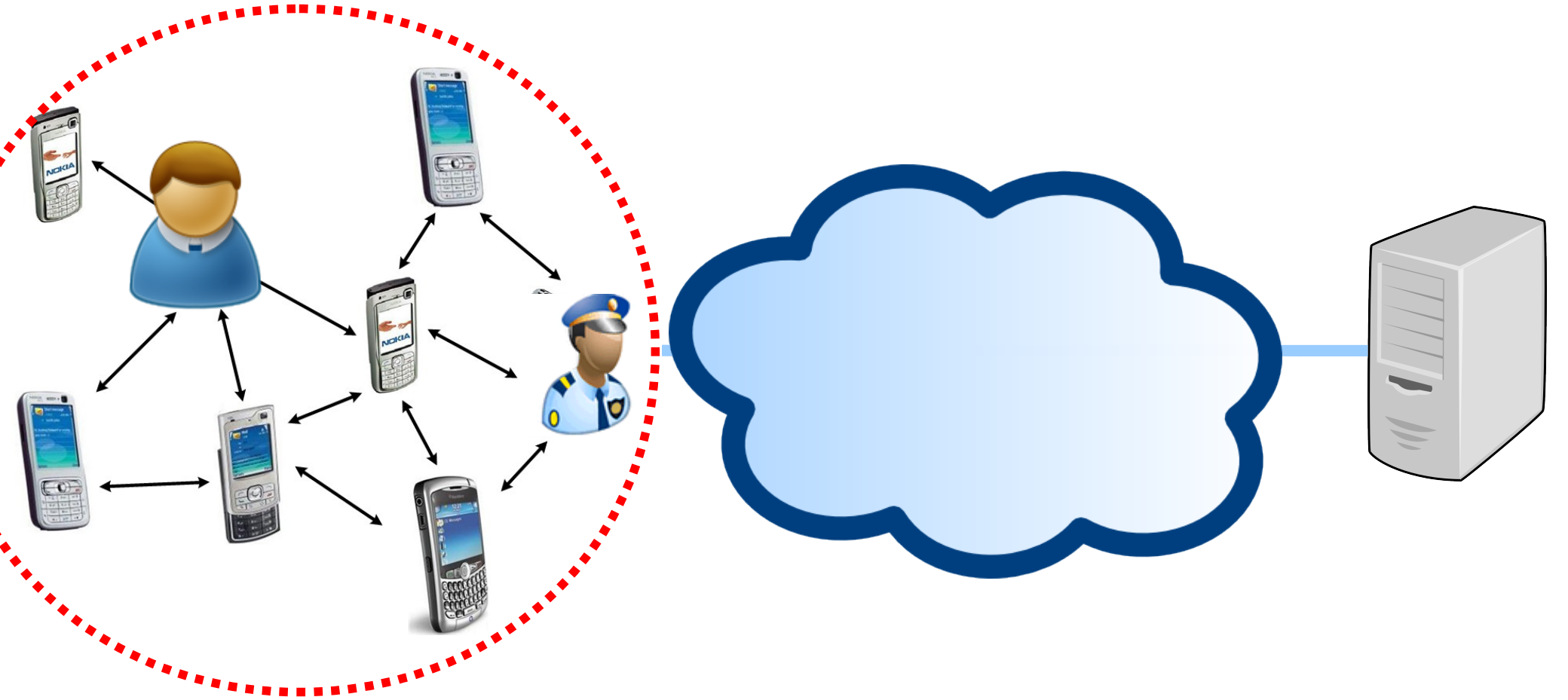

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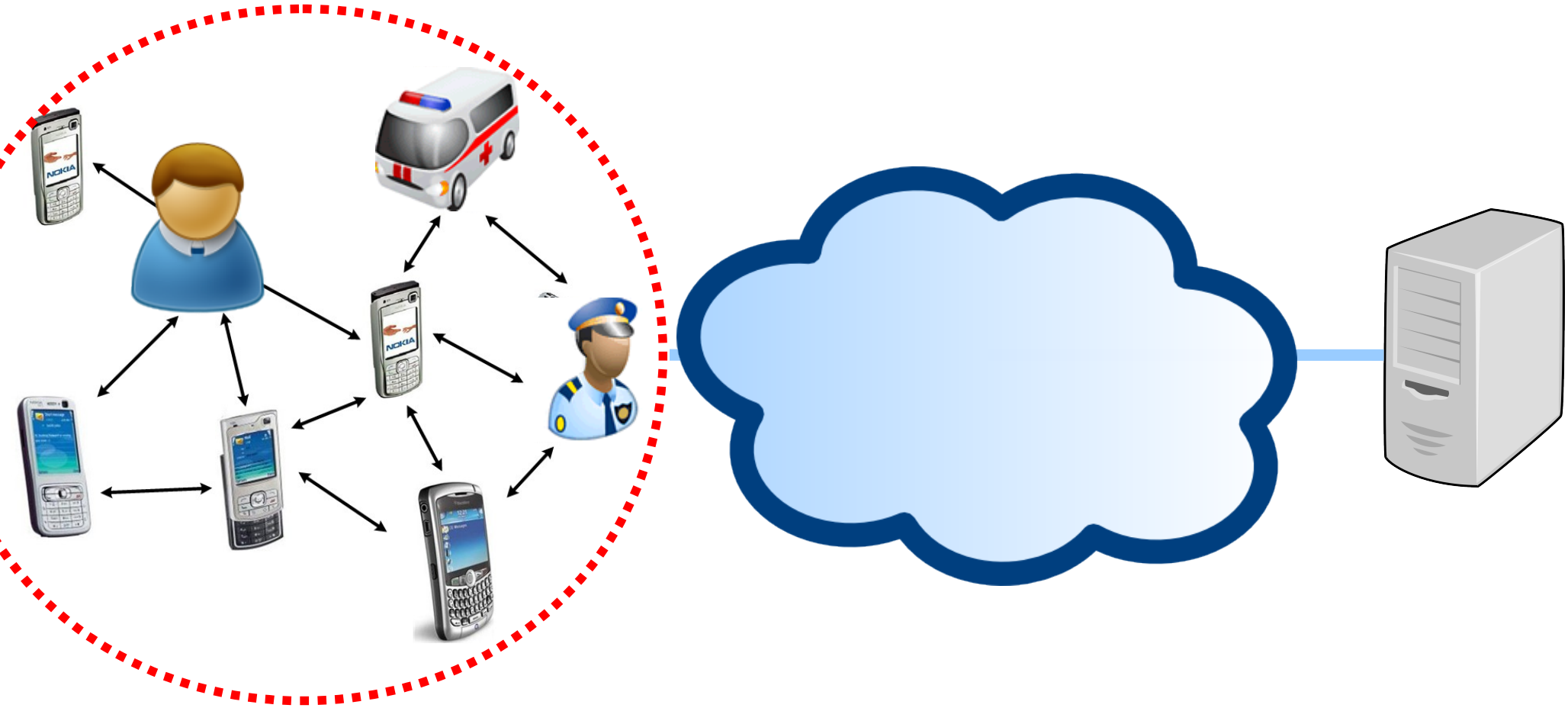

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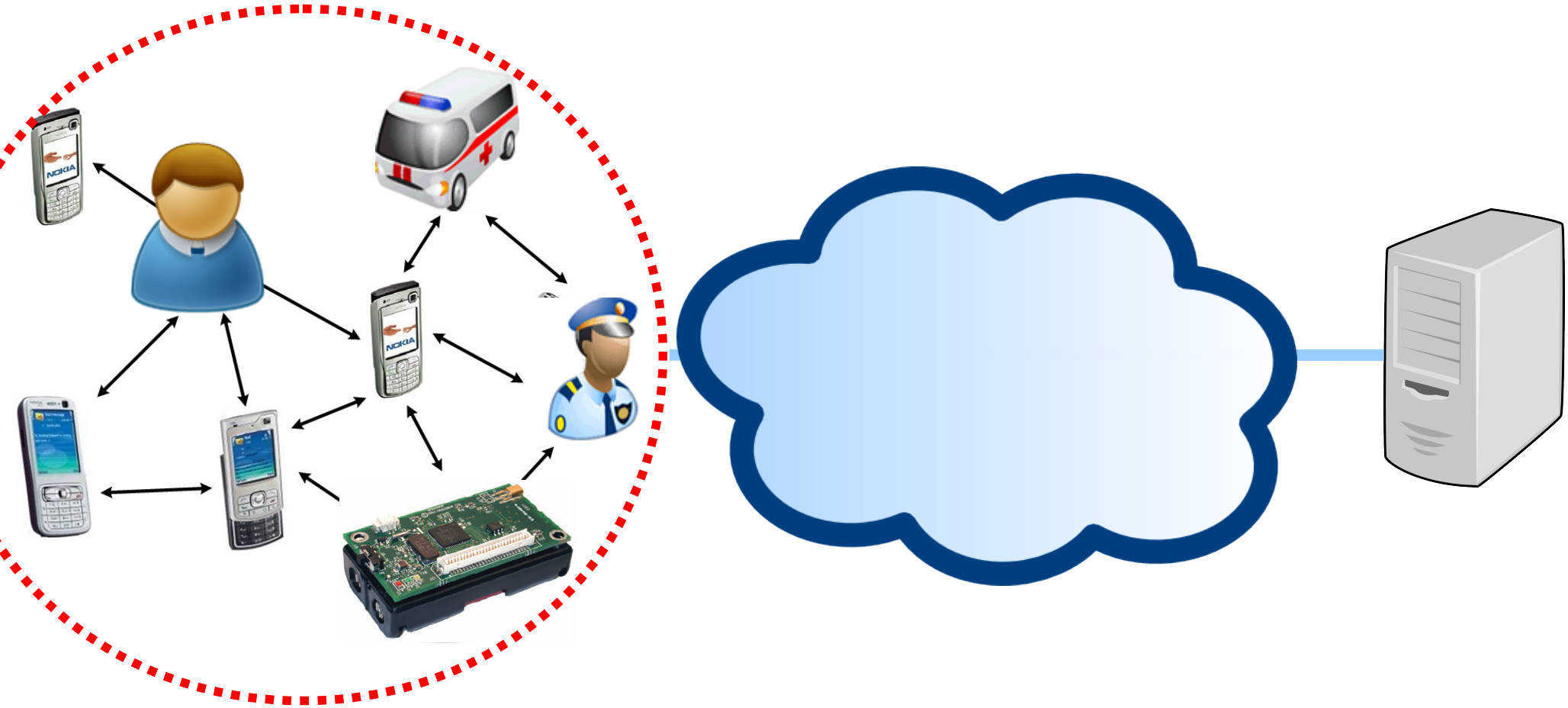

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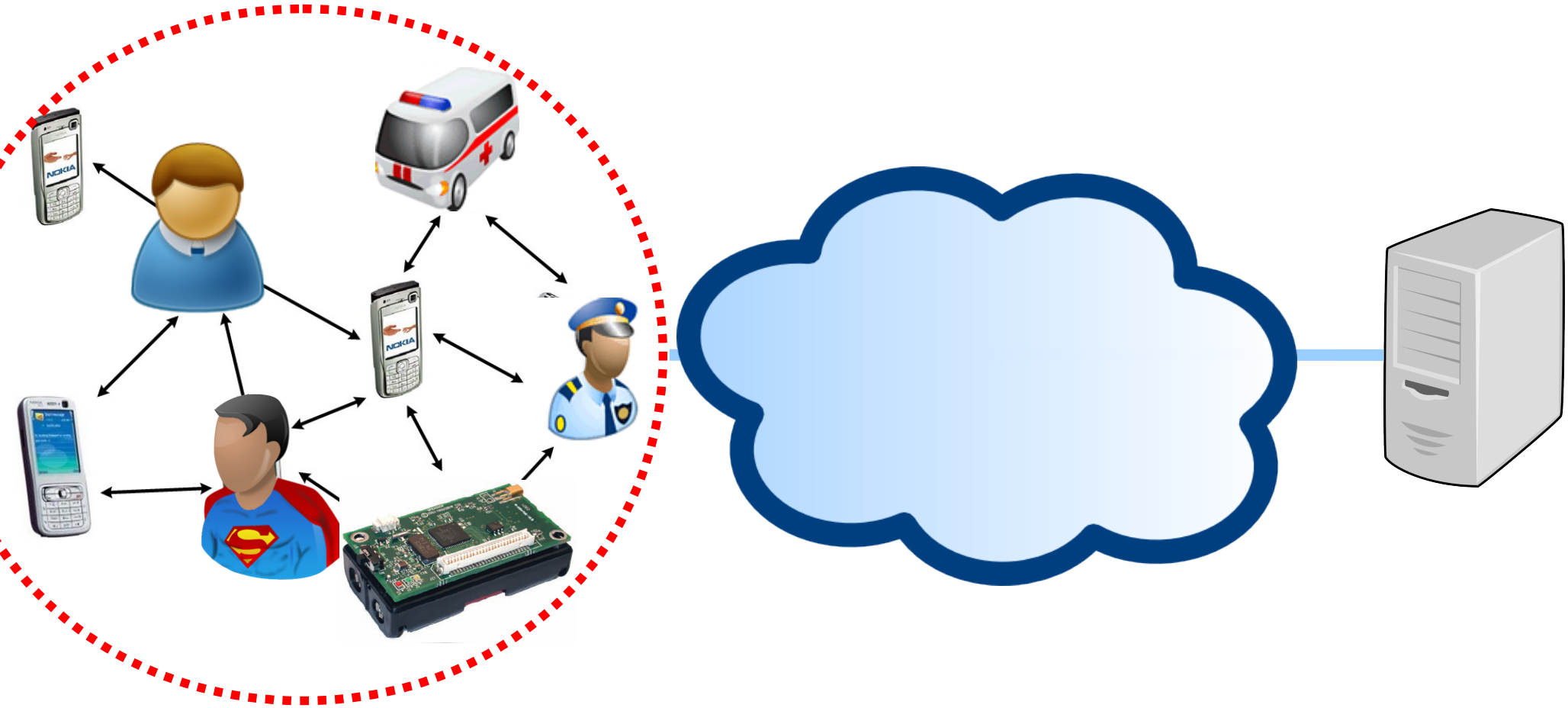
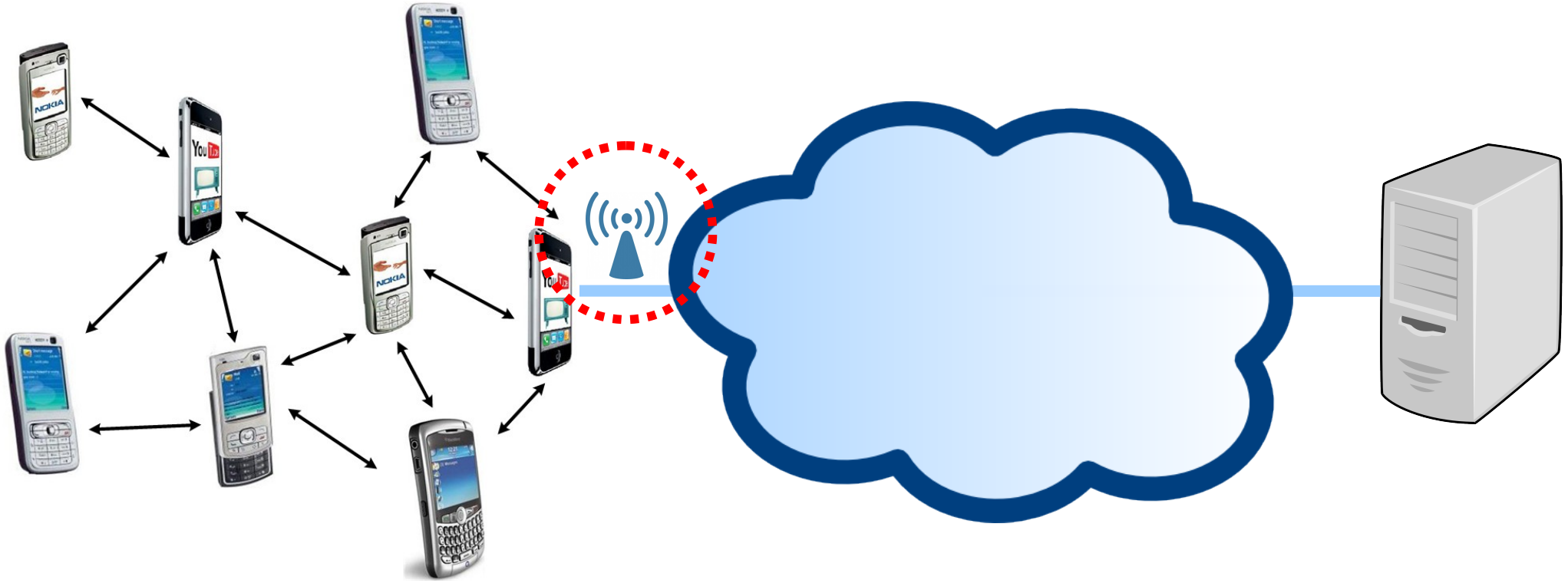


Back haul link



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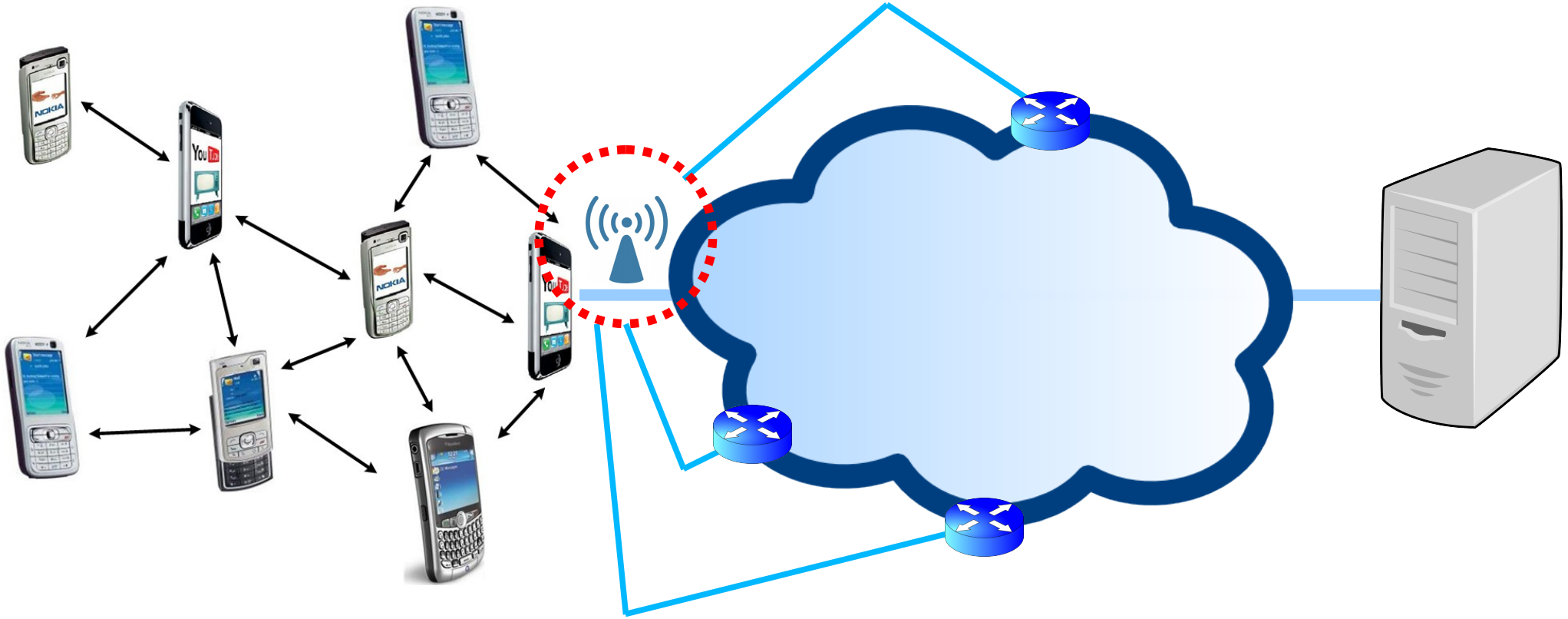
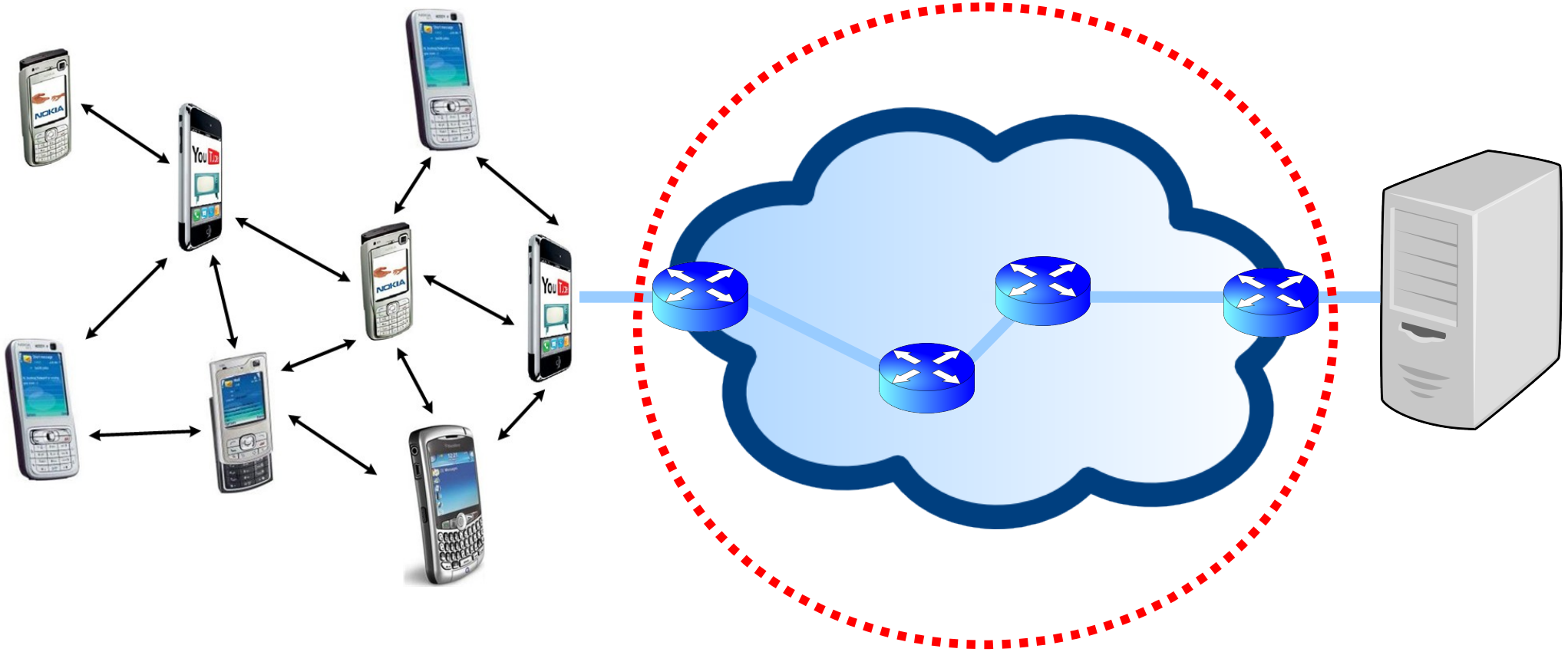
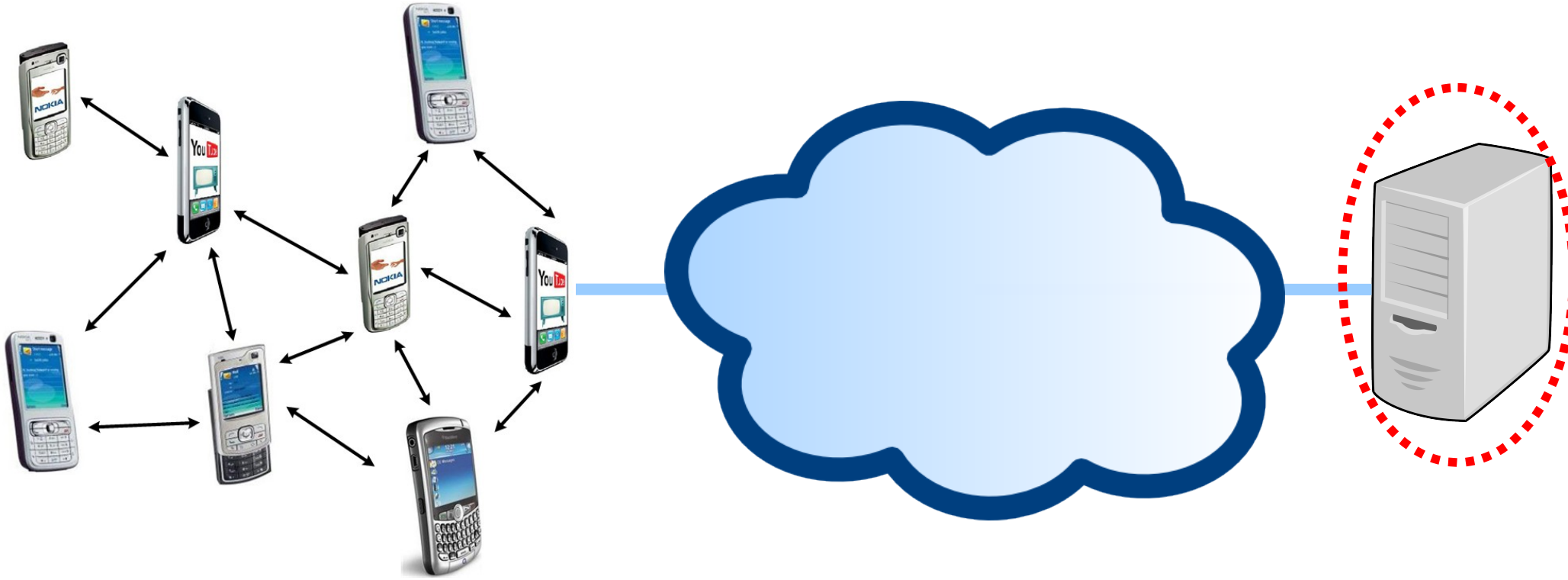


Core network



MOM Broker



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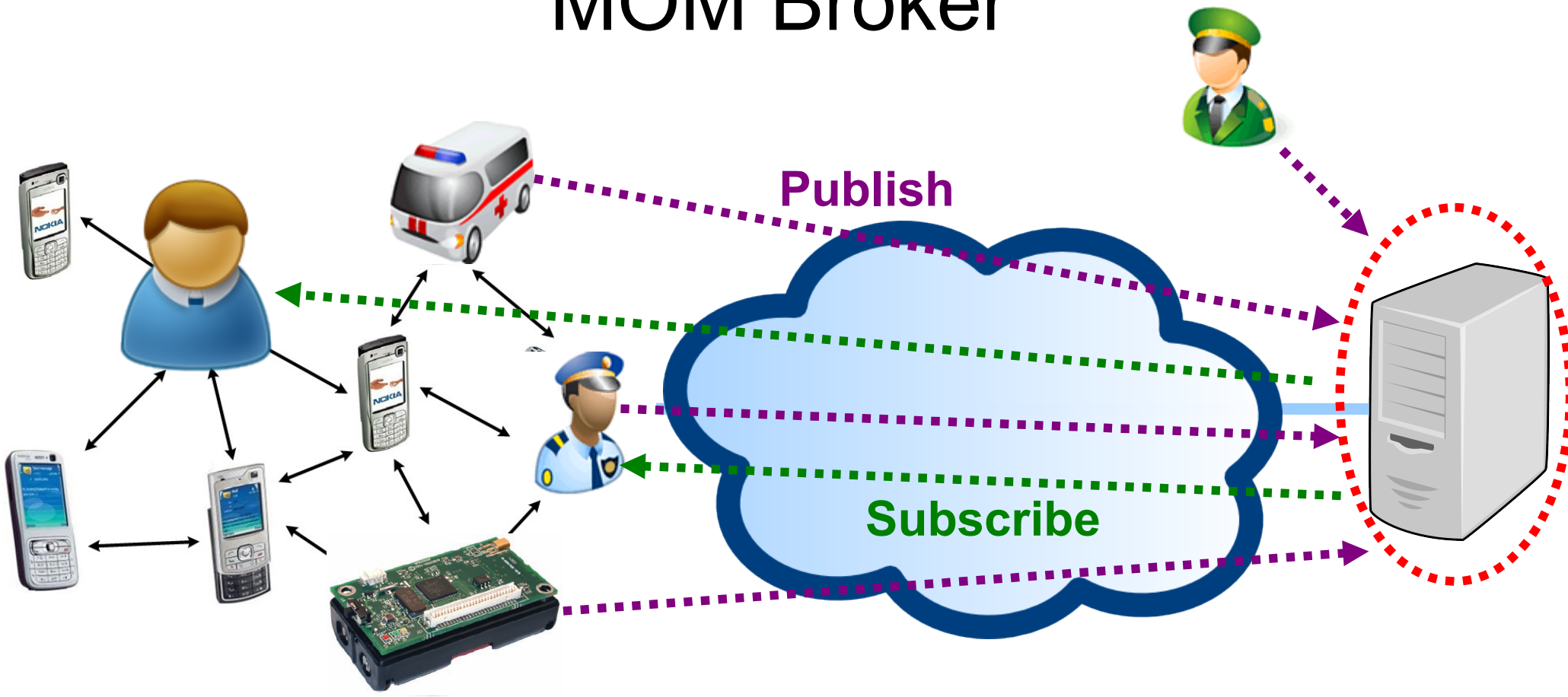

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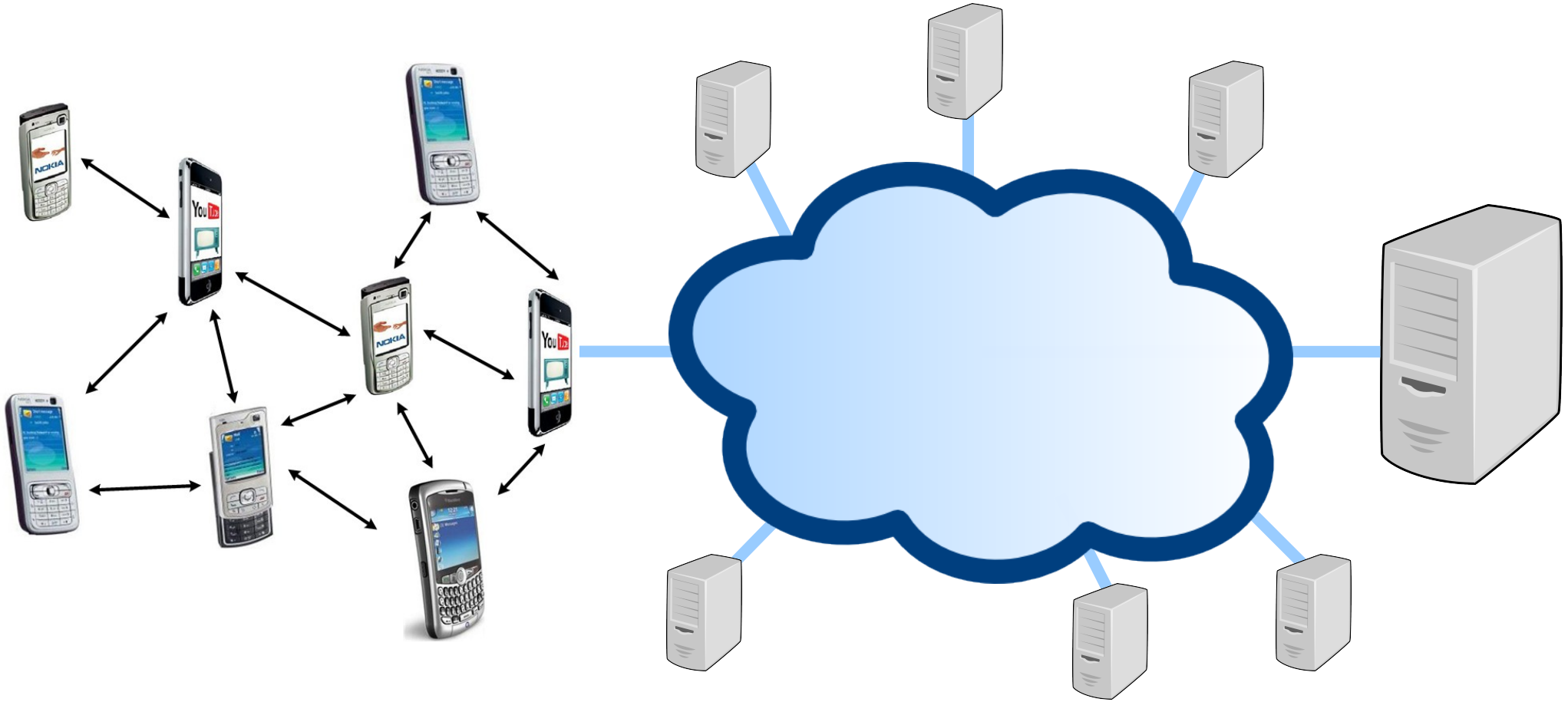
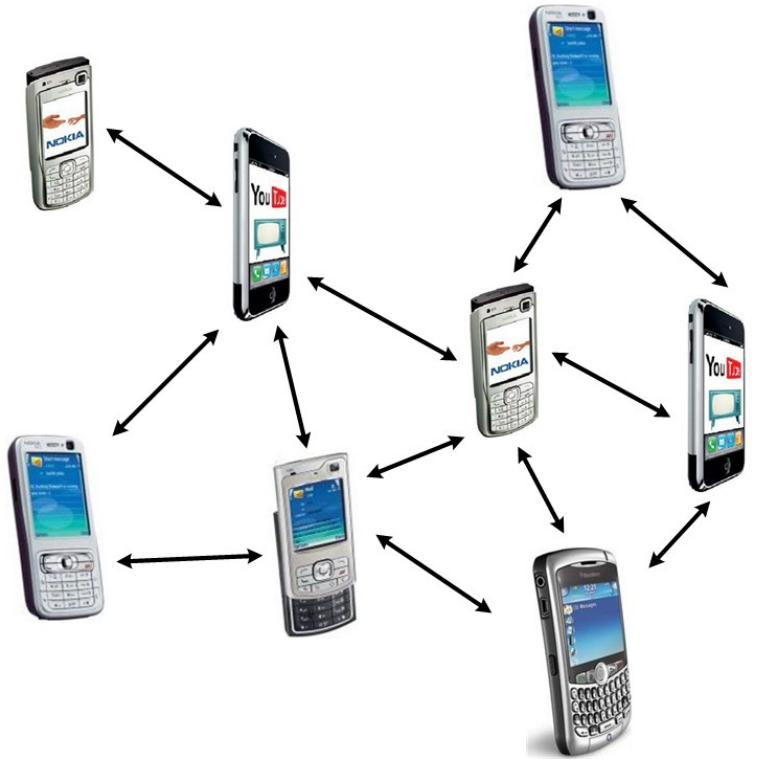
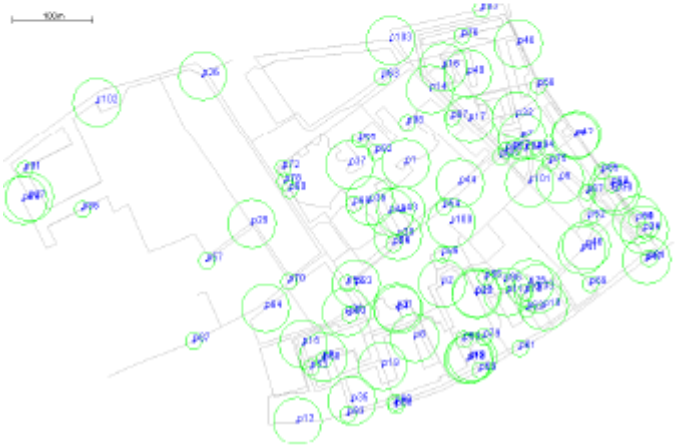


Preliminary Investigation:
DTNs

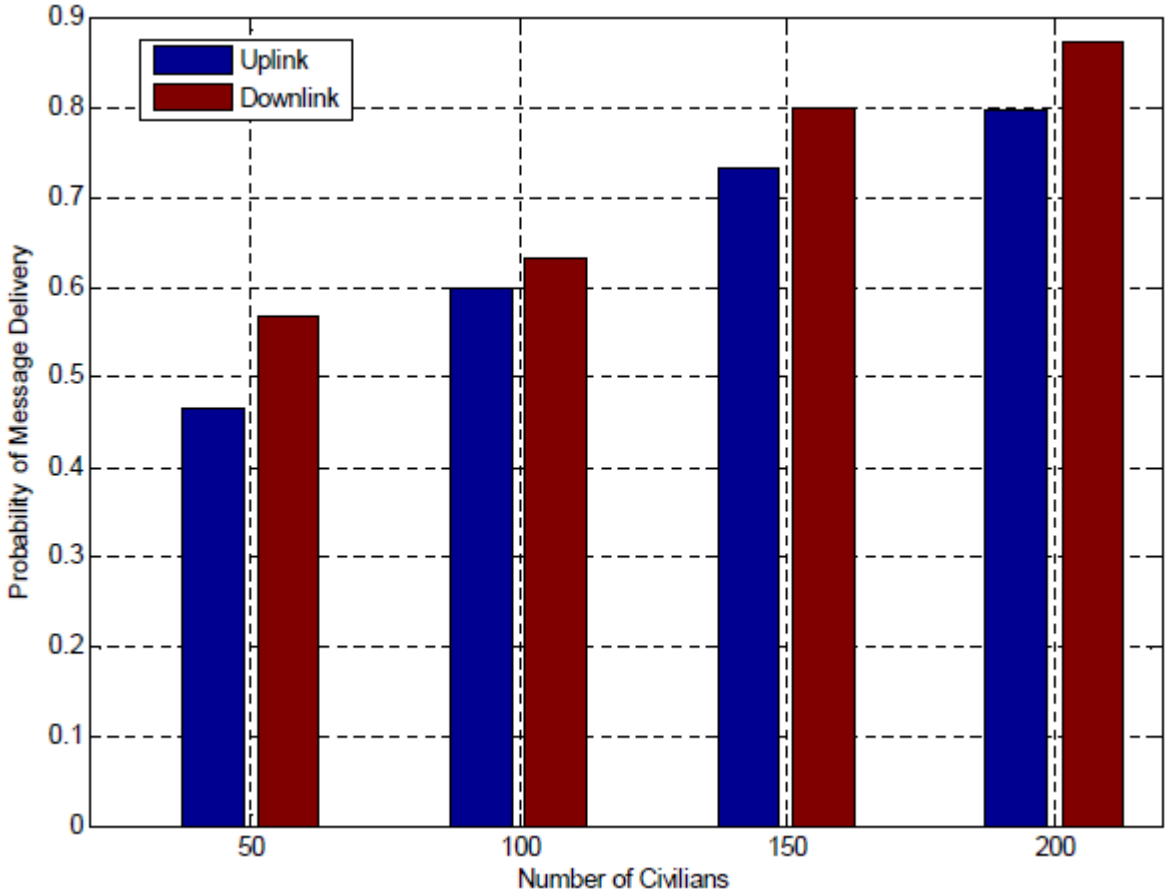


Preliminary Investigation: DTNs

- QMUL map
  - Civilians move around paths at 30m-60m/min
- Civilians broadcast help beacons
  - 1 every 3 minutes
- Four rescue teams
  - Fixed locations

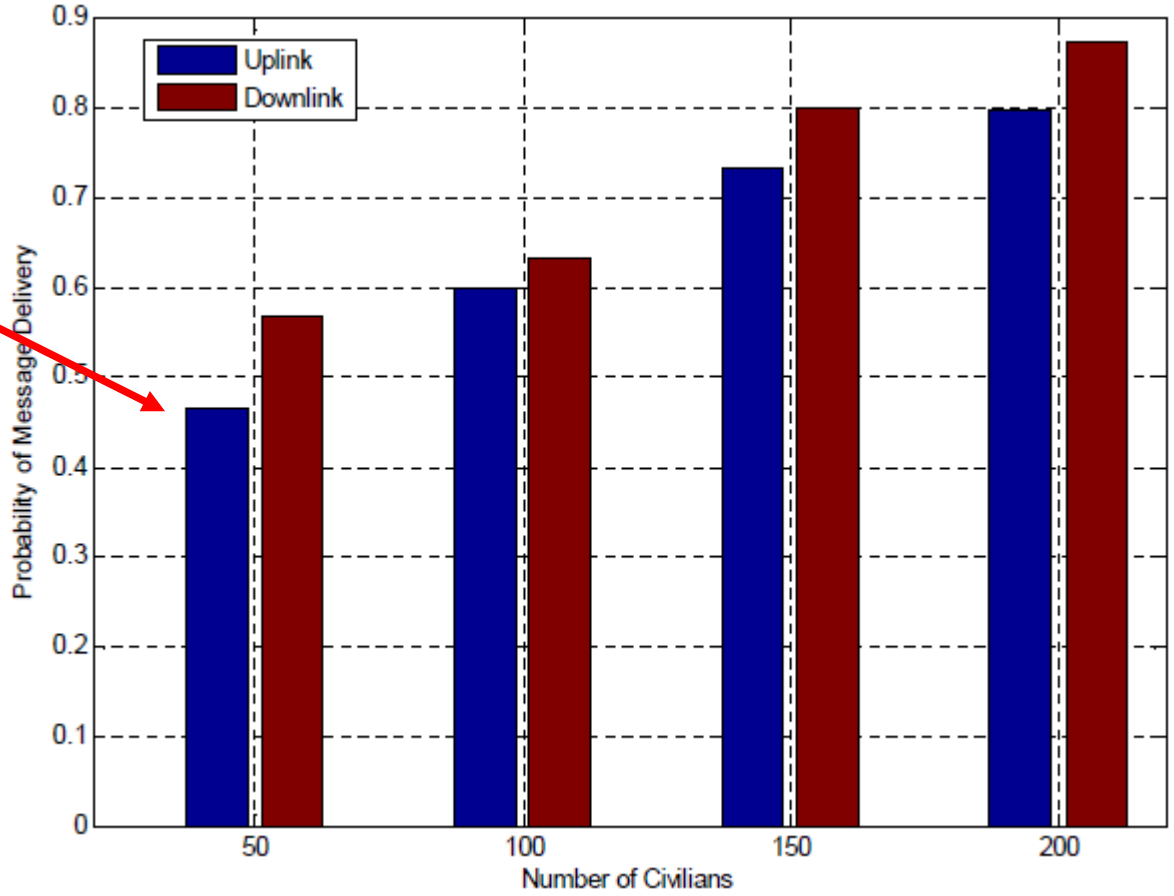


Delivery probability

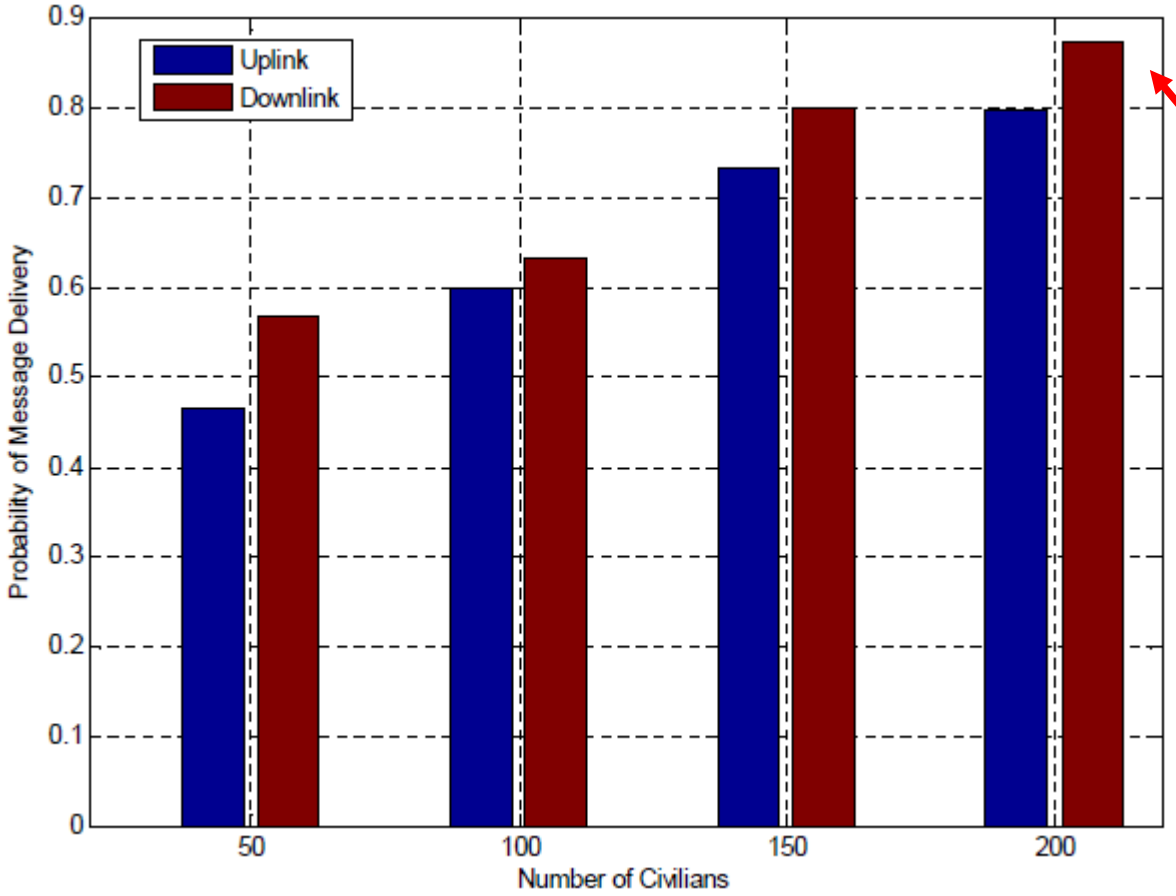


Delivery probability

Less than 50%!

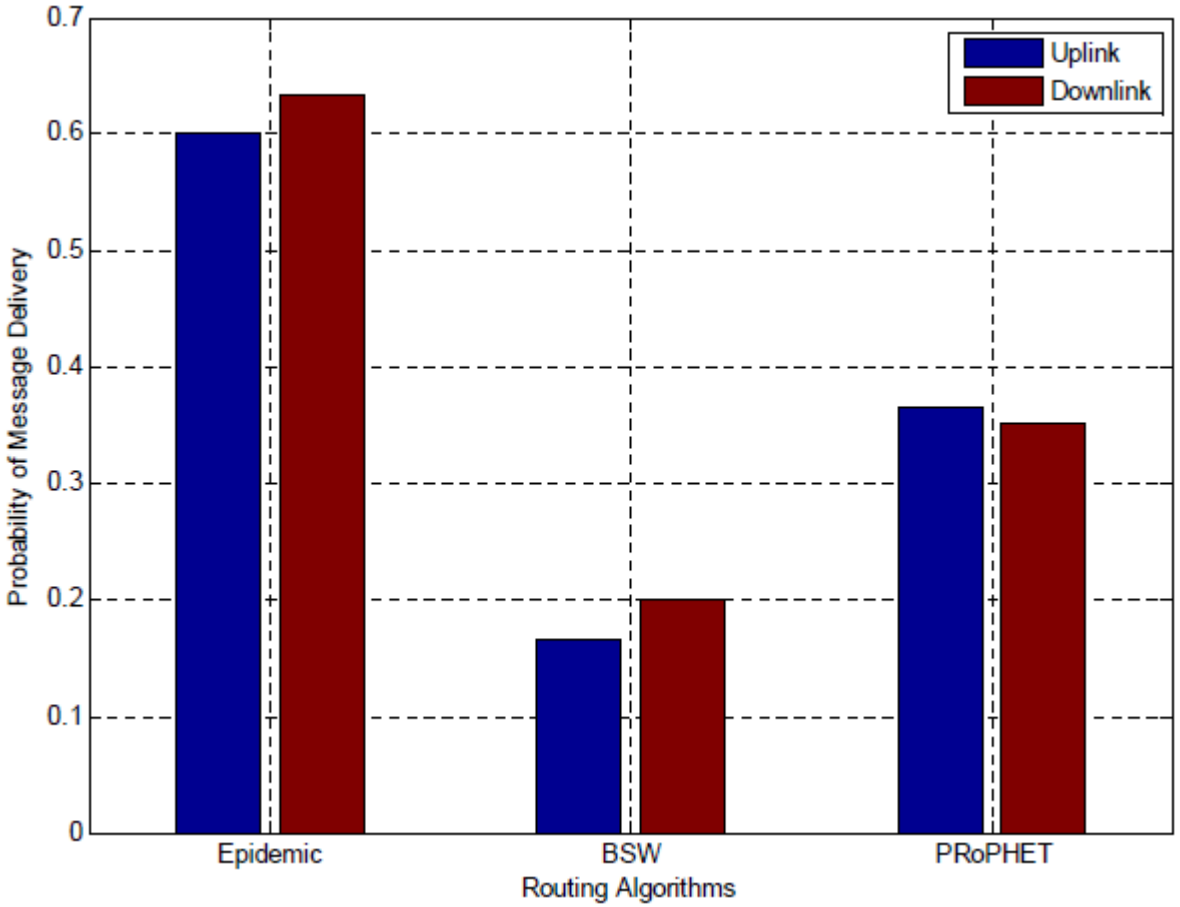


Delivery probability



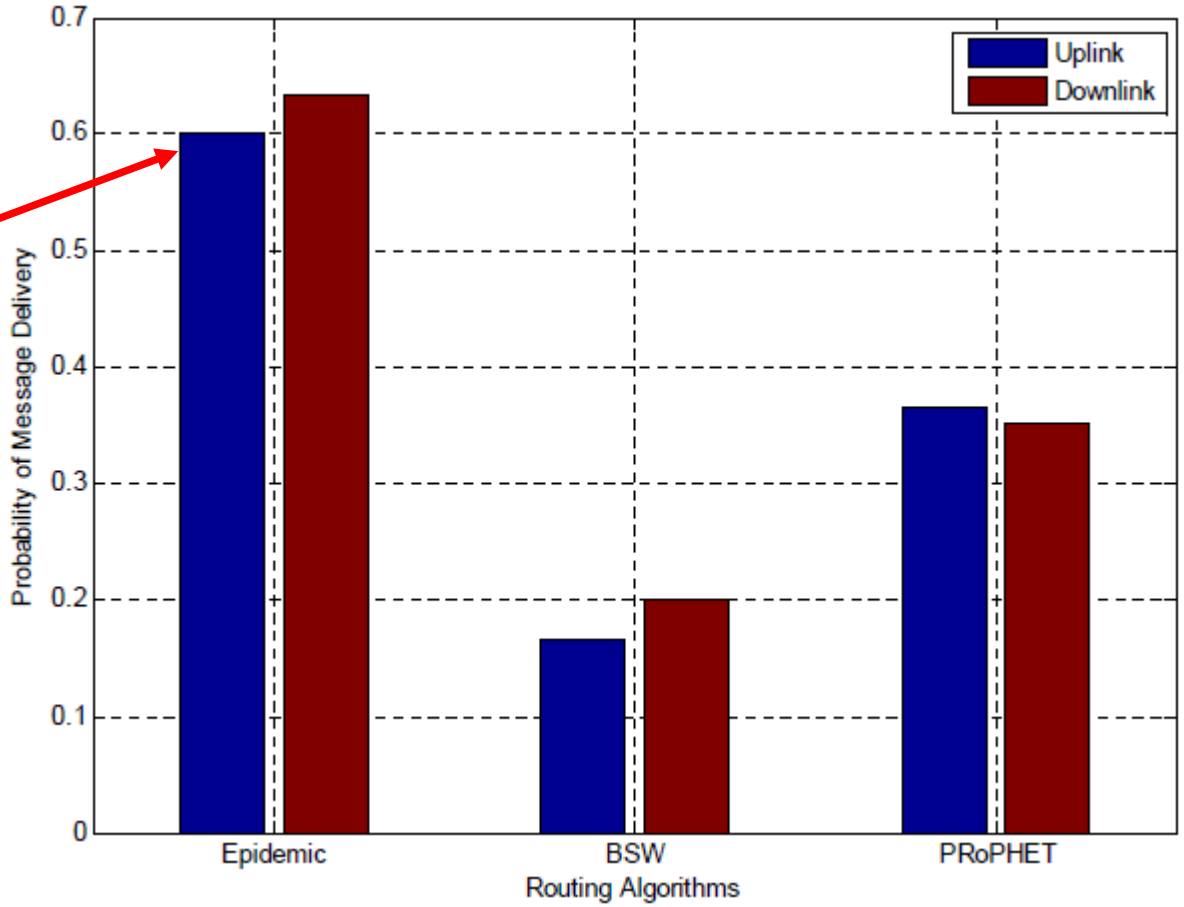
Needs 200 people to even approach 90%!

Delivery probability

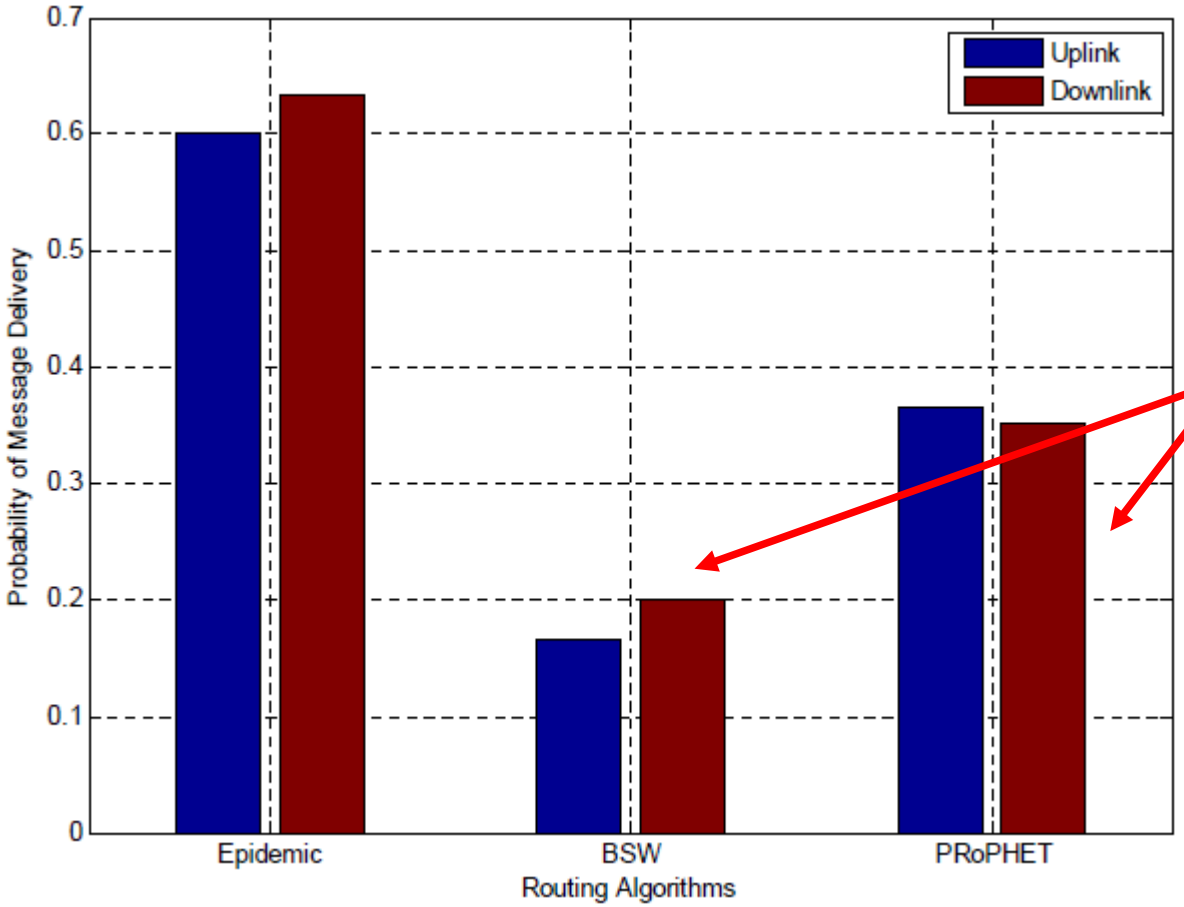


Delivery probability

High delivery probability requires flooding



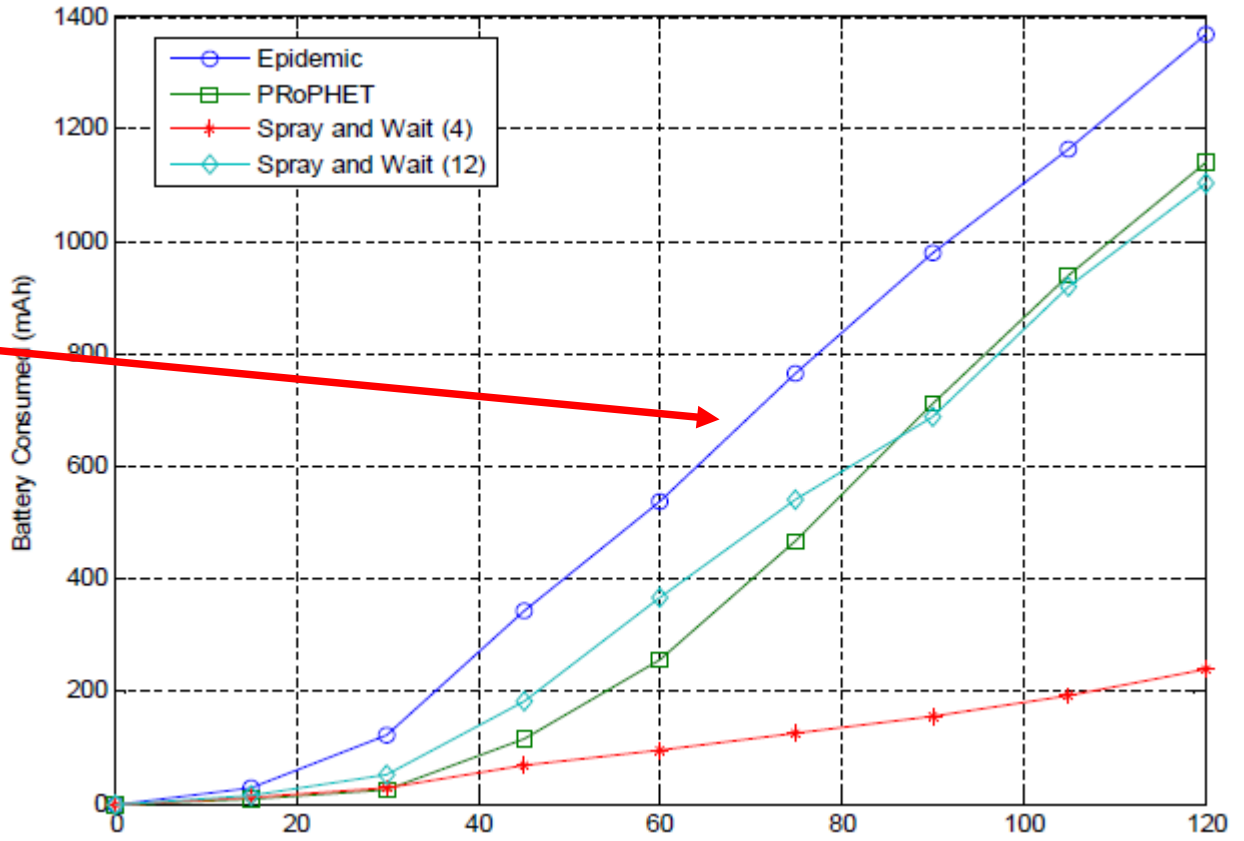
Delivery probability



Low overhead requires low delivery probability

Delivery probability

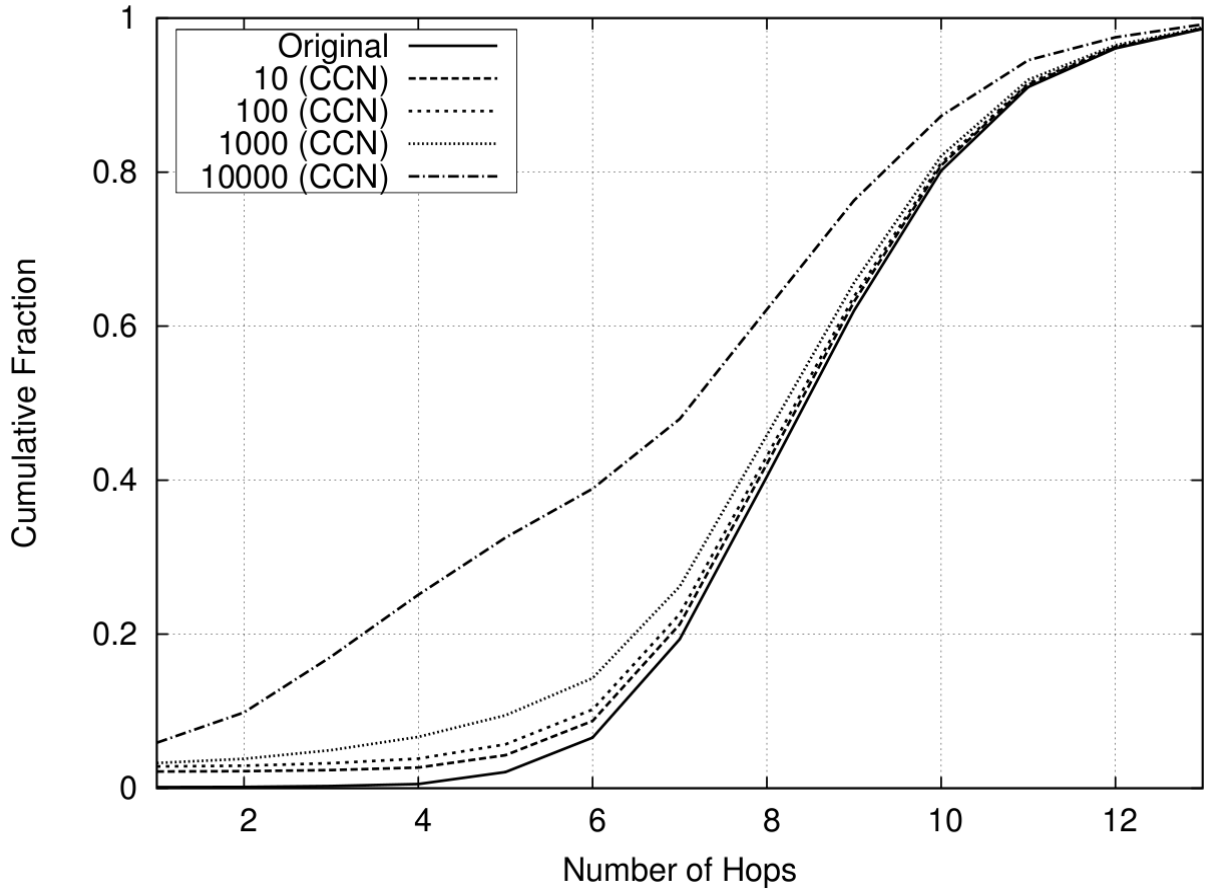
High overhead equals high battery



An alternative approach?

- Integrate ICN principles
  - Naturally delay tolerant
  - Often emergency communications are pub/sub
- Resilience a monotonically decreasing function of hop count
  - With each hop comes added risks
- ICN offers explicit resilience through caching

A peak into ICN



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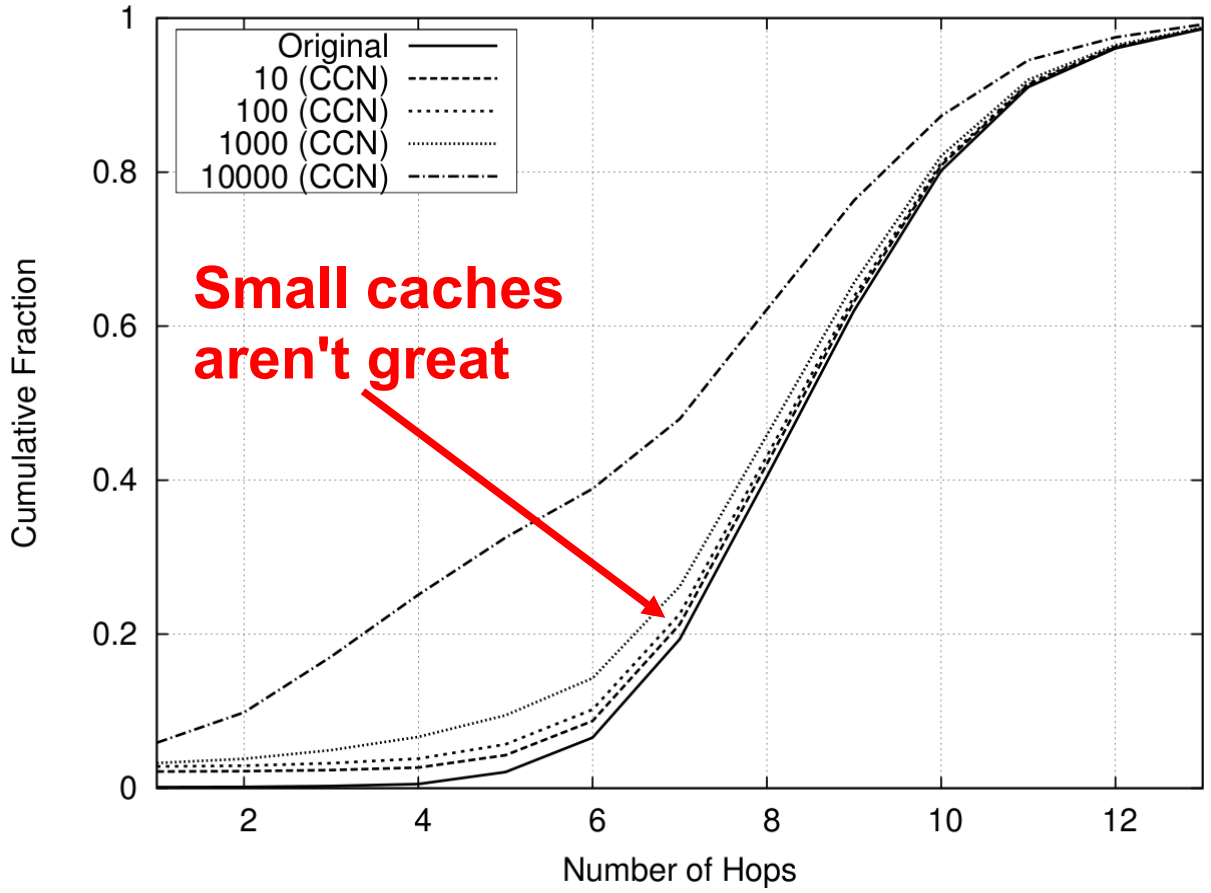

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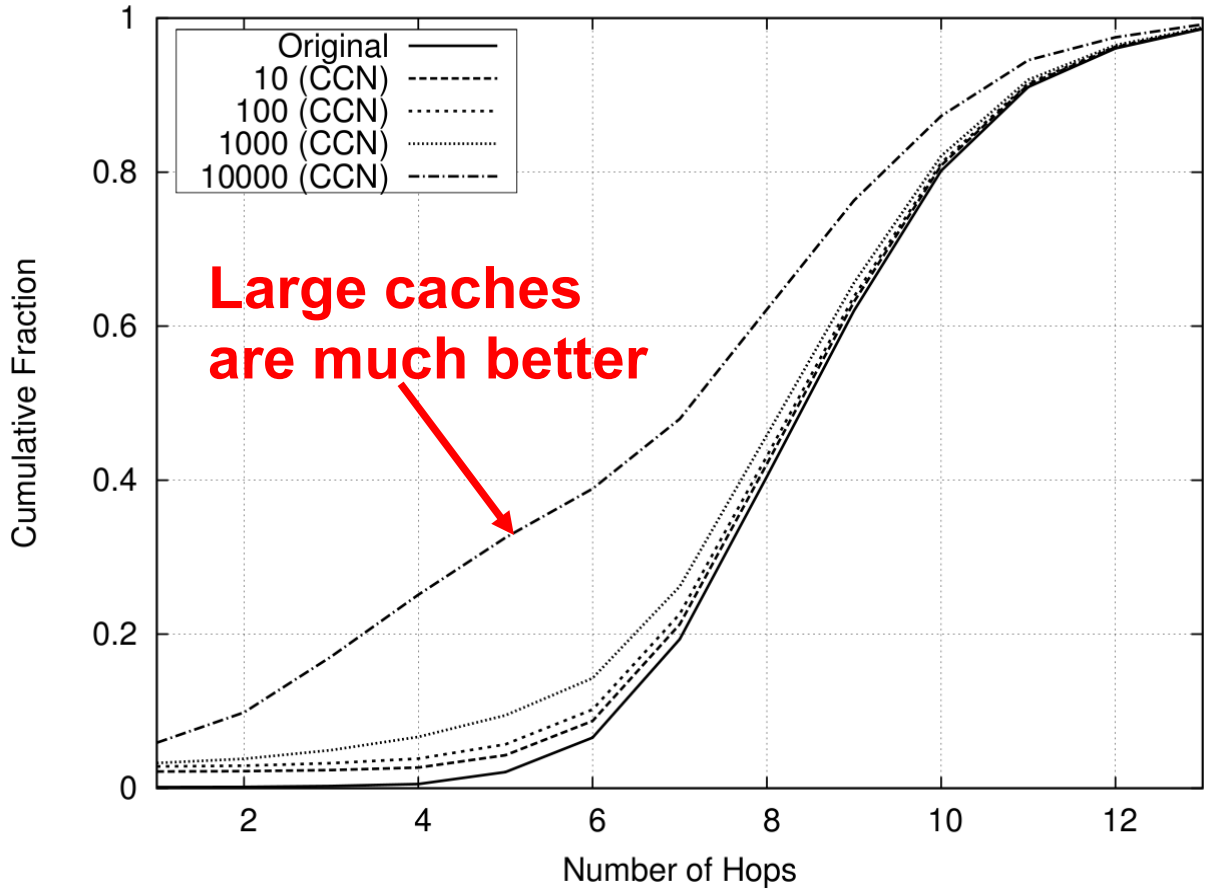

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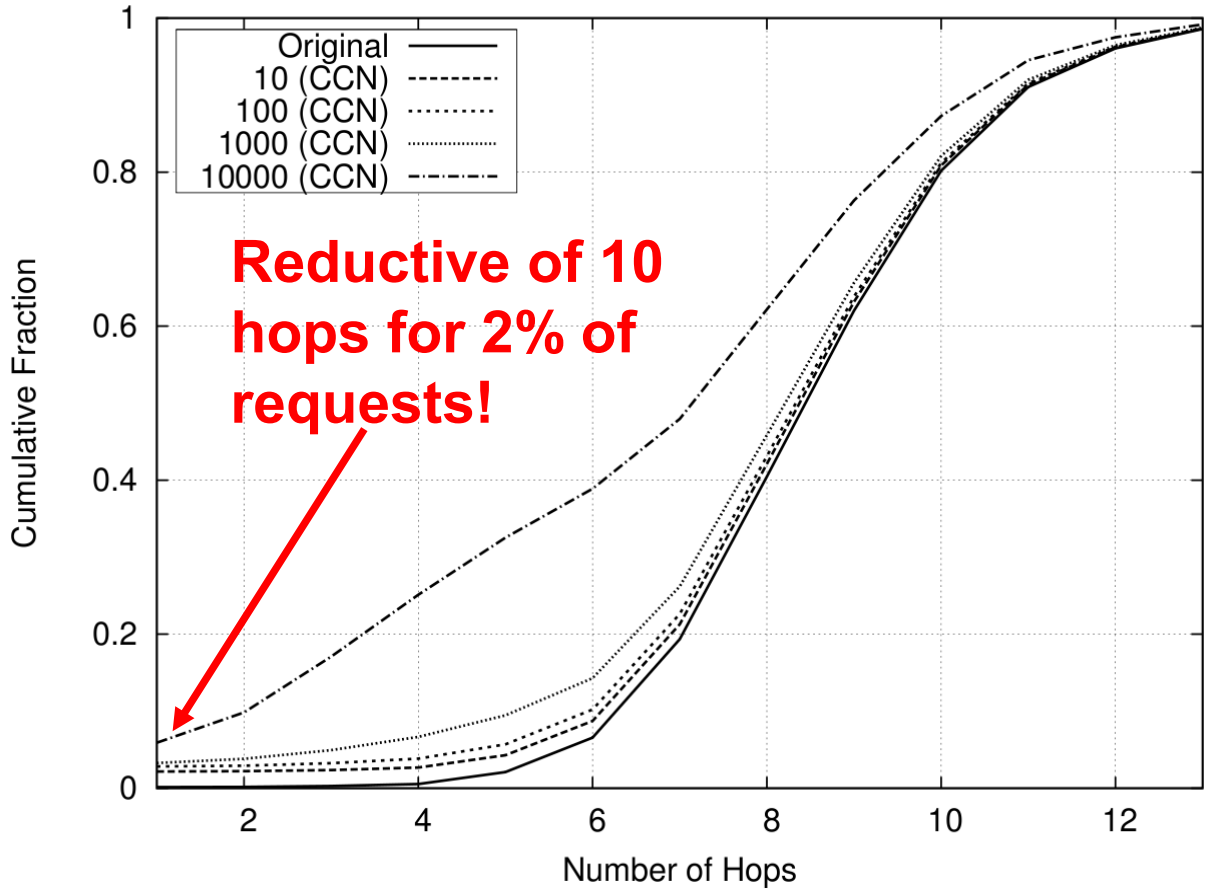

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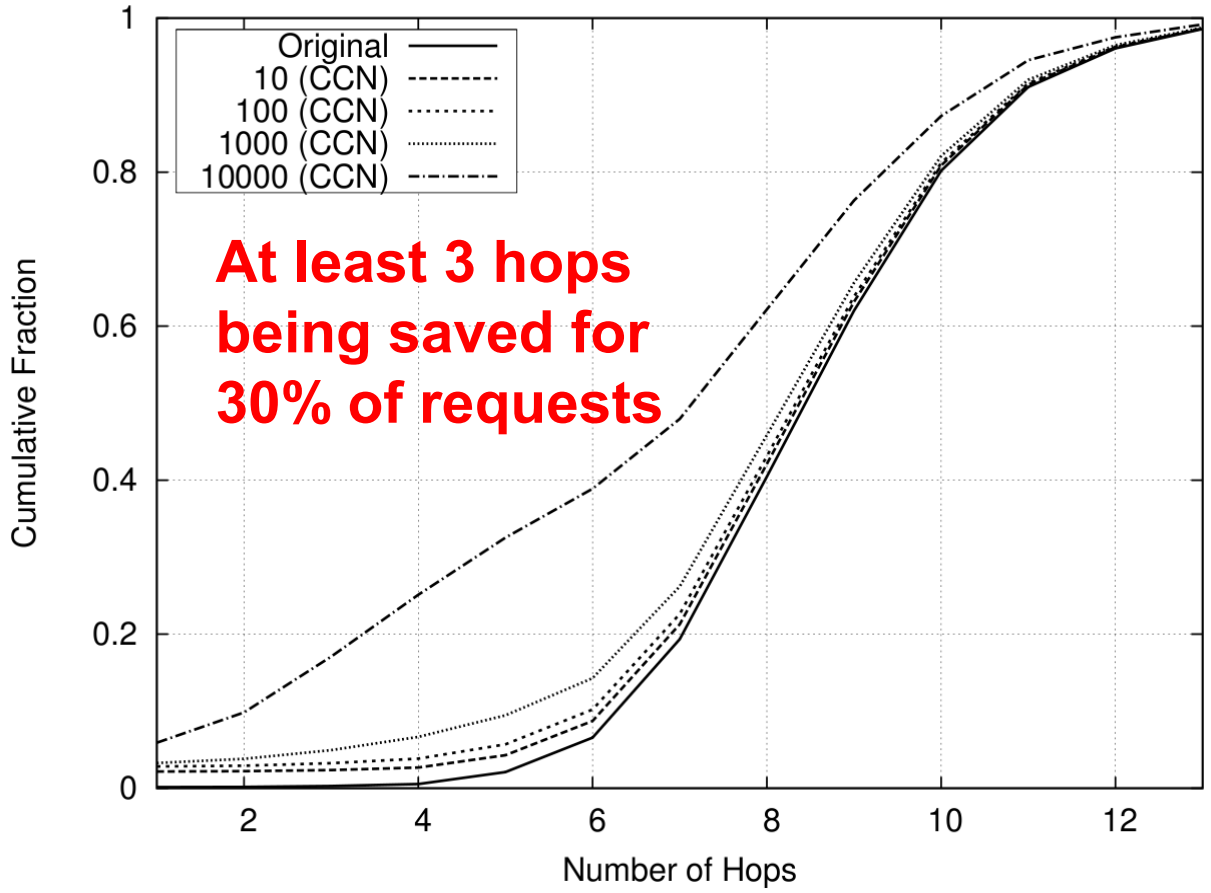
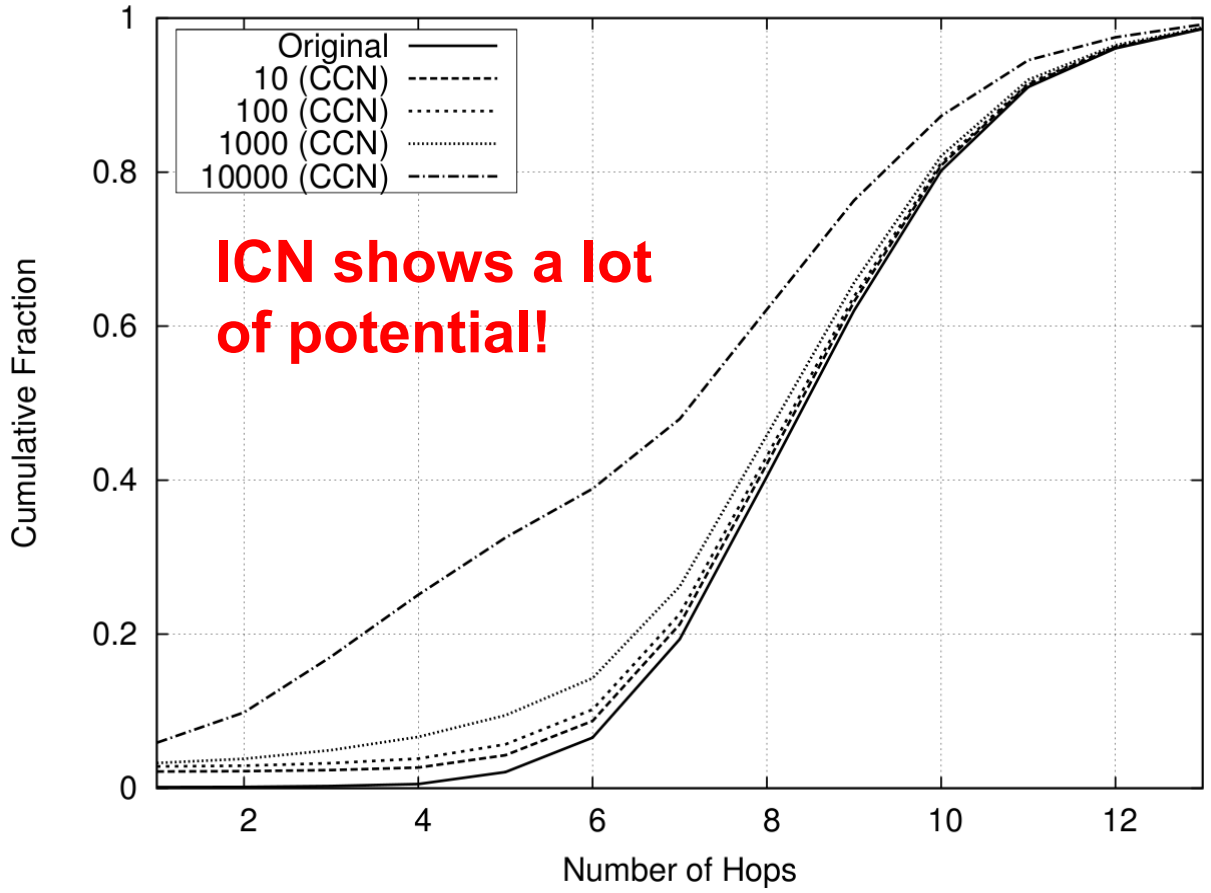
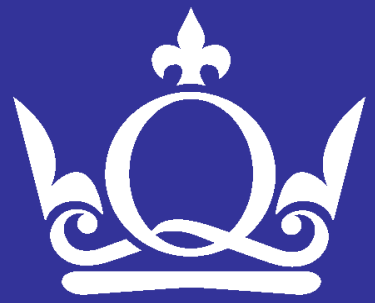


A peak into ICN



Conclusion

- Discussed challenges of emergency networking
- Presented IU-ATC's approach
  - Explored weaknesses
  - Explored future work



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Thanks!