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Service Discovery for Context-Aware Mobile Ad-hoc Networks for Health-care Applications

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Outline

- Motivation
- Related work
- Proposed distributed service discovery model
- Analysis and results
- Conclusion and future work

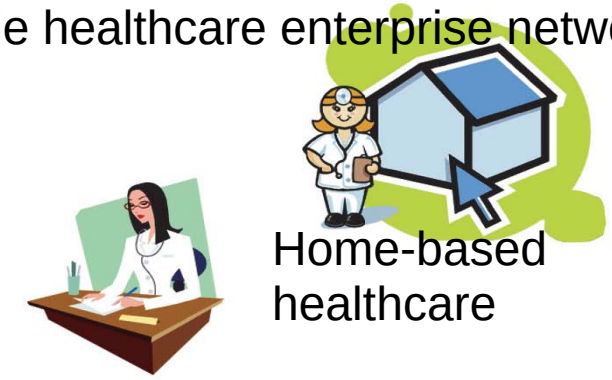
Applications of MANETs

- Healthcare monitoring

- Other healthcare as well
  - Security
  - Environmental monitoring
  - Ambient intelligence
  - Critical healthcare infrastructures monitoring

Mobile healthcare scenario
(Facility-centered services -> Patient–centered services)

Mobile healthcare enterprise network



Home-based healthcare

Affiliated medical center

Ultrasound laboratory

Main Hospital

Emergency assistance

[Note] Taken from “Enabling secure service discovery in mobile healthcare enterprise networks” by A. Toninelli.

Service Discovery in MANETs

- Service discovery in fixed networks
  - Assumes reliable communication
  - Mainly centralized approaches
- Service discovery in MANETs
  - Distributed / decentralized
  - Scalable
  - Energy efficient (Low message overhead)
  - Fast response time (especially for the real-time applications)

Related Work

- Directory-less service discovery architecture
  - For dynamic small-scale ad hoc networks
  - For networks difficult to host service directories
  - Important research: DEAPspace, Konark, Allia, Group-based Service Discovery (GSD)
- Directory-based service discovery architecture
  - For large ad hoc networks
  - *Choose directory nodes & communication frequency between service discovery nodes*
  - Important research: Kozat and Tassiulas's Service Discovery Protocol , Service Rings , SANDMAN , DSDM

Proposed Distributed Service Discovery Model

- Distributed service directory selection/ notification phase
  - Resource capabilities : memory capacity, power energy, processing speed and bandwidth
  - The number of neighbor nodes
  - Relative stability of the nodes in the network
  - The value of each above node capability changes over time
- Service registration phase
  - Register service information with the nearest service directory
  - Notify other neighboring SD nodes
- Service discovery phase

r_0

Analysis

- How the number of service directory nodes affects path availability between a random node and its nearest service directory node
  - The stability of the whole network
  - Reduction of the response time
  - Scalability
- Assumption:
  - Rectangular area of size (A = a*b)
  - A mobile multi-hop network with N uniformly distributed nodes, each of them with radio transmission range r0
  - Each node moves at a randomly chosen direction and a random velocity

- Probability density function (pdf) of the distance S between two random nodes

$$f_S(s) = \frac{4s}{a^2 b^2}\left(\frac{\pi}{2}ab - as - bs + \frac{1}{2}s^2\right)$$
$$\text{for } 0 \le s \le b \le a.$$

- The probability that the number of hops between one node and its nearest service discovery node within h-hop is:

$$\lim_{\substack{n \to \infty \\ A}} P(H \le h) = F_{\min(X)}(hr_0)$$
$$= 1 - (1 - F_S(hr_0))^{N_{SD}}$$

Results-1

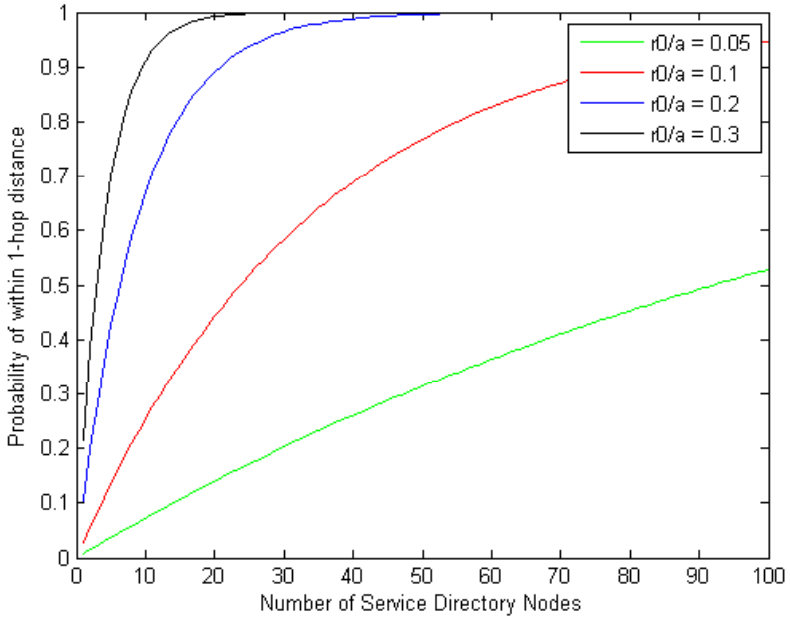


Figure 1: Probability of within 1-hop distance between a random Node and its nearest SD node

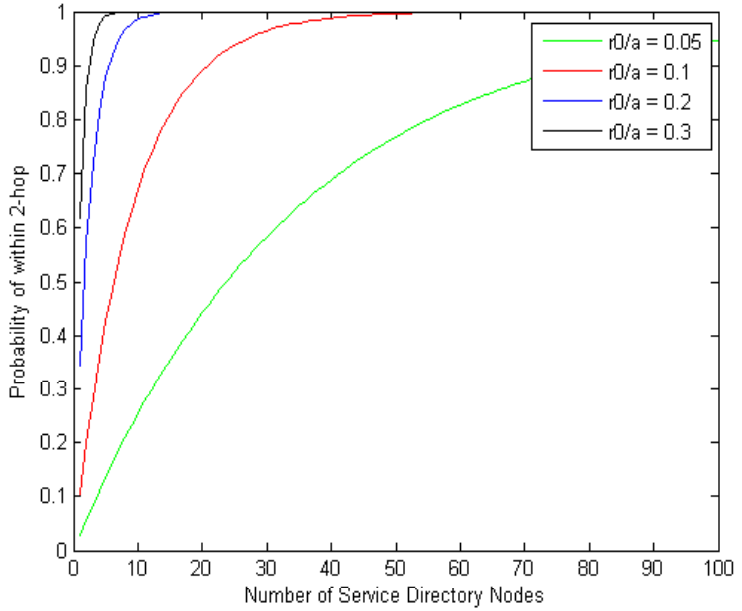


Figure 2: Probability of within 2-hop distance between a random node and its nearest SD node

Results-2

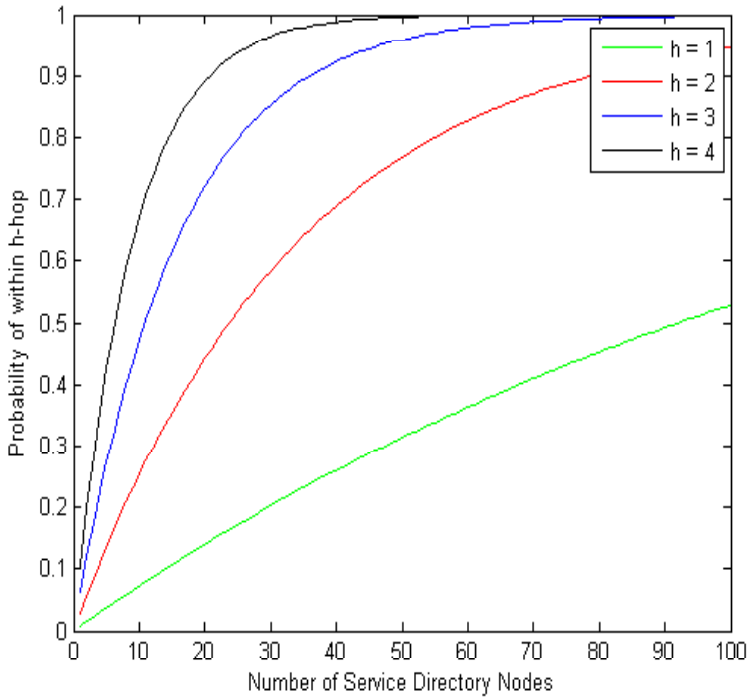


Figure 3: Probability of within h-hop distance between a random node and its nearest SD node when $r_0/a = 0.05$

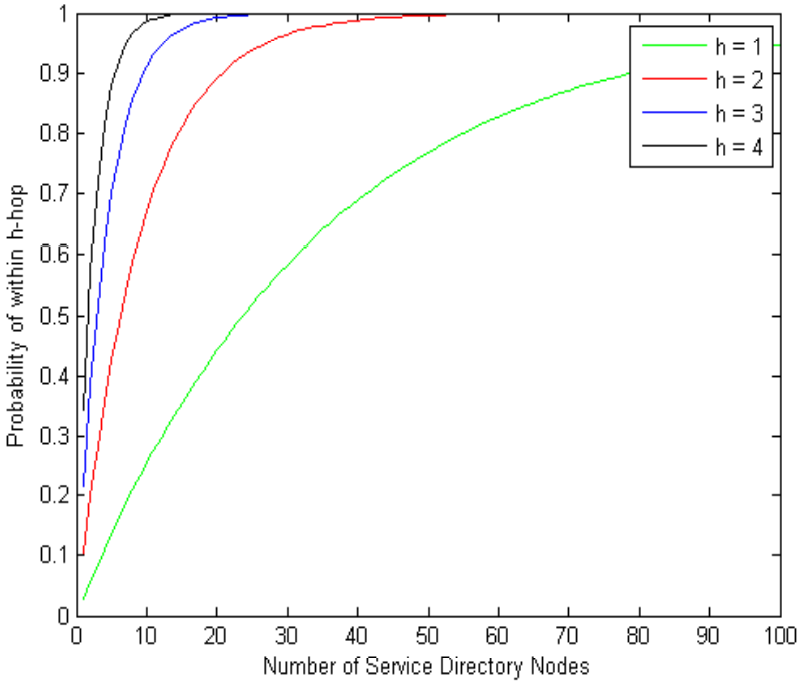


Figure 4: Probability of within h-hop distance between a random node and its nearest SD node when $r_0/a = 0.1$

Results-3

- The probability that the link availability time is less than t is

$$F(r,t) = \iint f_{vr}(v_r, q_r)\, dv_r\, dq_r$$

- The probability of an *h*-hop path availability time greater than t is as follows $P_h(t) = (1 - F(t))^h$

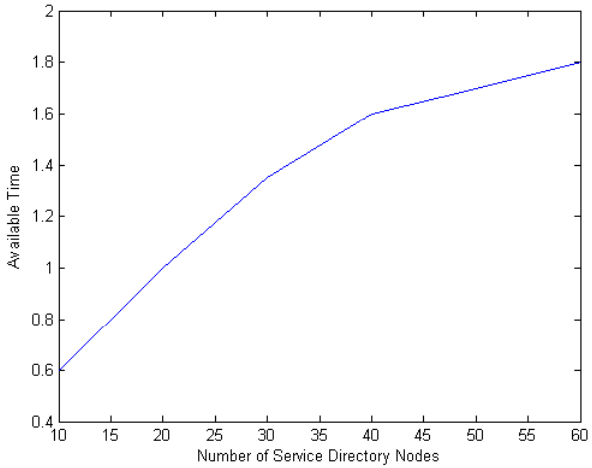


Figure 5: the relationship between the number of service discovery nodes in the network and the average path available time when $r_0/a = 0.1$

Conclusion

- Overview Directory-less / Directory-based service discovery architectures
- Provide a totally distributed directory-based service discovery model
- Mathematical analysis and results

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Choosing Service Directory Nodes in Proposed Service Discovery Model for Mobile ad-hoc Networks

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