Information distribution on a bus-based opportunistic network

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Title analysis

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Comparison among routing strategies: flooding and social-aware forwarding strategies
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Comparison among routing strategies: flooding and social-aware forwarding strategies

bus-based
Title analysis

- Information distribution
  - Comparison among routing strategies: flooding and social-aware forwarding strategies

- bus-based
  - The backbone of the network is realized by buses: the bus schedule helps in developing in a simple manner a mobility model
Title analysis

- Information distribution
- Comparison among routing strategies: flooding and social-aware forwarding strategies
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- The backbone of the network is realized by buses: the bus schedule helps in developing in a simple manner a mobility model
- Opportunistic network
Information distribution

Comparison among routing strategies: flooding and social-aware forwarding strategies

bus-based

The backbone of the network is realized by buses: the bus schedule helps in developing in a simple manner a mobility model

opportunistic network

The architecture is a kind of Delay Tolerant Networks in which each node acts as a relay
Title analysis

Comparison among routing strategies: flooding and social-aware forwarding strategies

The backbone of the network is realized by buses: the bus schedule helps in developing in a simple manner a mobility model

The architecture is a kind of Delay Tolerant Networks in which each node acts as a relay
Outline

1. The architecture
2. Mobility Model
3. Information Distribution
   - Flooding
   - Social-aware routing algorithms
The reference architecture

- Delay Tolerant Networks (DTNs) are composed of independent regions connected by gateways.

- When each node acts as a DTN gateway DTNs are also called Opportunistic Networks.
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The mobility model

- Human mobility models are very difficult to be predicted.
- Google Transit Feed provides public bus schedule information.

**Parameters of the mobility model**

- Torino Google Transit Feed Data;
- *relevance* $r$: is the number of bus passages per stop;
- *uniformity coefficient* $\alpha$: describes the relation between passenger deployment and relevance.

- Passengers move according to...
The parameters of the mobility model

- Uniformity coefficient:
  \[ \alpha = \begin{cases} 
  0 & \text{passengers deployed proportionally to the stop relevance;} \\
  1 & \text{passengers deployed independently of the stop relevance.} 
\end{cases} \]

- Relevance:
  \[ \tilde{r}_i = r_i \cdot (1 - \alpha) + (\alpha r_{\text{max}}) \quad \text{where } r_{\text{max}} = \max\{r_i\} \]

- The probability to get off the bus:
  \[ p_{\text{down}} = \frac{r_i}{\sum_{j=i}^{n} r_j} \]

- The probability to get on the bus:
  \[ p_{\text{up}} = 1 - p_{\text{down}} \]
The parameters of the mobility model

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Map with the relevance of the stops
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The target

- Proximity-based communications.
- Compare the performances of:
  - flooding;
  - social-aware algorithms.

Flooding

- simple;
- the cost in terms of network resources utilization is high.

Social-aware algorithms

- require a priori human relation knowledge;
- are less aggressive in consume network resources;
- lead anyway to good performances.
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Flooding: evaluation conditions

- Evaluation of:
  - *stop infection process*;
  - *passengers data diffusion*;

- Content injection in:
  - peripheral stop;
  - medium-relevant stop;
  - hub stop.

- Different initial passenger deployment.

- The population consists of 100,000 passengers.

- The simulation period is 8:00-12:00 am.
Flooding: performances

- Stop infection process
Flooding: performances

- Passenger data diffusion process

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</table>

- Users infected
  - Hub $\alpha = 0$
  - Medium-rel $\alpha = 0$
  - Peripheral $\alpha = 0$
  - Hub $\alpha = 1$
  - Medium-rel $\alpha = 1$
  - Peripheral $\alpha = 1$
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Social model

- Model based on the concept of *social space*:
  - *mono-dimensional* $[0, 1]$;
  - user *mapping* based on the degree of interest in the content;
  - forwarding when the *social distance* is below the *infection radius* $R$;
  - an example:

![Diagram of social model](image-url)
Social-aware forwarding schemes

- Deterministic forwarding scheme (DFS): passengers are always altruistic.
  \[ d(A, B) < R \]

- Probabilistic forwarding scheme (PFS): content forwarded likely to social-neighbours.
  \[ P(A \text{ communicate with } B) = 1 - \frac{d(A, B)}{2R} \]
Social model: performance evaluation

Analysis have been performed:
- in a multi-hop fashion (whole population, several timeslots);
- in a single-hop fashion (limited population, one timeslot);

considering:
- a social-oblivious mobility model (SOM);
- a social-based mobility model (SBM).

Results proved that in:
- multi-hop analysis: PFS - DFS in both mobility models;
- single-hop analysis: PFS - DFS in SOM;
  DFS - PFS in SBM;

Selected scheme
Comparison between flooding and DFS
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    \[\text{DFS} \quad \uparrow\downarrow \quad \text{PFS} \quad \downarrow\uparrow\] in SBM;
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  - single-hop analysis: PFS \(\uparrow\) - DFS \(\downarrow\) in SOM;
    DFS \(\uparrow\) - PFS \(\downarrow\) in SBM;

Selected scheme

Comparison between flooding and DFS
Comparison flooding/deterministic forwarding scheme

![Graph showing comparison between flooding and deterministic forwarding schemes.](chart)

- Flooding
- $R = 0.05$
- $R = 0.04$
- $R = 0.03$
- $R = 0.025$
- $R = 0.02$
- $R = 0.015$
- $R = 0.01$
Thank you!
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