### Motivation

Pocket Switched Networks (PSN)
- **opportunistic networking** in intermittently connected human networks
- **store-and-forward communication**

Problems and solution approach
1. **large forwarding tables** in probabilistic routing → Bloom Filter extensions
2. **non-scalable handling of dense PSN** situations (e.g., bus, train, place) → overlay with DHT approach

### Bloom Filter Extensions

**Bloom Filter**: space-efficient element storage
- **lookup functionality**, no false negatives, tunable false positives
- \( m \) bits, \( k \) hash functions \( h_i(x) \): \( ID_x \mapsto [0,m-1] \)
  - \( insert(ID_x) \)
  - \( ID_x \)

- **lookup** \( ID_x \) → **true** if all \( k \) bits are set

**Extension – Fuzzy Bloom Filter**
- use \( f \) hash functions out of \( k \) available, with \( j/k \sim p \), granularity of \( p \) depends on \( k \)
- false positive rate has different semantics, new error rate is induced

**Extension – Aging Fuzzy Bloom Filters**
- aging element probabilities over time
- deletion of random bits ages all elements in the Bloom Filter

**Aging Fuzzy Bloom Filter**:
- Five elements inserted and aged over time.
- False positives arising can be seen

### Conclusion and Outlook

**Fuzzy Bloom Filters** allow for
- **space-efficient probabilistic forwarding** and in combination with overlays and DHTs
- **scalable forwarding** in dense PSNs

**Next steps**
- formal analysis of Bloom Filter extensions
- simulative evaluation of overlay scheme
- implementation using the **ari** library

**www.ariба-underlay.org**

**→ Space-efficient storage of forwarding tables for probabilistic forwarding**