



Minimizing the impact of buffer overflow in DTNs

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Introduction

- Message delivery in DTN
 - Store, carry and forward
 - TTL to avoid flood of messages in a limited buffer
 - It is critical for successful delivery ratio to select a message to be discarded on a full buffer
 - Five types of primitive drop policies
 - DL (Drop Last) , DF (Drop Front), DO (Drop Oldest), DY (Drop Youngest), DOFO (Drop Most Forwarded)
 - DOFO and DF policies show nice performance in delivery ratio and latency
 - Older message is likely to be duplicated to more nodes
 - Deleting the message with more copies can decrease the impact of message drop
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Objective

- We propose a new drop policy which compares the expected number of copies and drops the message with most copies



Drop the message with most expected copies

- In DTN, each node plays a role of a message distributor
- The number of possible copies is determined by
 - Rate of meeting neighbors (λ)
 - The message duplicated to a node with higher frequency can have more copies
 - Message's queuing time at the buffer (R)
 - The longer queuing time at the buffer can generate more copies.
 - Remaining TTL and Buffer status
- Assumption
 - Inter meeting time of a node is exponentially distributed with parameter, λ



Metric for the proposed scheme

- How actively a node distributes a message is reflected on $e^{-\lambda R}$, which is the probability a node cannot encounter any other node during R
- Each message contains an additional field metric value
- Whenever a message is duplicated, metric value in the message is updated
- Each node monitors λ , during unit time
- Queuing time is estimated by
 - rTTL- average rTTL of dropped messages at a node

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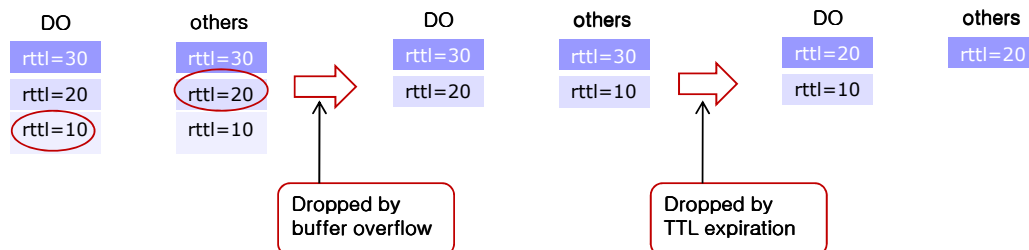
Metric for the proposed scheme

- node i creates messages, M
 - Initial metric $\rightarrow e^{-\lambda_i R}$
- node i has M and node j does not
 - Metric for both nodes = $e^{-\lambda_i R} * e^{-\lambda_j R_{ij}}$
- node i encounters node k which already has M
 - *Minimum of (v_1, v_2)*
 - v_1
 - If M in node i already visited node k , then $v_1 \rightarrow$ current metric
 - Else *current metric* * $e^{-\lambda_k R_{ik}}$
 - v_2
 - same way in node k 's side

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Constraints

- DO policy makes a node to relay the largest number of messages compared with other policies



- A new policy should not decrease the total number of messages to be relayed
 - Comparison of metric values among the messages whose $rttl$ is less than $rttl$ of the oldest + inter meeting time (unit time/ λ)

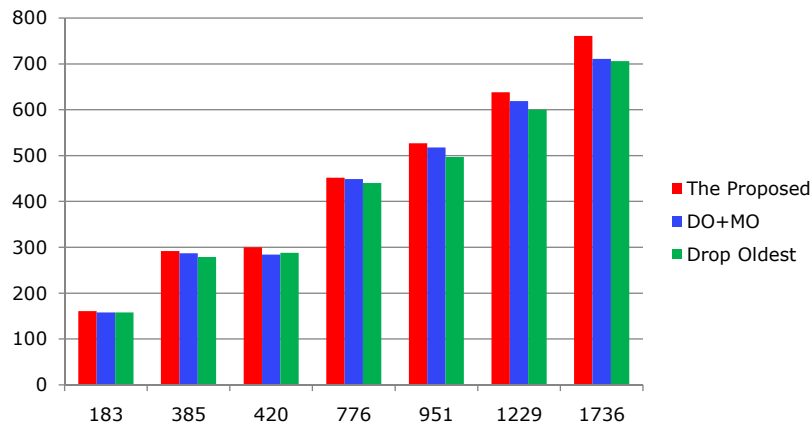
Simulation - scenario

- Opportunistic Network Environment simulator
 - Developed by Helsinki University of Technology
- Parameter set

Topology	5km * 5km	Sim. Time	6h
# of group	4	# of nodes	15/group
Nodes' speed (m/s)	0.5, 1, 5, 10	Wait time	0~10 sec
Message size	1MB	Buffer size	10MB
Trans. Speed	2Mbps	Trans. Range	250m
TTL of message	1h	Movement model	Random waypoint

Simulation Result

■ Delivery Ratio



- 3% of generated messages are delivered more successfully, compared with DO
- In the proposed scheme, 30%~40% different messages are dropped, compared with DO

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Conclusion

- We develop a new metric to compare the expected number of copies to minimize the impact of buffer overflow
- Our scheme can achieve up to 10% improvement in delivery ratio, compared with existing drop policies.

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