Eliminating Communication Redundancy in Wi-Fi Networks

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Overview

- Communication redundancy
  - Internet traffic redundancy
  - Wi-Fi traffic redundancy
- Explore in multiple dimensions
  - Temporal, inter-users, applications, data types
- Wireless Memory
  - Two-ended approach
  - Layer-2.5
- Trace-driven evaluation

Wi-Fi Traffic Analysis: **Focus**

- Intra-redundancy vs. Inter-redundancy
  - Intra-redundancy can be easily eliminated
  - Focusing addressing inter-redundancy
- Wi-Fi traffic
  - 3 different types of Wi-Fi networks
- Characterizing the potential improvement when eliminating inter-redundancy
  - Rzip

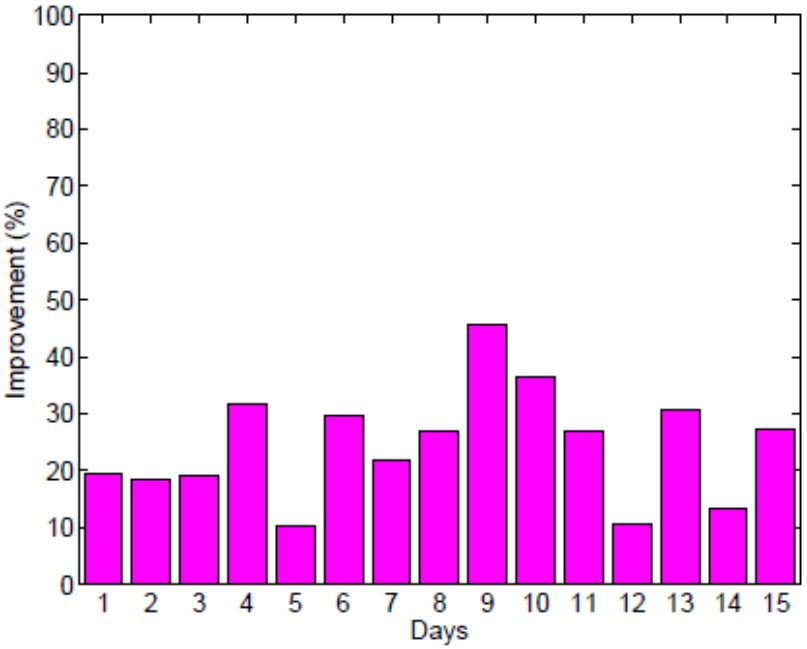
Wi-Fi Traffic Analysis: **Methodology**

- Data units of D $d_i \quad 0 \leq i \leq I$
- Set of data units $D_i = \{d_0+, \ldots, +d_i\}$
- Def. coded size of d_i $Rzip(d_i)$
- Ideal incremental coded size: C_i $Rzip(D_i) - Rzip(D_{i-1})$
- Ideal improvement $1 - \frac{C_i}{Rzip(d_i)} =$

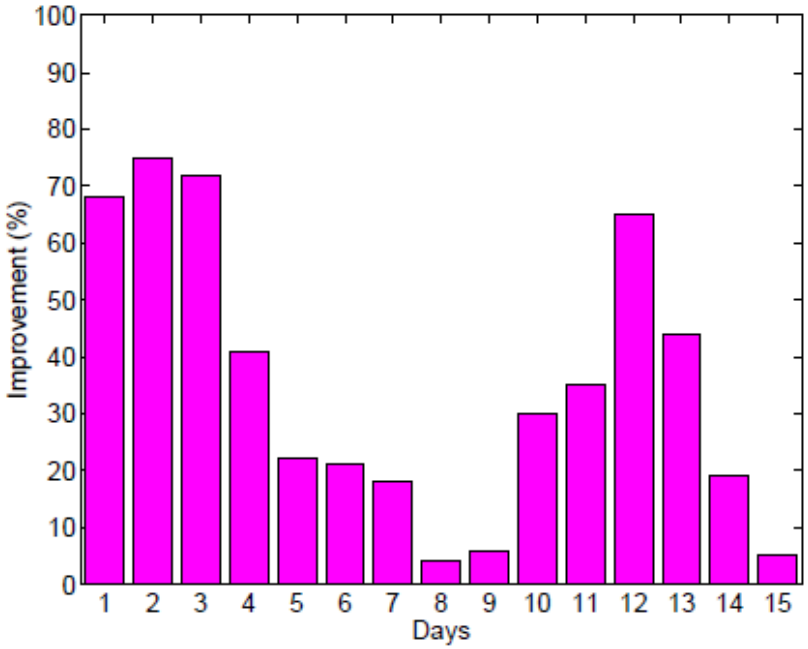
$$[1 - \frac{Rzip(D_i) - Rzip(D_{i-1})}{Rzip(d_i)}] x 100\%$$

Motivation: Temporal Redundancy

- Dominant user of each building



(a) Building A



(b) Building B

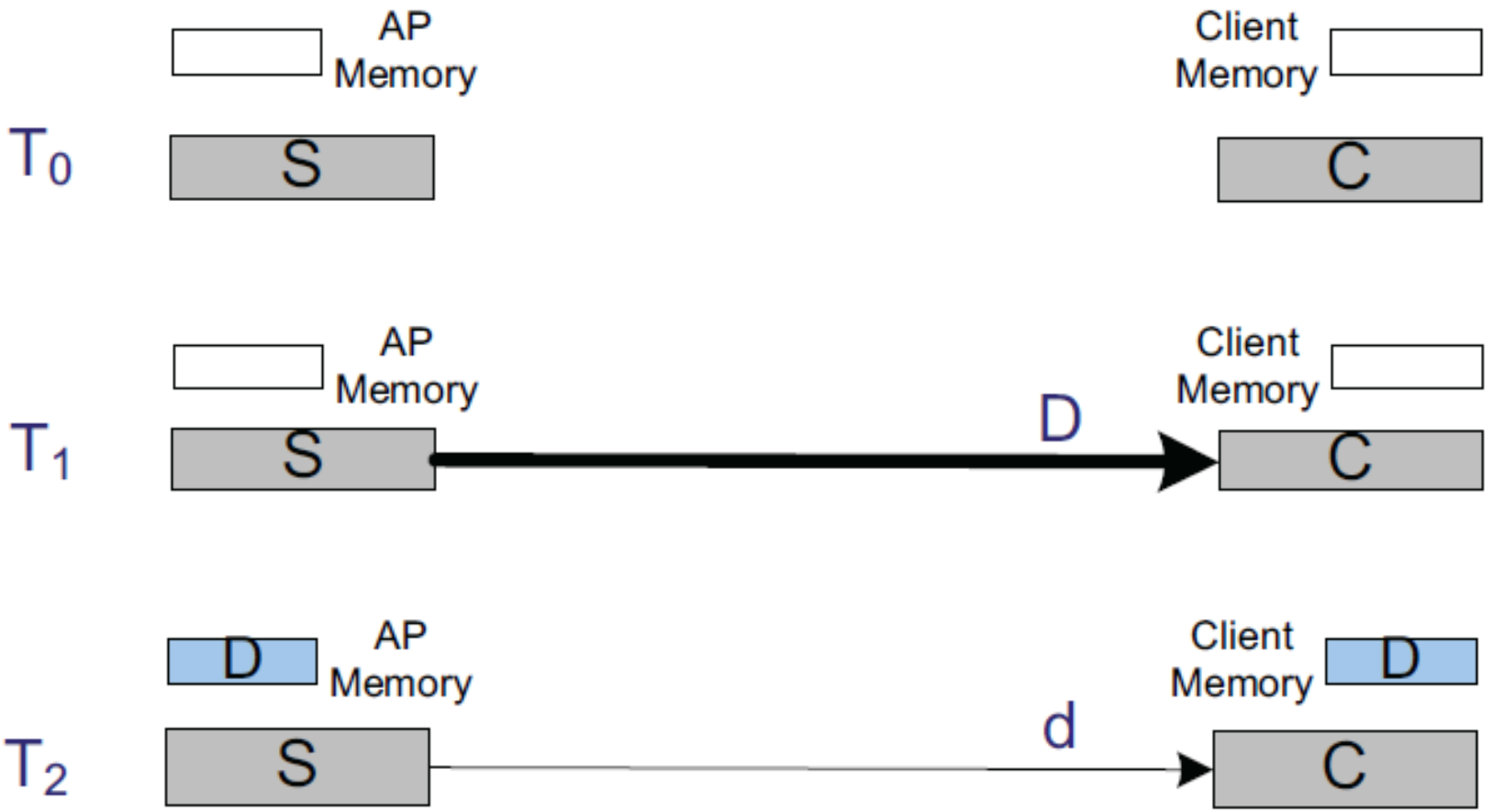
Motivation: Inter-user Redundancy

- Dominant user vs. other top users

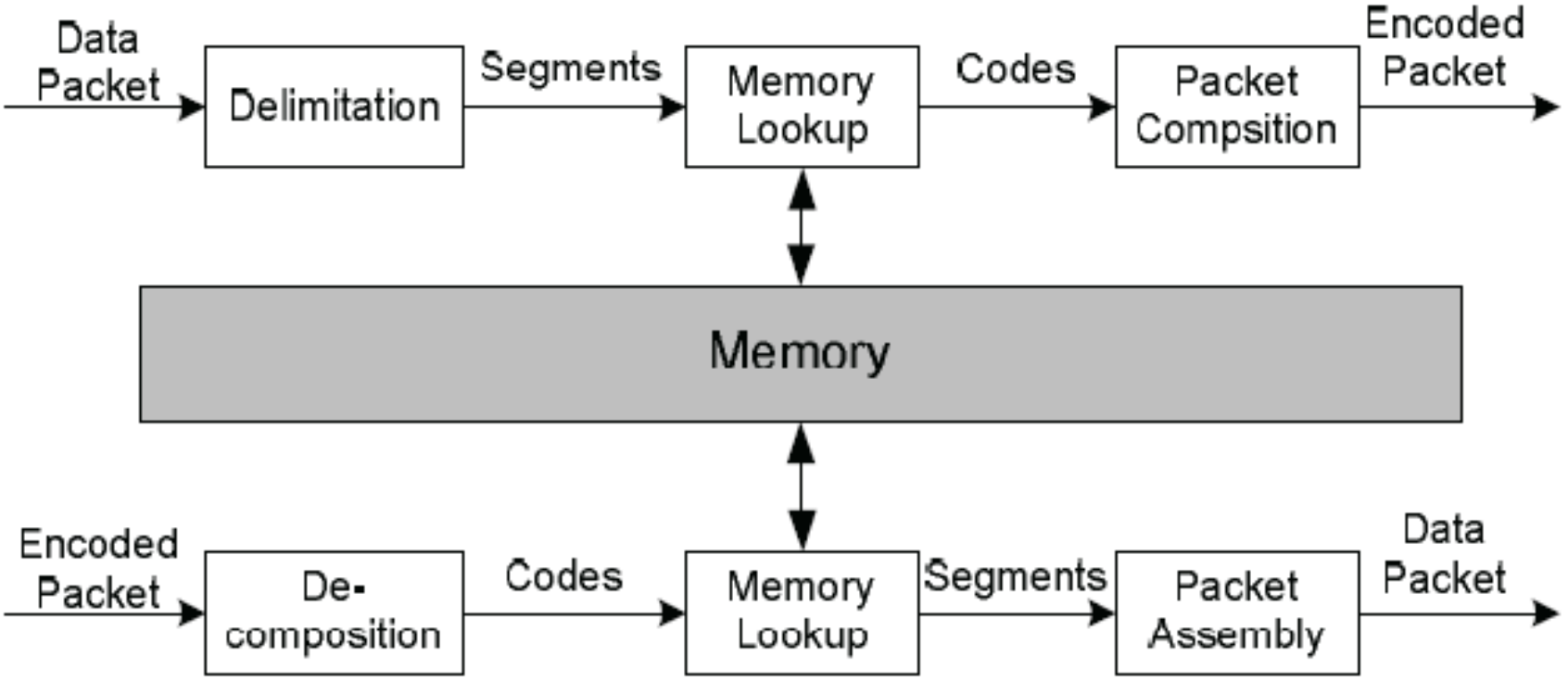
User Pair	1	2	3	4	5	6	7	8	9
Building A	12	12	14	27	7	3	19	11	17
Building B	8	13	10	7	10	14	9	27	11
Building C	49	42	33	26	17	31	29	11	8

TABLE I
REDUNDANCY OF USER-PAIRS (%): DOMINANT VS. OTHER TOP USERS)

Wireless Memory: Concept

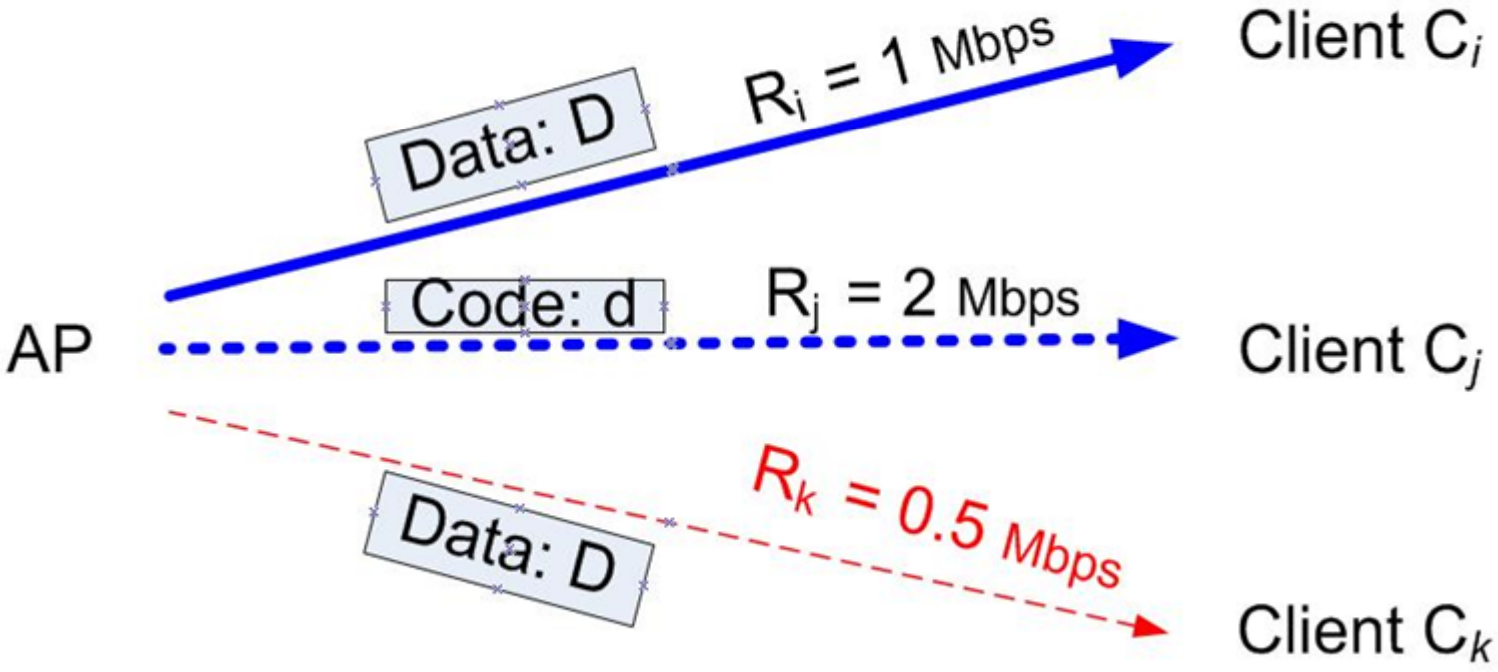


WM: Basic Components



WM: Advanced Component

- Memory fidelity enhancement (MFE)

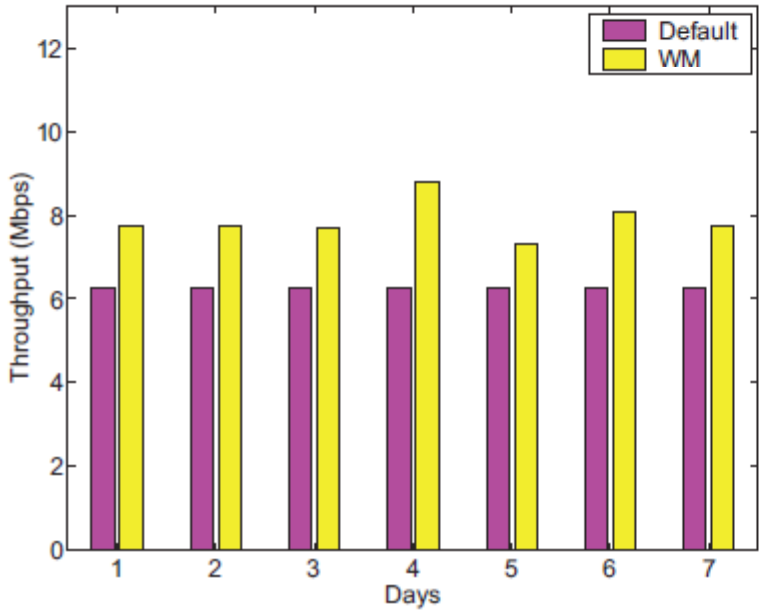


Evaluation

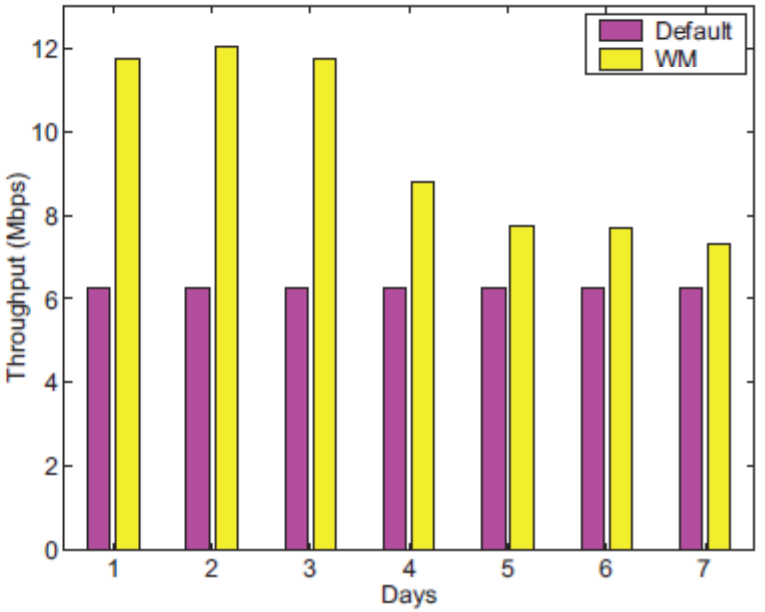
- Trace driven simulation
  - NS2-based
  - Top 8 users
- Wi-Fi setup
  - 802.11b: 1 AP, 8 clients
  - Single TCP connection for each client
  - Wired path: 60ms RTT, 100Mbps

Aggregated Throughput

- Baseline throughput: 6.24 Mbps
- Building A: 7.25 Mbps (16%)
- Building B: 12.03 Mbps (93%)



(a) Building A



(b) Building B

Impact of Redundancy Degree

- Low. redundancy (10%)
  - 6.90 Mbps (11%)
- Med. redundancy (35%)
  - 8.22 Mbps (32%)
- High redundancy (60%)
  - 9.79 Mbps (57%)

Related Work

- Internet traffic redundancy
  - Temporal redundancy
  - Application-specific: Web, P2P, etc.
- Designs to eliminate traffic redundancy
  - Application-specific
  - Application-independent
- Link compressions
  - Protocol headers

Thanks!

- Comments/Questions
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