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Enhancing Blockage Detection and Handover on 60 GHz Networks with P4 Programmable Data Planes

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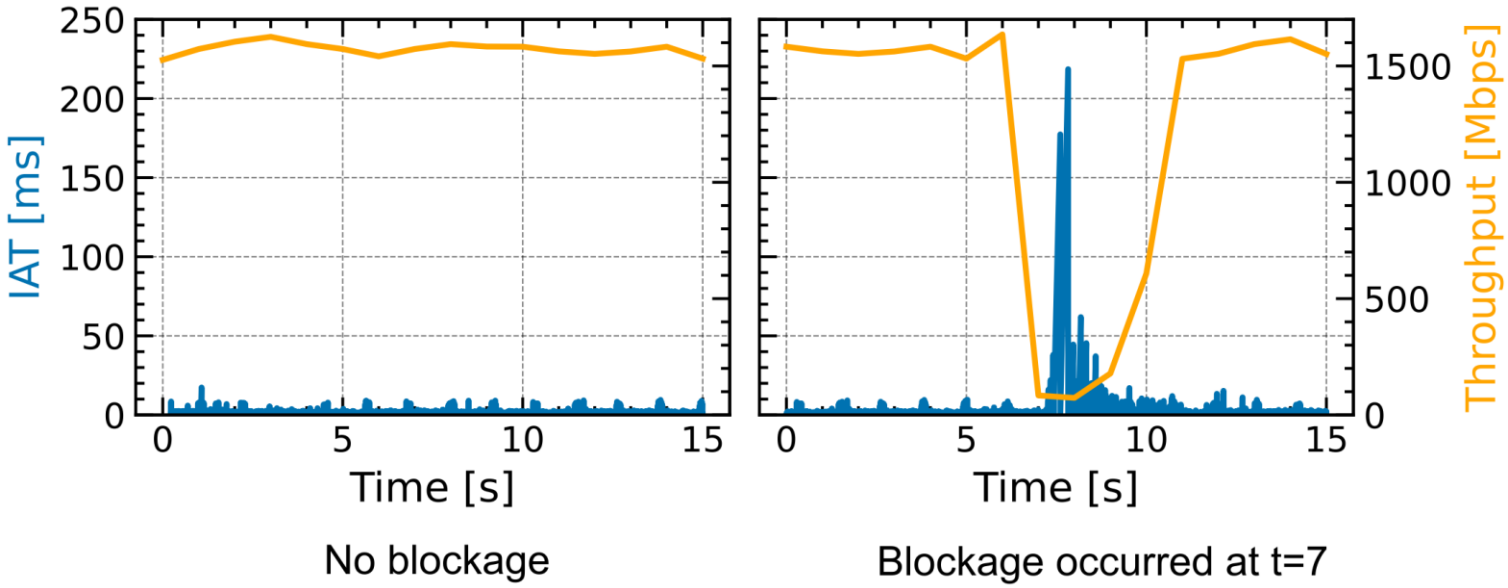
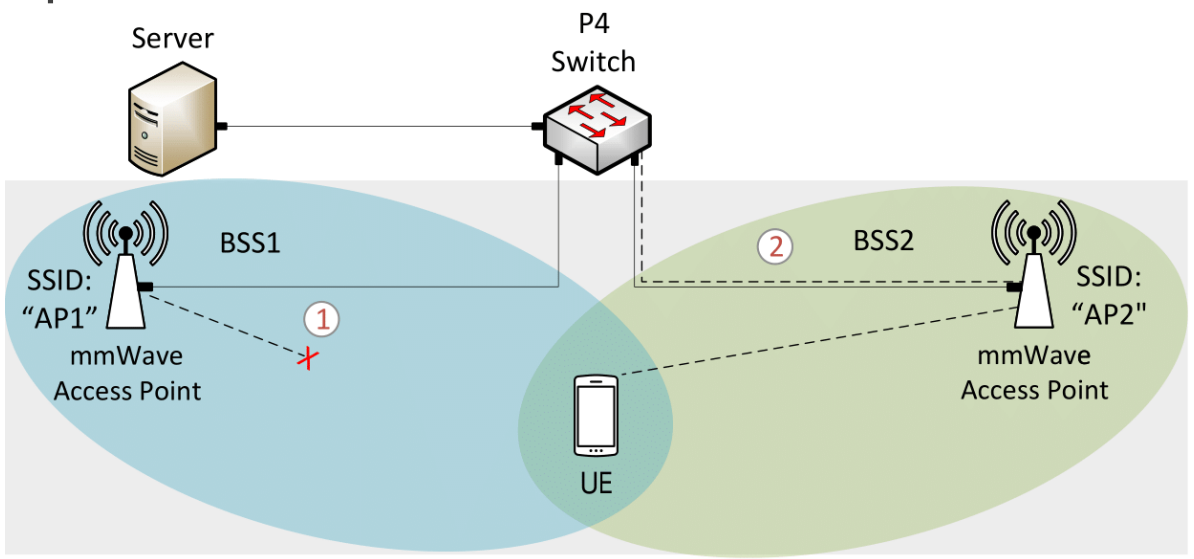
Motivation

- The performance of a mmWave connection significantly degrades upon blockage
- Solutions rely on handover connections from the current (blocked) access point to an alternative (non-blocked) access point
- Upon blockage, the inter-arrival time (IAT) of the packets increases by multiple folds
- The increase in the IAT provides a clear indication of the blockage



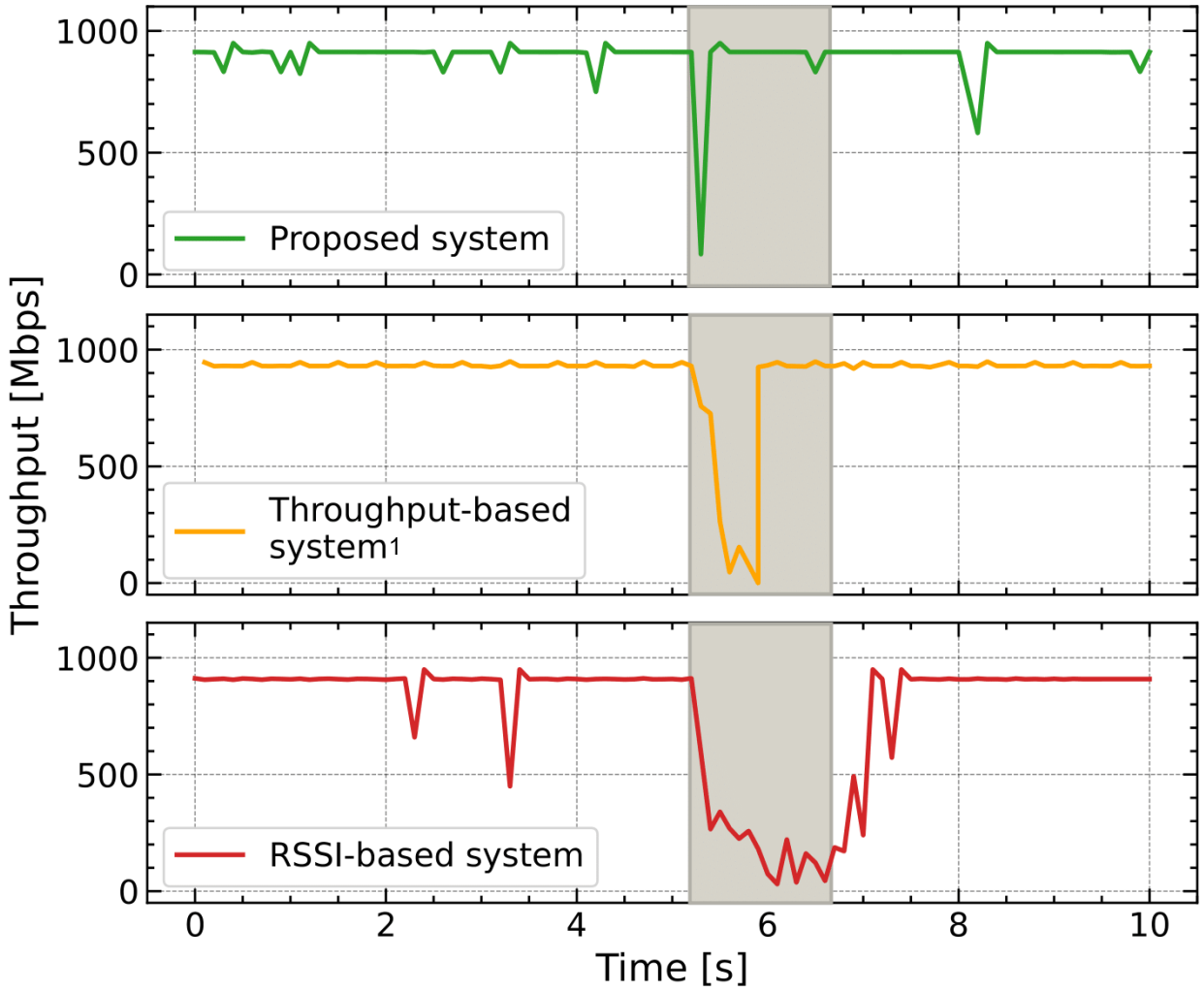
Proposed System

- The system leverages programmable switches to monitor the inter-arrival time (IAT) of the packets
- Using the measurements, the programmable switch detects the blockage and then notifies the end user to handover
- The system was implemented and tested on a Tofino hardware switch and off-the-shelf mmWave-compatible devices



Results: Recovery Speed

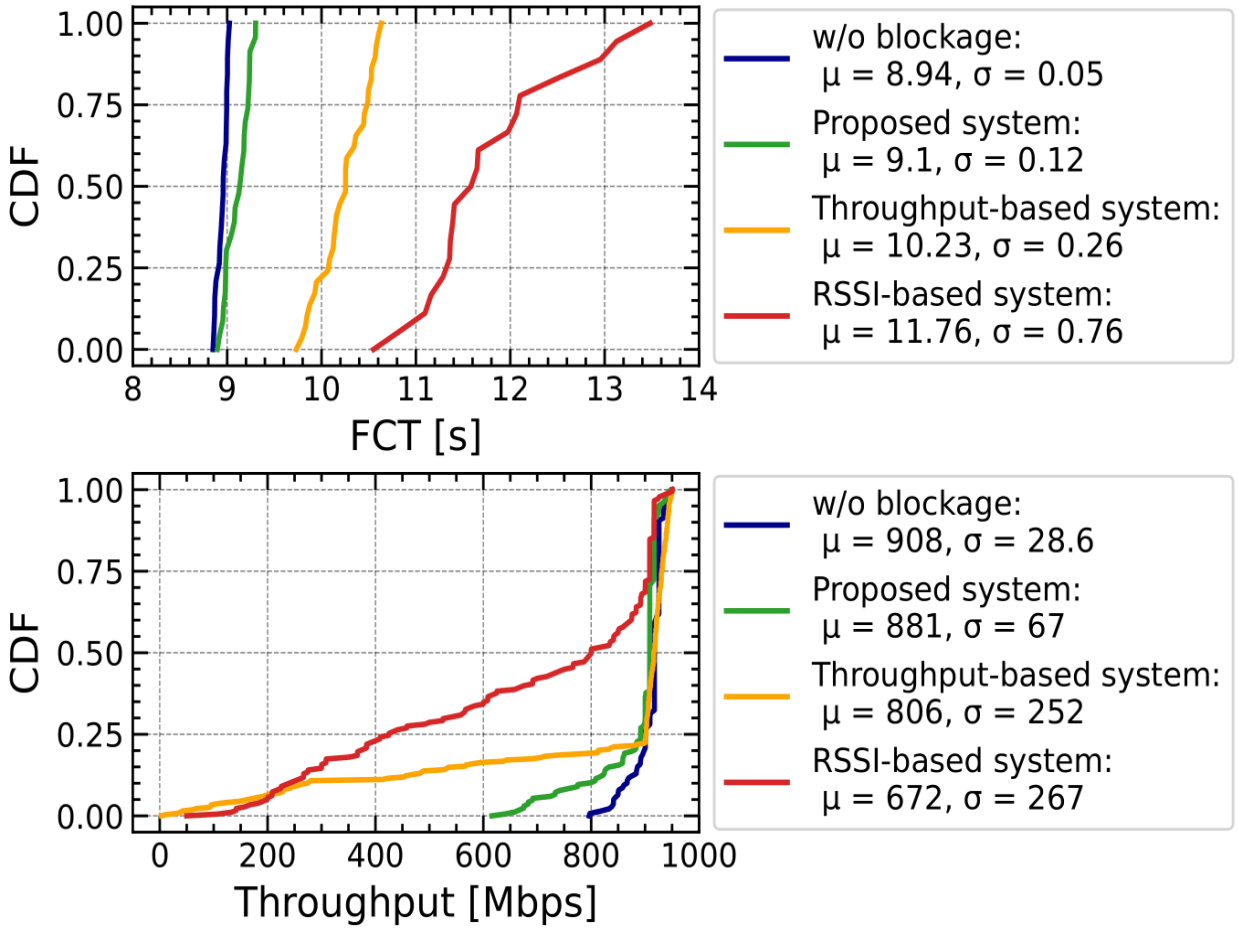
- The recovery speed from blockage was evaluated
- The line of sight (LOS) was blocked for 2 seconds
- The proposed system required around 160 milliseconds to fully recover from the blockage



[1]Y. Oguma et. al. "Implementation and evaluation of reactive base station selection for human blockage in mmWave communications," Asia-Pacific Conference on Communications (APCC), 2015

Results: Flow Completion Time

- The flow completion time (FCT) of a 1-gigabyte flow was evaluated in four scenarios
- Each scenario was repeated 50 times
- The LOS was blocked for 2 seconds
- The FCT of the proposed system is close to the w/o blockage scenario



Contributions

- Leveraging PDP switches to compute the packet's IAT and detect mmWave blockage on a per-packet basis
- Conducting evaluations on a testbed composed of real devices, including a widely used PDP switch (Intel's Tofino), mmWave access points, and a mobile device operating in the 60 GHz band
- Detecting the blockage and initiating handover before the throughput degrades from the blockage
- Proposing a solution to the handover decision problem without modifying end devices
- Future work aims at extending the system to select the best alternative non-blocked access point by utilizing information from end devices

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For additional information, please refer to
http://ce.sc.edu/cyberinfra/

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