END-TO-END CONGESTION CONTROL APPROACHES FOR HIGH THROUGHPUT AND LOW DELAY IN 4G/5G CELLULAR NETWORKS

Computer Communication and Networks - ISE 2
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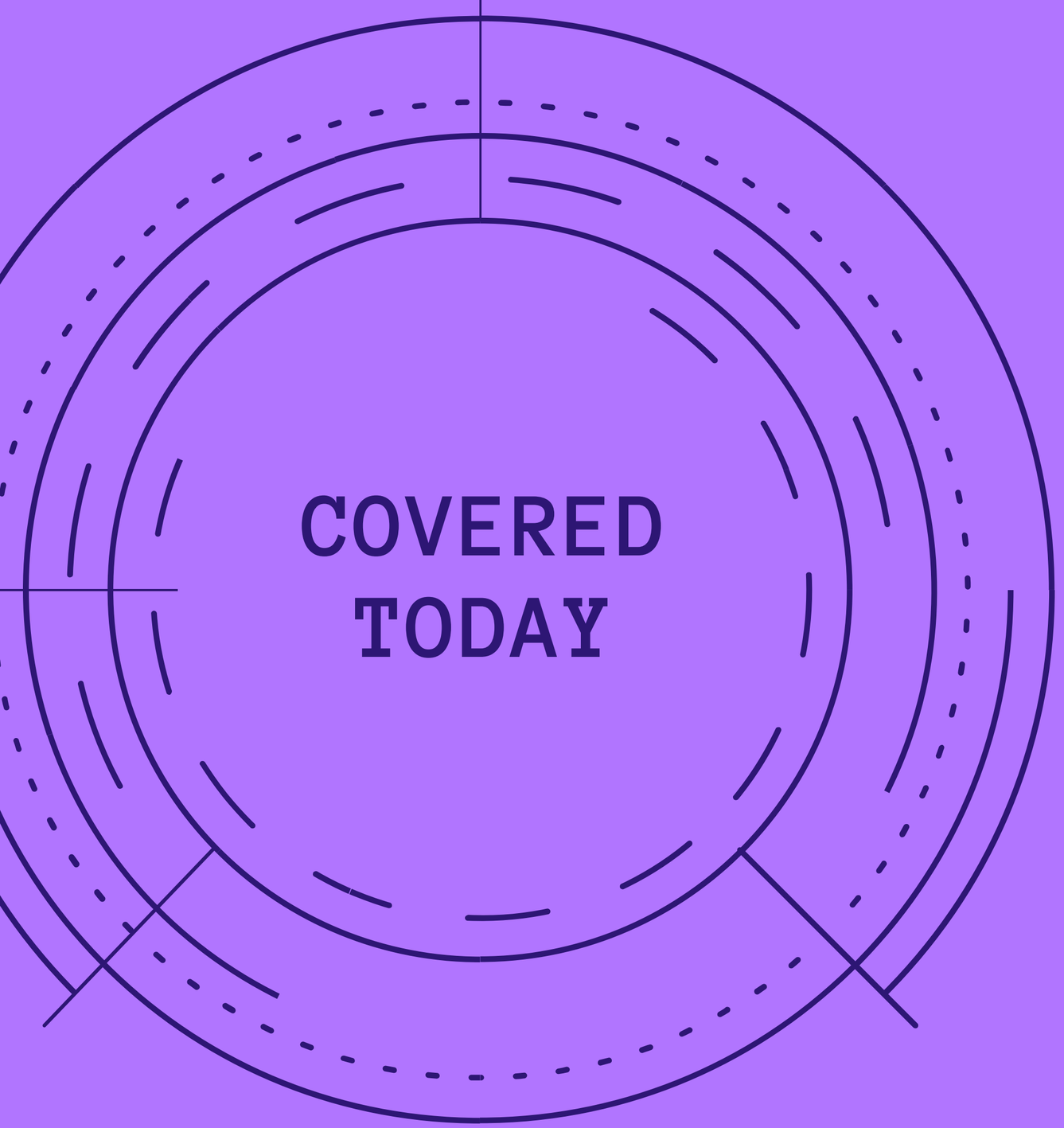

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A BRIEF OUTLINE

Introduction

Conventional congestion control

4G/5G technologies

Use cases on congestion control

References

INTRODUCTION

- Data delivery through cellular networks has seen a meteoric rise.
- Ubiquitous use of smartphones.
- 2G networks introduced the first digital infrastructure for data services like SMS.
- 3G made mobile Internet usage and video calls possible.
- 4G technology has paved the way for gaming and video conferencing services over cellular networks.

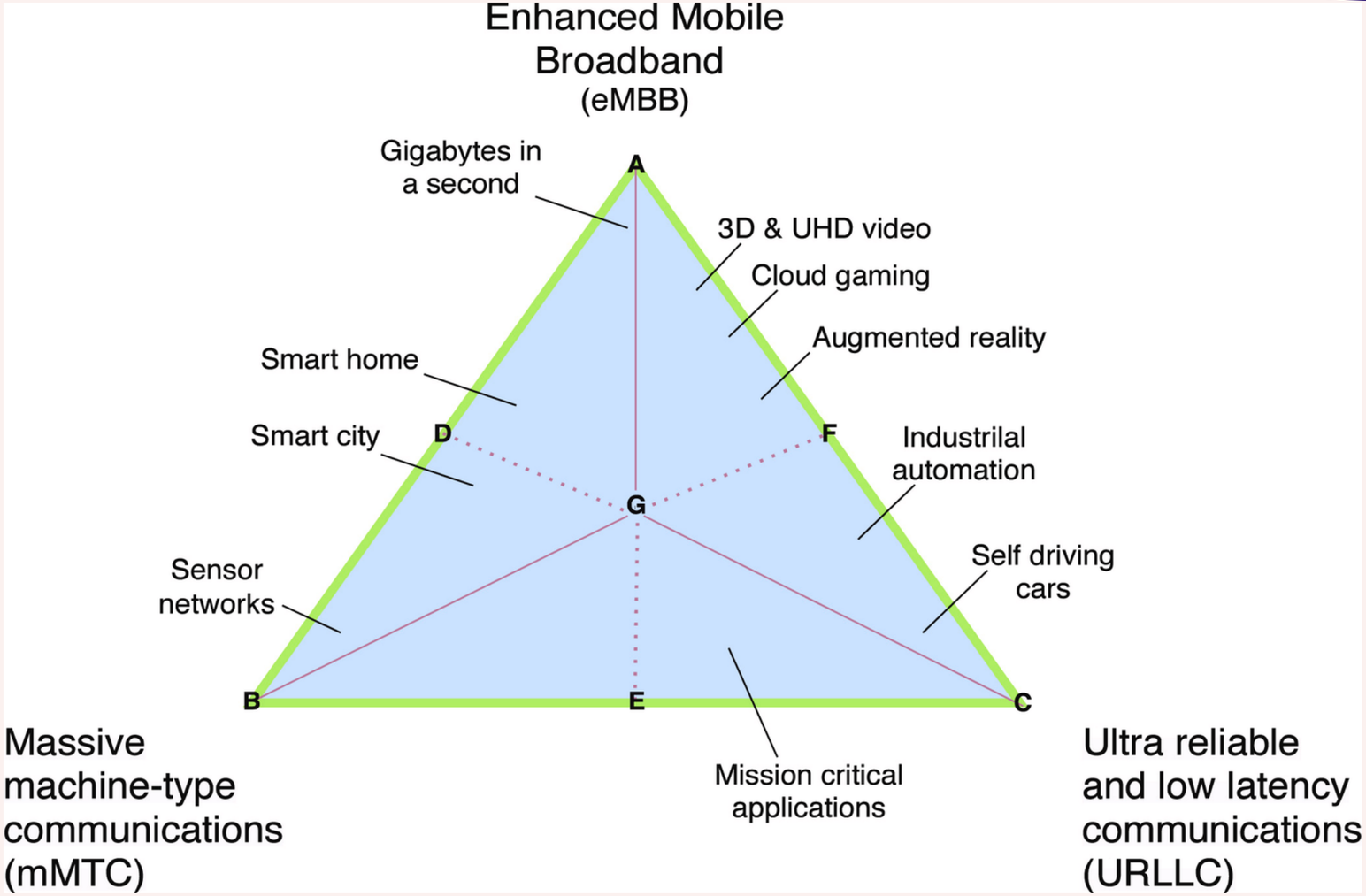
CONVENTIONAL CONGESTION CONTROL

- Combination of flow and congestion control
- Leaky bucket and Token bucket algorithms
- Problems
  - Slow-start: starts slowly, increment is exponential to threshold
  - Congestion avoidance: After threshold, increment is by 1
  - Congestion detection: Sender goes back to Slow start phase or Congestion avoidance phase.

4G/5G TECHNOLOGIES

- Enhanced mobile broadband (eMBB),
- Ultra reliable and low latency communications (URLLC),
- Massive machine-type communications (mMTC).
- eMBB intends to increase the data rates achieved by 4G MBB.
- UHD videos, cloud gaming, and augmented reality, among others.
- The 1 ms latency, 99.999% requirement of URLLC.
- Self-driving cars and industrial automation.

4G/5G TECHNOLOGIES



USE CASES IN CONGESTION CONTROL

- Link adaptation: Modulation and coding scheme based on the signal quality
- mmWave: 30 GHz and 300 GHz, high data rates and propogation loss
- Small cells: increase in the capacity
- Carrier aggregation: Use multiple carriers simultaneously to obtain a larger bandwidth for transmission

USE CASES IN CONGESTION CONTROL

- Multiple input multiple output (MIMO) systems: Multiple antenna transmissions, higher data rates, better transmission reliability.
- Dual connectivity: Two access networks at the same time. (LTE, WLAN, 5G), high fluctuations in data rate
- Dynamic network slicing and resource allocation

REFERENCES

Haile, H., Grinnemo, K., Ferlin, S., Hurtig, P. and Brunstrom, A., 2022. End-to-end congestion control approaches for high throughput and low delay in 4G/5G cellular networks.

THANK YOU