

# NC-CELL: Network Coding-based Content Distribution in Cellular Networks for Cloud Applications

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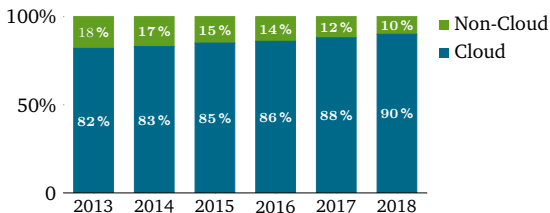
# Agenda

- 1 Introduction
- 2 Network coding in cellular networks (NC-CELL)
- 3 Evaluation
- 4 Conclusion

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# Motivation

- ▶ Mobile data traffic will rise up to 15 EB per month by 2018
- ▶ By 2017 4.4 billion people will use mobile cloud applications
- ▶ \$ 45 billion market
- ▶ Mobile cloud applications will account for 90% of all mobile data traffic by 2018



Source: Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2013-2018

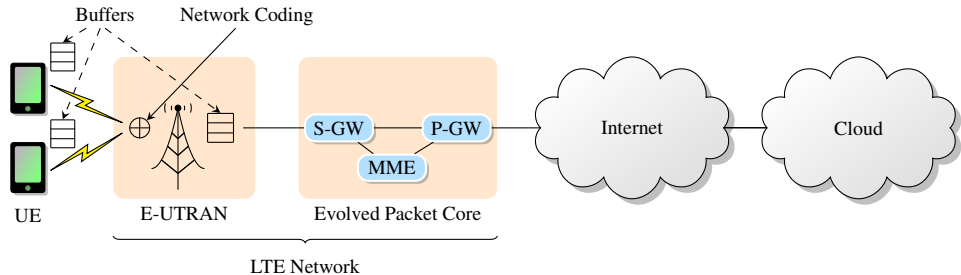
# The key idea

Optimizing information delivery of flows in mobile networks with overlapping or partially overlapping content through network coding.

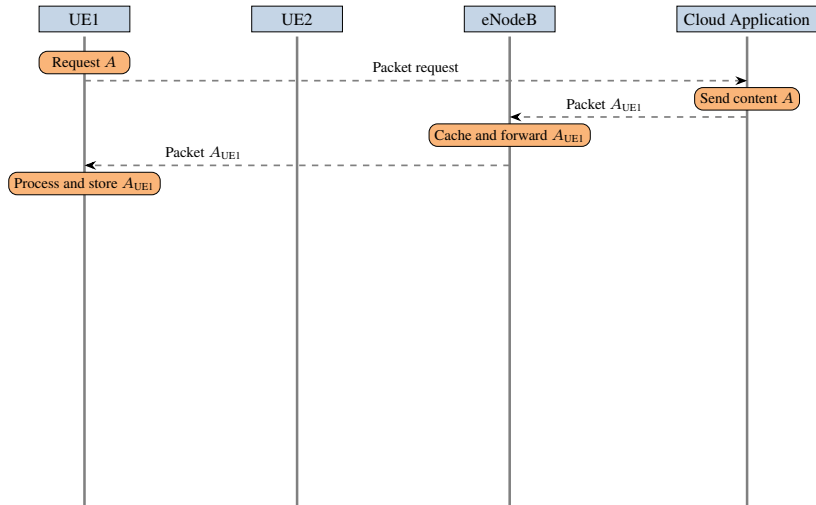
- ▶ Geographically co-located users
- ▶ Mobile cloud applications content
  - ▶ Advertisement
  - ▶ Maps
  - ▶ Meteo
  - ▶ Google Now

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# The scenario

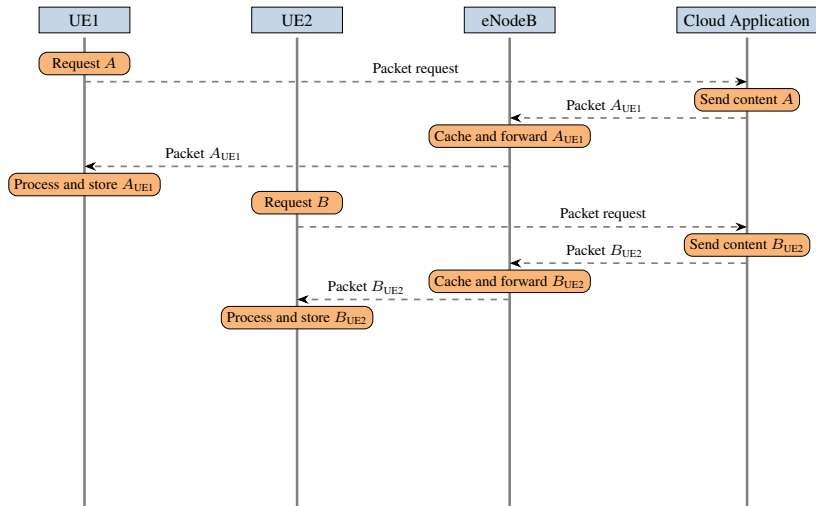


# An example

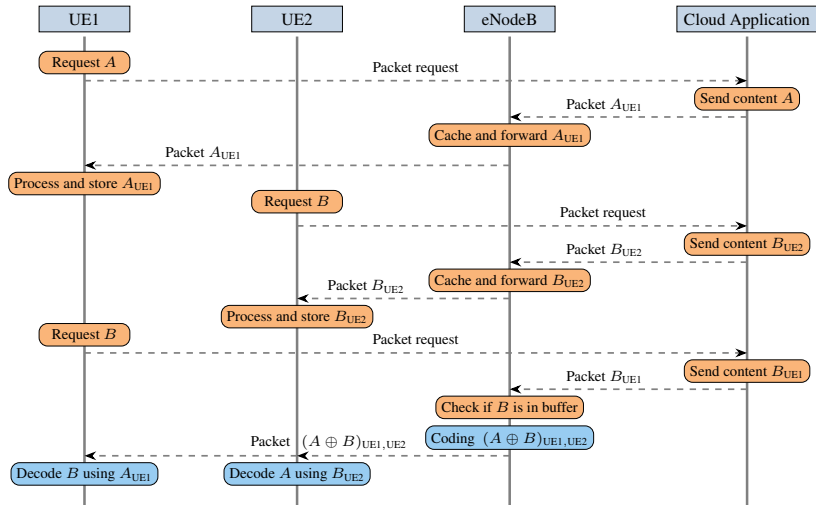




# An example



# An example



# The key aspects

- ▶ Monitor and cache in transit traffic
- ▶ Identify coding opportunities

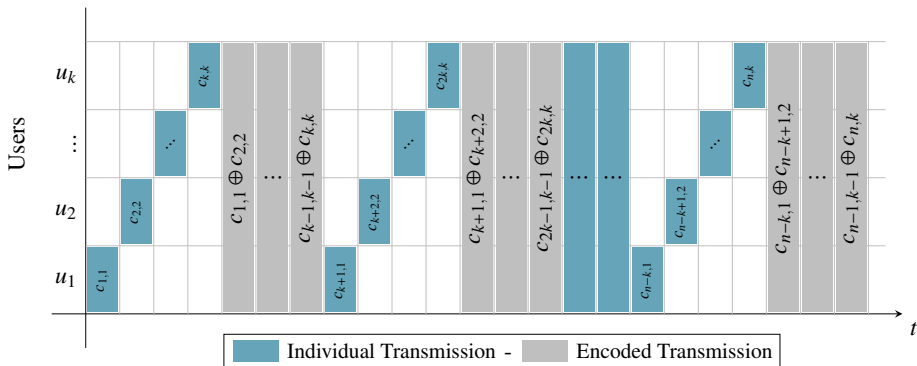
## Coding Opportunities

eNodeBs can deliver information needed by two or more users with a single coded transmission.

- ▶ XOR to combine packets

# Content distribution

## Optimal allocation for content distribution



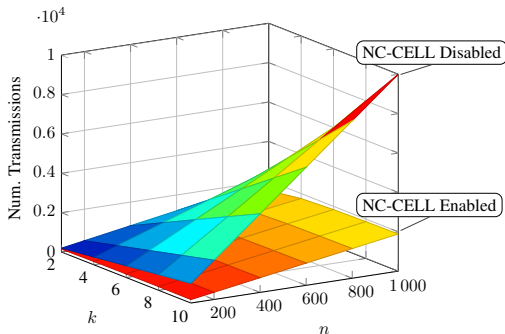
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# Throughput improvement

- ▶ Number of transmissions at eNodeB

$$\sigma = \begin{cases} \frac{n}{k} \cdot (k + \vartheta), & \text{if } r = 0 \\ \lfloor \frac{n}{k} \rfloor \cdot (k + \vartheta) + k + (r - 1), & \text{otherwise} \end{cases}$$

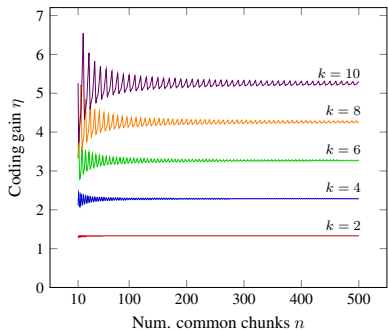
- ▶  $n$ : common chunks
- ▶  $k$ : users
- ▶  $\vartheta$ : encoded transmissions
- ▶  $r$ : remainder of  $n/k$



- ▶ Coding gain

$$\eta = \frac{\gamma}{\sigma}$$

- ▶  $\gamma$ : total number of chunks



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# Conclusion

- ▶ Efficient content distribution for cloud applications in mobile cellular networks
- ▶ Network coding and caching performed at eNodeB
- ▶ Considerable throughput improvement



Thank You!  
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