

# Study on Uplink Throughput of Radio Resource Sub-granting and Shortening TTI Schemes for Overlay D2D

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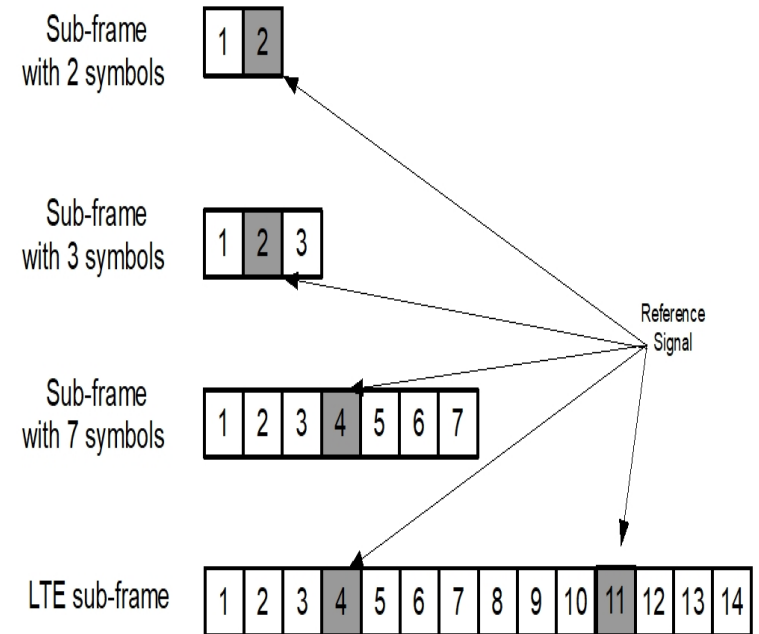
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# Introduction

- Motivation:
  - Applications, e.g. vehicle to vehicle (V2V) and internet of things (IoT)
    - High-reliability, low-latency and high capacity
    - Small payload size, e.g. 10-100 Bytes
  - Device to device (D2D) communication
    - Resource reservation
- Solutions:
  - Two approaches:
    - Shortening transmission time interval (sTTI)
    - Sub-granting
- Objective:
  - Uplink cell throughput comparison
    - Payload size
    - Active users

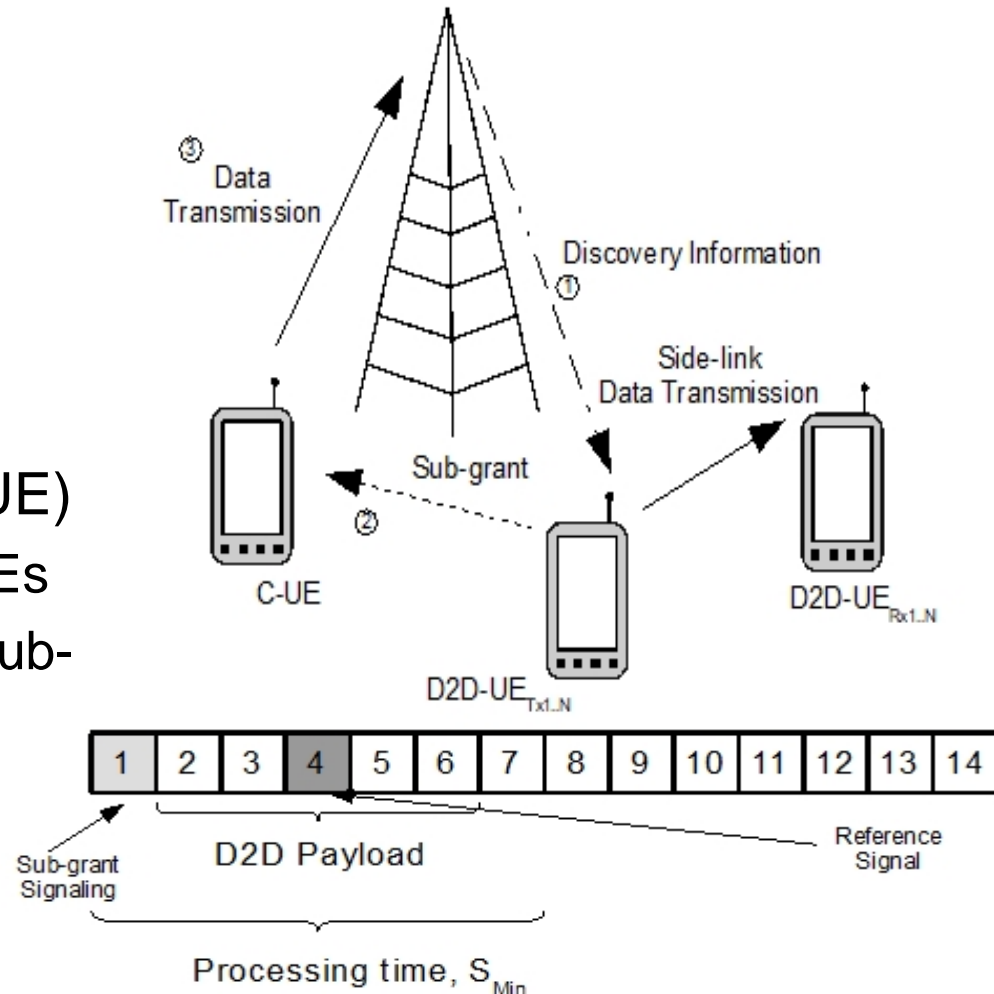
# sTTI Scheme

- 2, 3, and 7 symbols in a sub-frame
  - Throughput improvement & latency reduction
- Demodulation reference signal (DMRS) overhead
  - Sub-frame with 2, 3, and 7 symbols are 50%, 33% and 14%



# Sub-granting Scheme

1. eNB:
  - Resource allocation
2. Sub-grant provider (D2D-UE)
  - Inform free symbols to cellular user (C-UE)
3. Sub-grant beneficiary (C-UE)
  - Monitors assigned D2D-UEs
  - Transmits uplink data on sub-grant



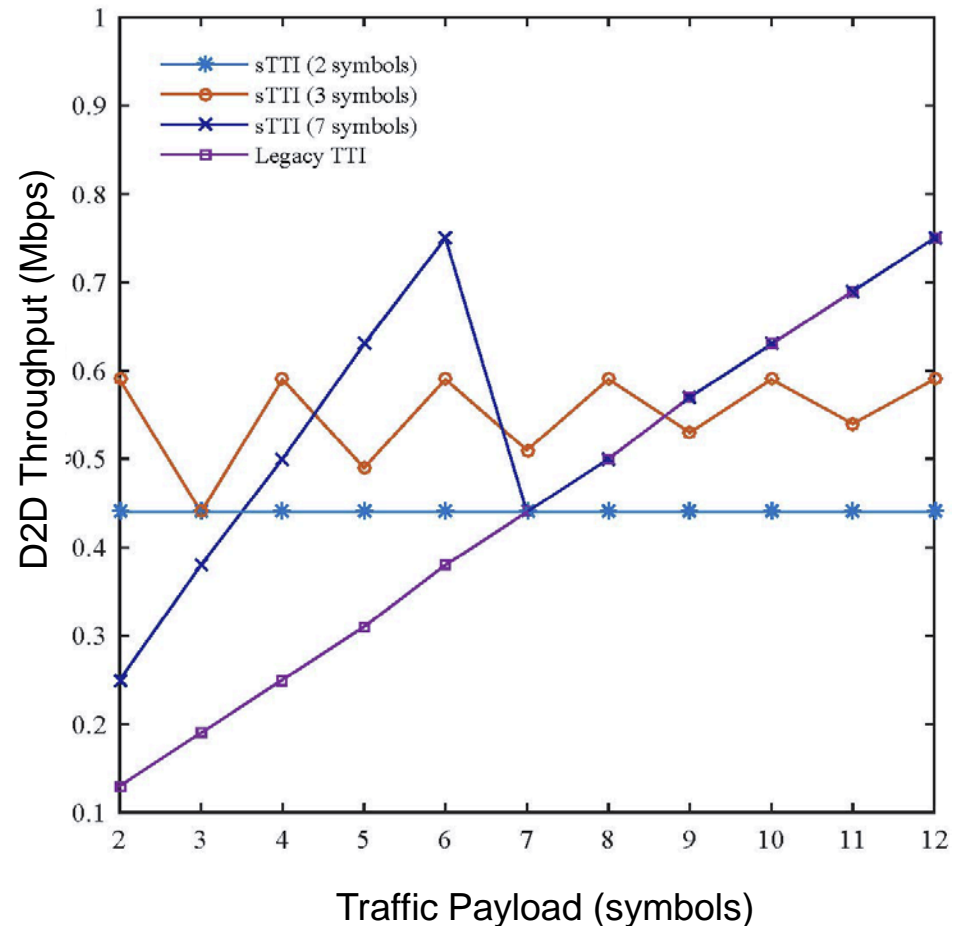
M. Soleymani, D. et al. : A Hierarchical Radio Resource Management Scheme for Next Generation Cellular Networks , IEEE WCNC Workshop on Device

# System Model

- Single cell:
  - One CUE,  $n$  D2D users
- Assumptions:
  - All UEs
    - Max. MCS: 64QAM
    - Orthogonal resource allocation
  - Overhead:
    - One DMRS for sTTI
    - Sub-granting signaling
  - C-UE
    - Full buffer traffic
  - D2D-UE pair
    - Same payload size for all D2D-UEs
    - One RB
    - sTTI and customized sub-frames

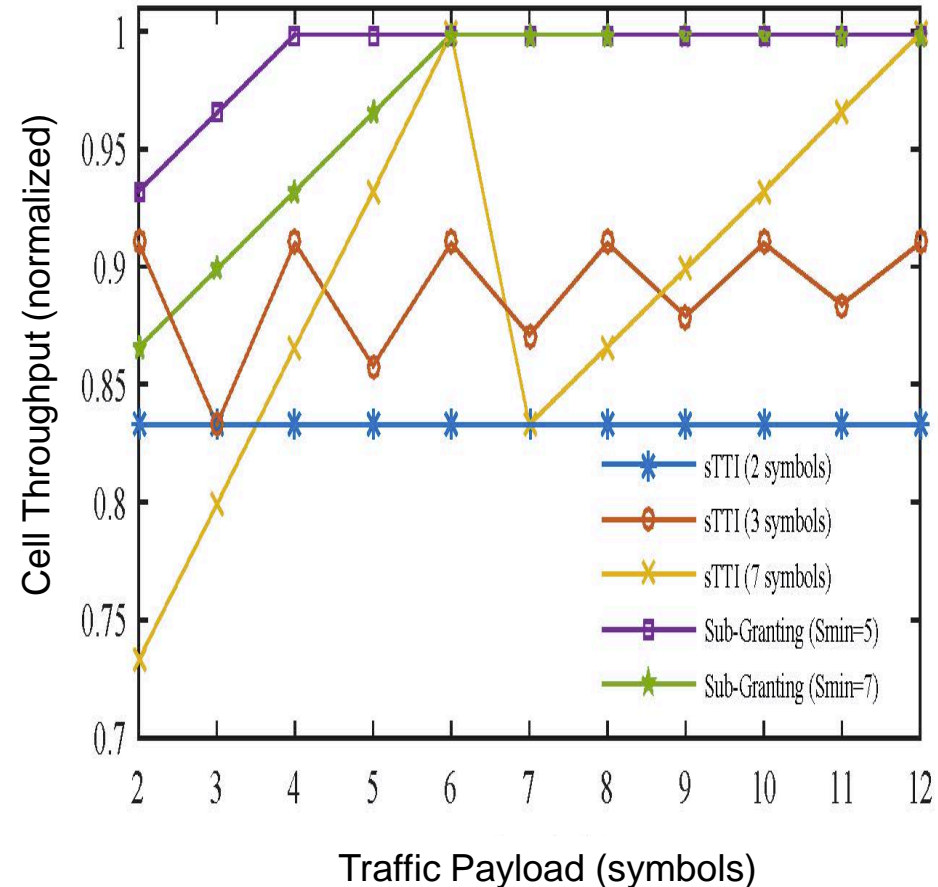
# Results (1/4): Throughput vs. Payload

- sTTI with 2 and 3 symbols:
  - High overhead
  - Small payload size
- sTTI with 7 symbols and LTE sub-frame:
  - Too coarse for small payload



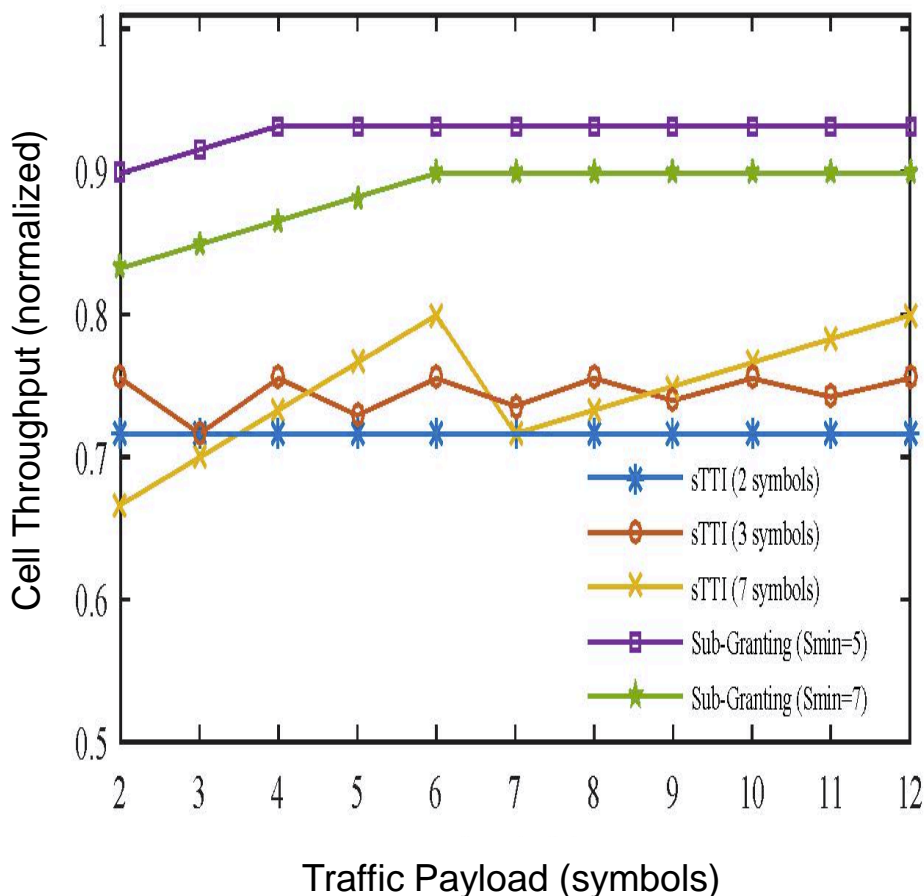
## Results (2/4): Throughput vs. Reserved RBs

- 100% active D2D-UEs, 40 RBs
  - 10% to 20% reduction for all schemes except sTTI with 7 symbols (full buffer)
- More loss for all schemes except sub-granting
- Less processing time → sub-granting gain



# Results (3/4): Throughput vs. Active Users

- Cell throughput with 50% active D2D users, 40 RBs
  - Cell throughput:
    - 10% to 20% reduction for all sTTI schemes
- More non active D2D users
  - 2% to 17% reduction on sub-granting scheme





# Conclusions and Future Works

- Uplink cell throughput
  - Shortening TTI
  - Sub-granting
- Analytical study and simulation study
  - Sub-granting scheme outperforms sTTI scheme
    - 3% to 20%
- Sub-granting requires appropriate algorithms
- Future works:
  - Beneficiary user selection algorithm
  - Mobility
  - Consolidate advantages of both schemes\*

\* M. Soleymani, D. et al. : Implementation Aspects of Hierarchical Radio Resource Management Scheme for Overlay D2D , 2017 9th International Congress on Ultra Modern Telecommunications and Control Systems and Workshops (ICUMT) (ICUMT 2017), 8 Pages , Munich, Germany, November 2017.

Thanks!  
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