An Advanced ARQ (A^2RQ) for 802.16j

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Purpose:

Propose an advanced ARQ (A^2RQ) protocol for 802.16j to improve capacity, delay and reliability performance on relay links.

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Advanced ARQ (A^2RQ) for 802.16j

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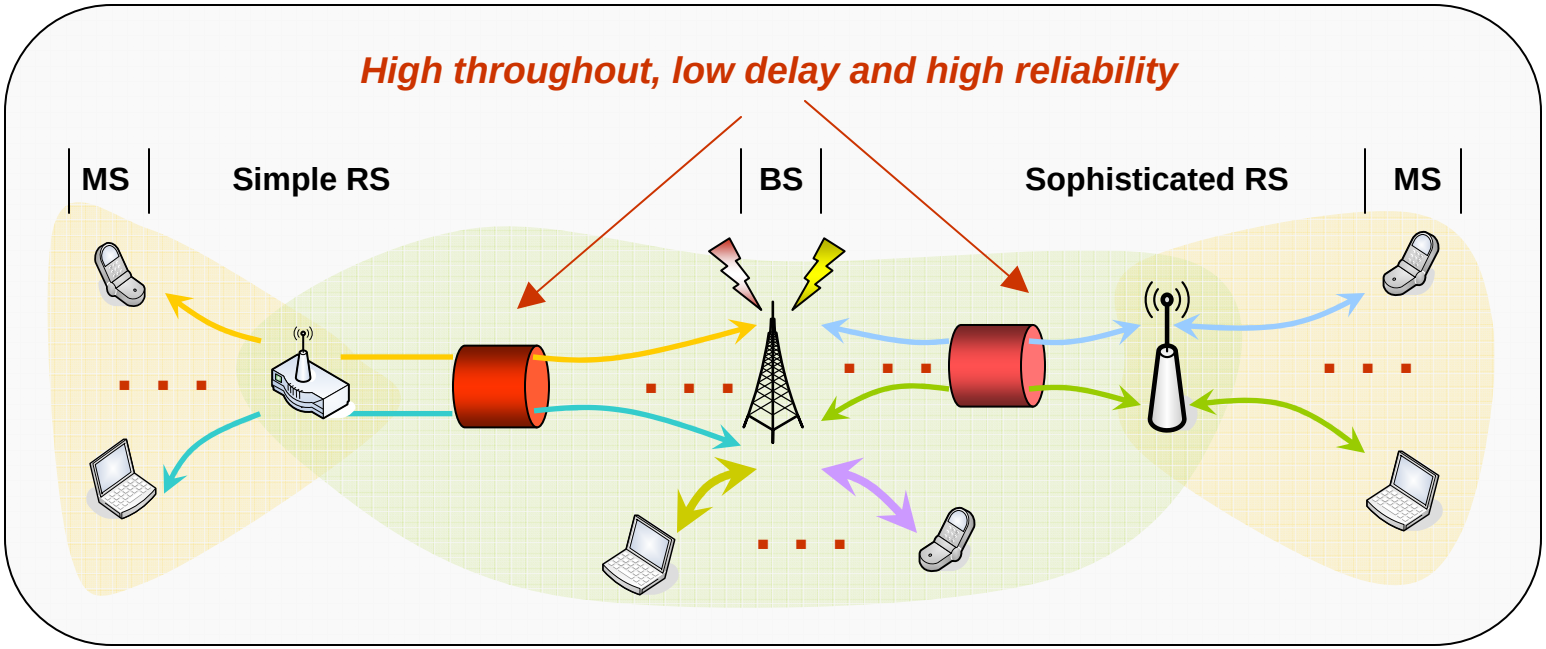
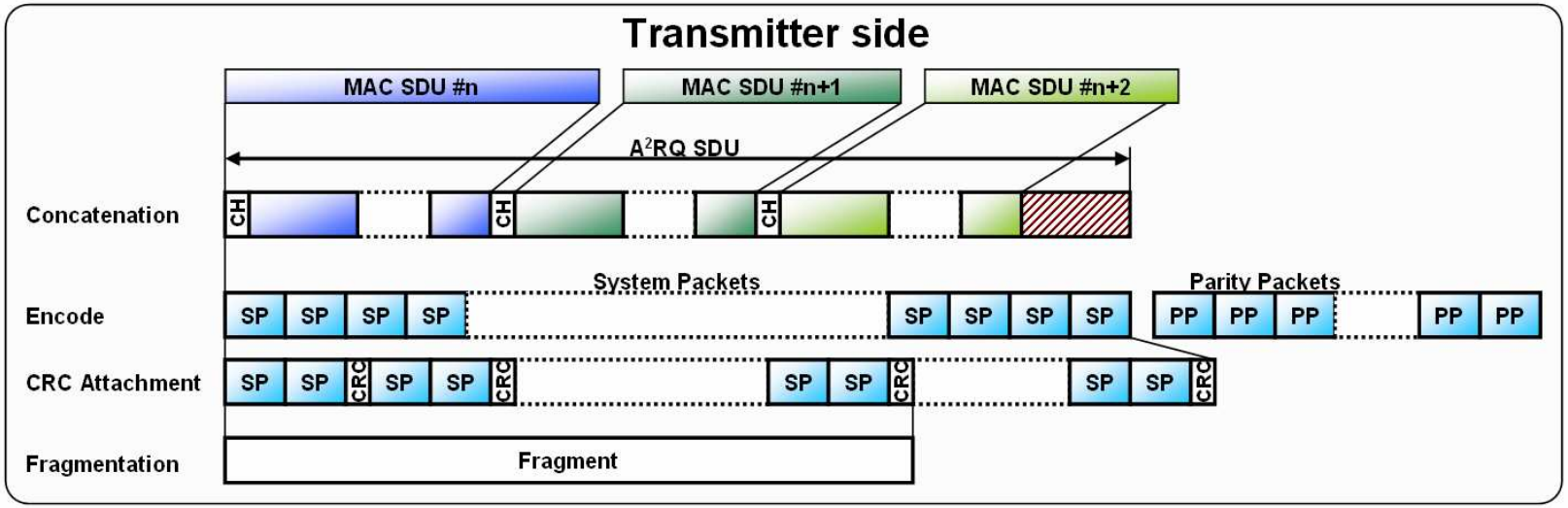
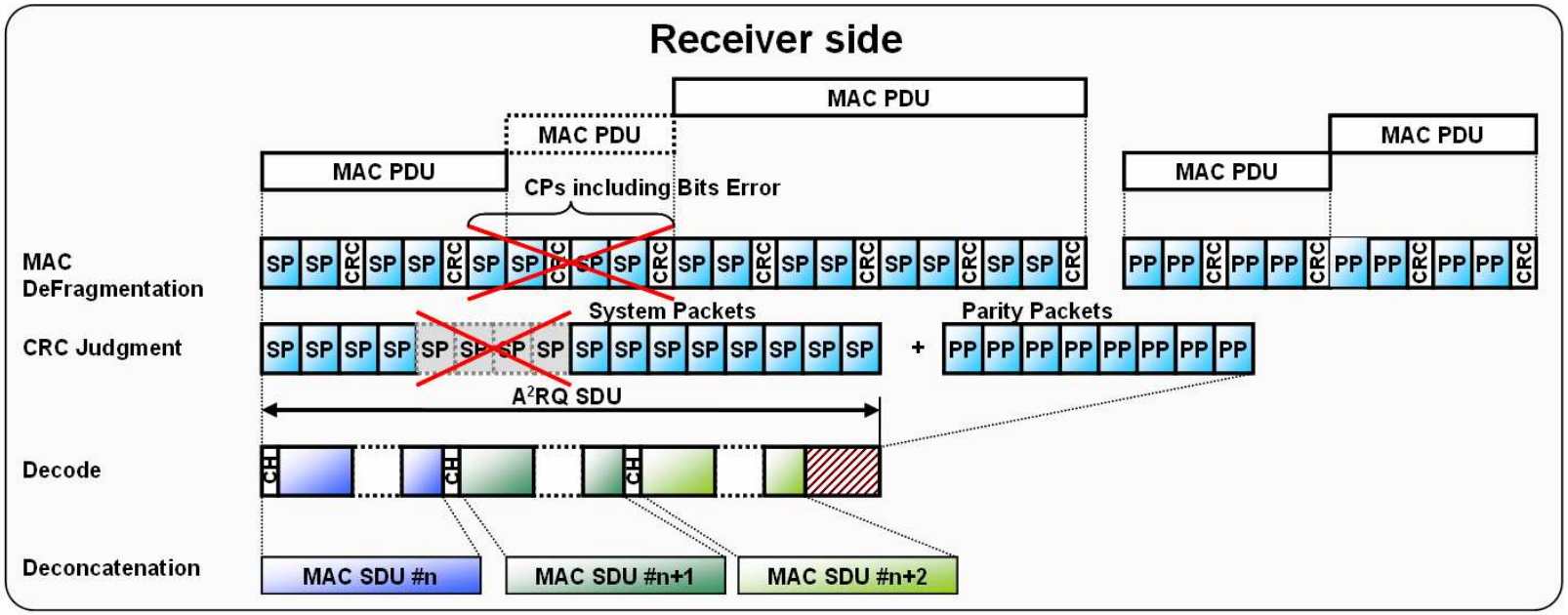
Advanced ARQ (A²RQ): Motivation



- Traffic aggregation occurs on relay links, which requires the relay links to deliver high capacity, low delay and high reliability.
- Current ARQ protocol suffers from several ailments, and cannot meet the stringent requirements.
  - Window Lock
  - Over-sensitivity to CINR estimation.
- Our Key solution
  - Leverage the erasure correction code in ARQ
  - Large Window Size

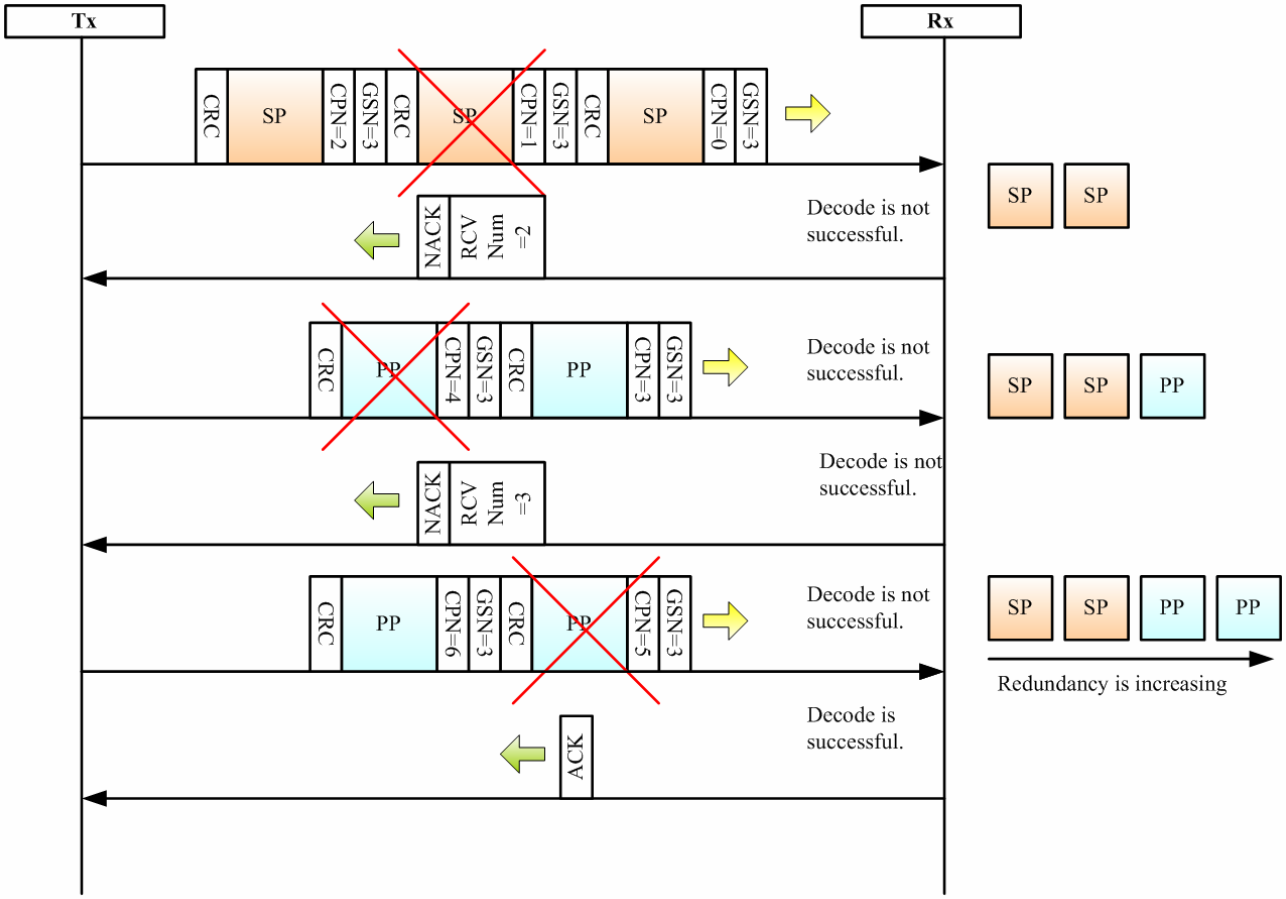
A²RQ: Basic Data Flow





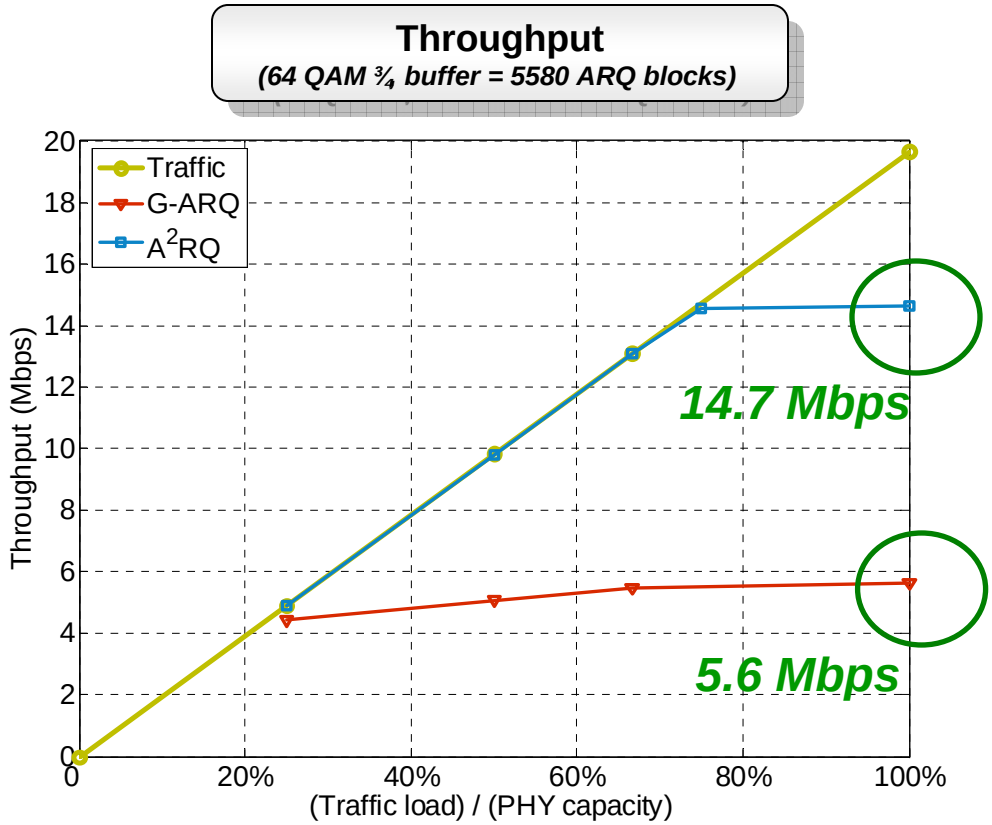
A²RQ: Sequence of Acknowledgement

- Sender transmits parity packets (PPs) in the case of receiving NACK.
- The redundancy is increasing in proportion to the number of received CPs.



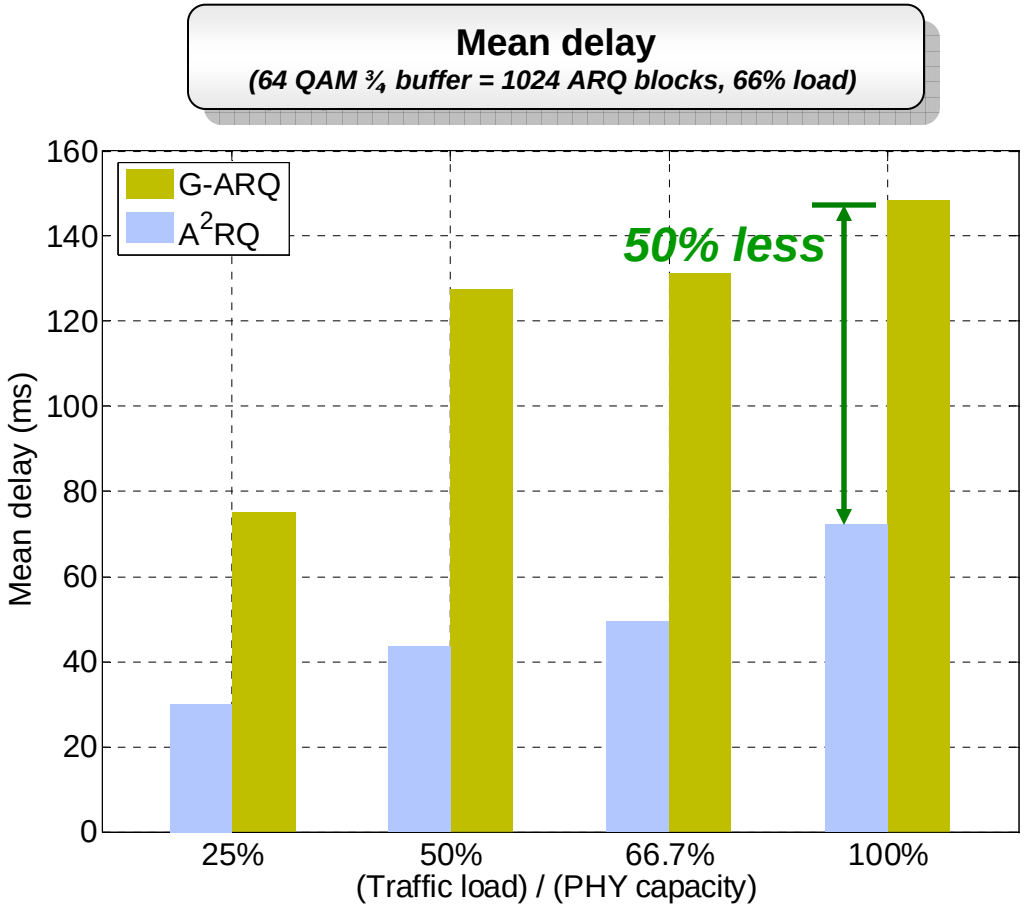
A²RQ: Throughput Performance

- **Major findings** (ACK period = 10 frames):
  - G-ARQ seriously suffers from the window lock effect, while A²RQ does not.
  - A²RQ significantly outperforms G-ARQ (*2.6* times higher)



A²RQ: Delay Performance

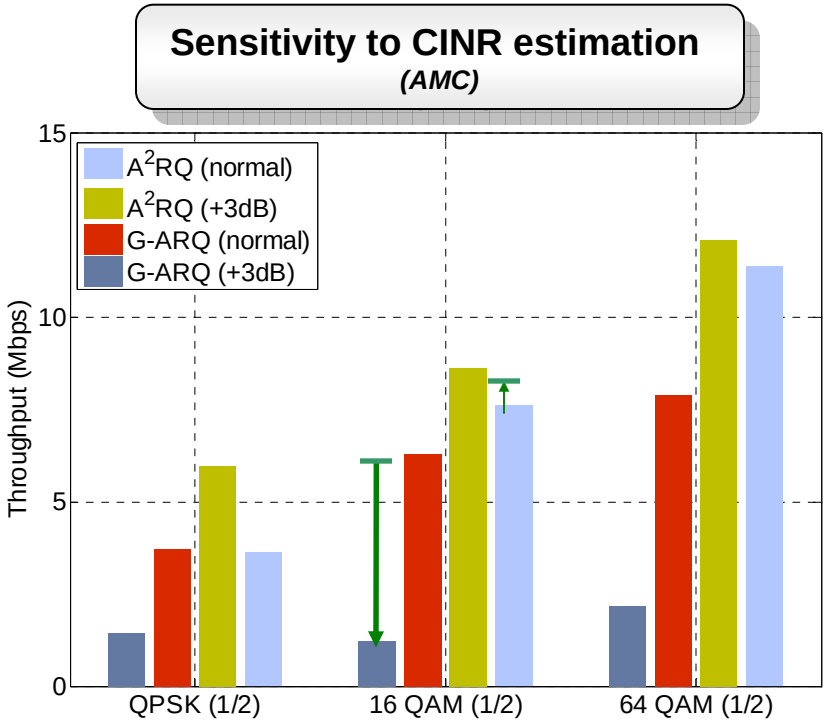
- **Major findings** (ACK period = 10 frames):
  - A²RQ has much shorter average delay than G-ARQ.

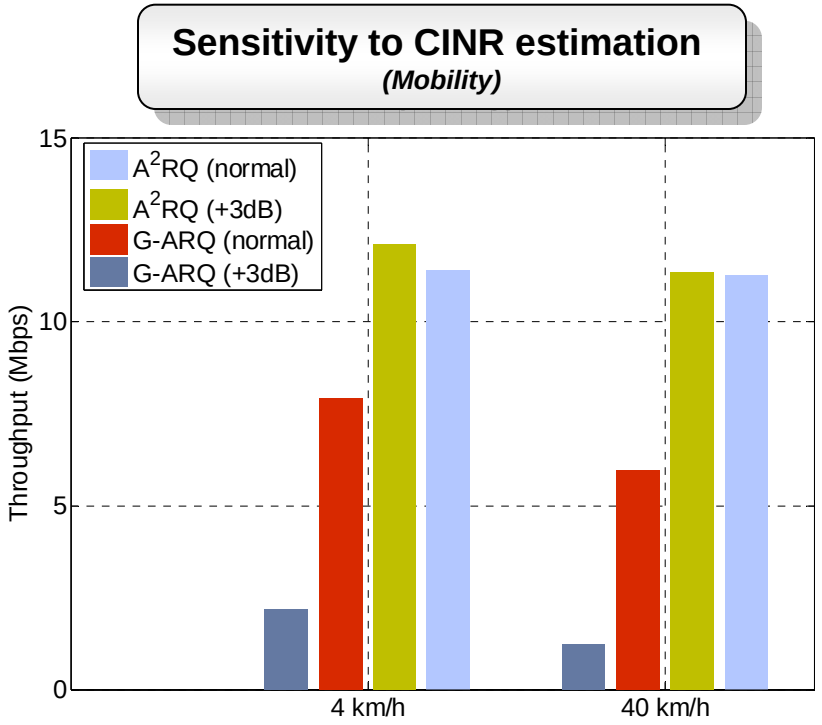


A²RQ: Sensitivity to CINR Estimation

- **Major findings** (ACK period = 10 frames):
  - A²RQ dampens the undesirable sensitivity to CINR estimation shift
  - When we have 3dB offset, throughput of G-ARQ decreases sharply, while A²RQ maintains a stable performance.

Simulation Condition	
Parameter	Value
Velocity	0km/h, 4/km/h, 40km/h
Traffic model	Full buffer model
CINR	Normal, Normal+3dB
ACK Period	10 Frames





Key Observations & Summary

- Several severe problems of G-ARQ have been observed, which lead to dismal performance degradation.
  - Window lock
  - Oversensitivity to CINR estimation

- As a result, when G-ARQ is directly applied on relay links, it cannot deliver the throughput, delay and jitter performance as demanded.

- An advanced ARQ (A^2RQ) addresses these issues, and consequently can achieve:
  - High throughput
  - Low delay
  - Small jitter
  - Improved reliability
  - With relatively low additional complexity

- To transport aggregated connections/traffic on relay links between BS and RS, A^2RQ provides a solution with superior performance.

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