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

IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number:

IEEE S802.16j-06/176

Date Submitted:

2006-11-07

Source:

***Toshiyuki Kuze**, Shigeru Uchida, Kentaro Sawa*
Mitsubishi Electric Corp.
5-1-1 Ofuna Kamakura, Kanagawa 2478501, JAPAN
Voice: +81-467-41-2885
Fax: +81-467-41-2486
Email: kuze.toshiyuki@ah.MitsubishiElectric.co.jp

Jeffrey Z. Tao, Koon Hoo Teo, Jinyun Zhang
Mitsubishi Electric Research Lab
201 Broadway, Cambridge, MA 02139, USA
Voice: 617-621-{7557, 7527}
Fax: 617-621-7550
Email: {tao, teo, jzhang}@merl.com

Venue:

IEEE 802.16 Session #46, Dallas, Texas, USA

Base Document:

None

Purpose:

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

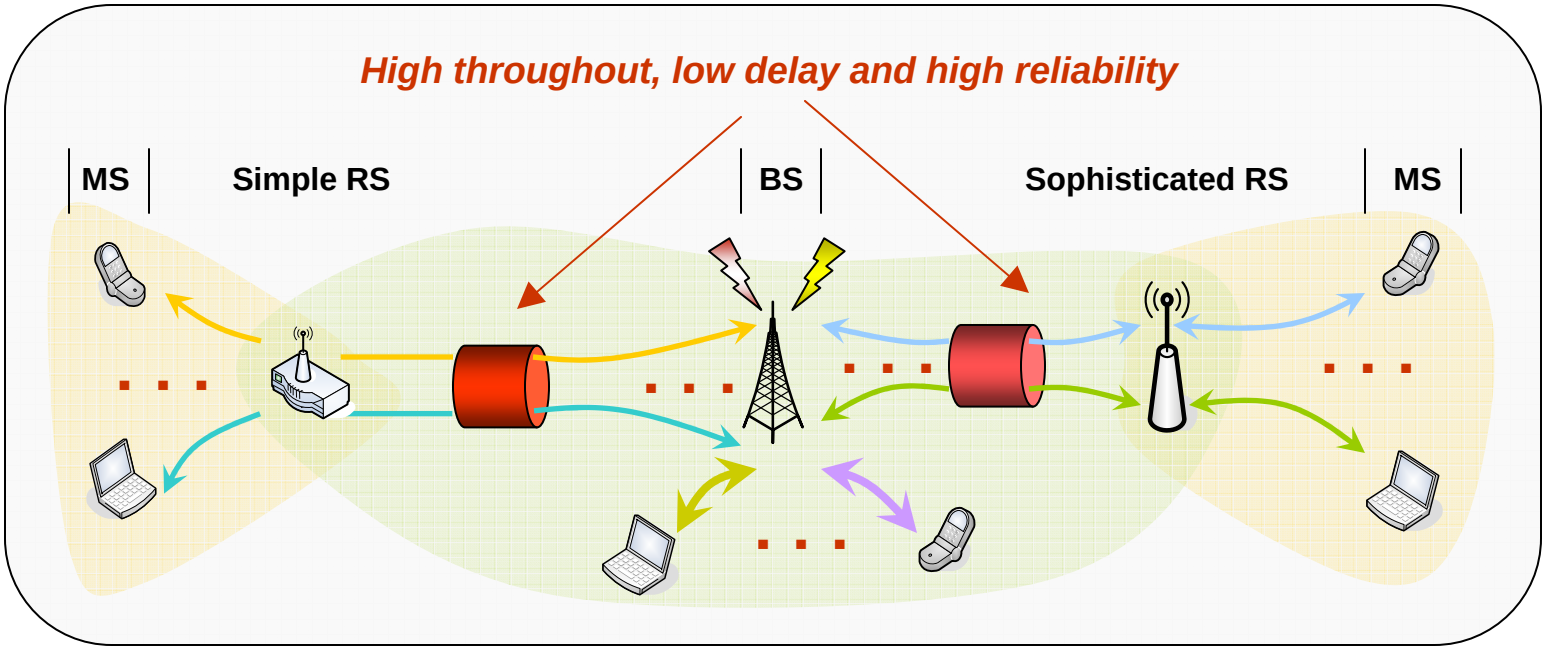
Advanced ARQ (A^2RQ) for 802.16j

Authors:

***Toshiyuki Kuze**, Shigeru Uchida, Kentaro Sawa*
Mitsubishi Electric Corp
5-1-1 Ofuna Kamakura, Kanagawa
2478501, Japan

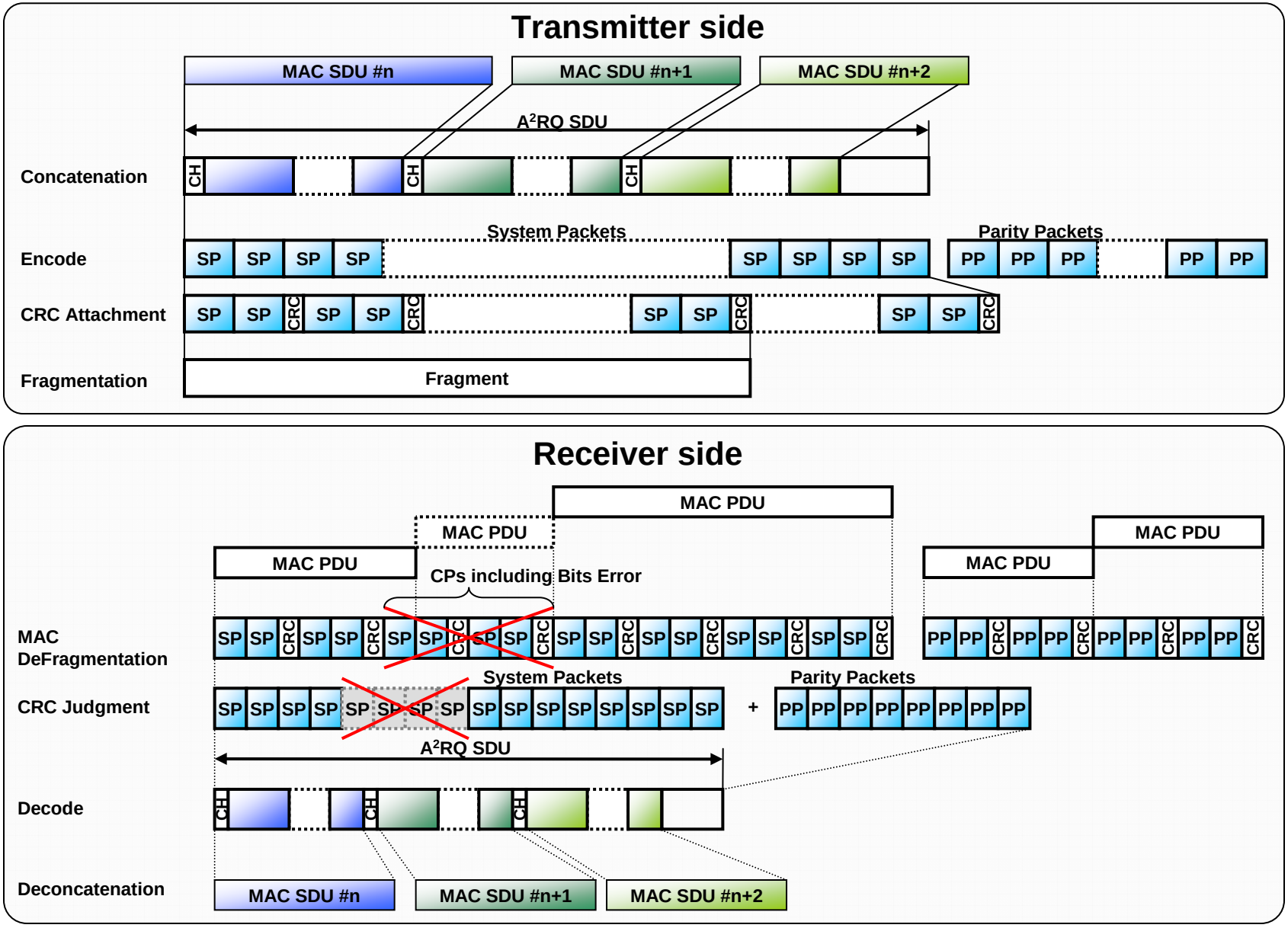
Jeffrey Z. Tao, Koon Hoo Teo, Jinyun Zhang
Mitsubishi Electric Research Lab
201 Broadway
Cambridge, MA 02139

Advanced ARQ (A²RQ): Motivation



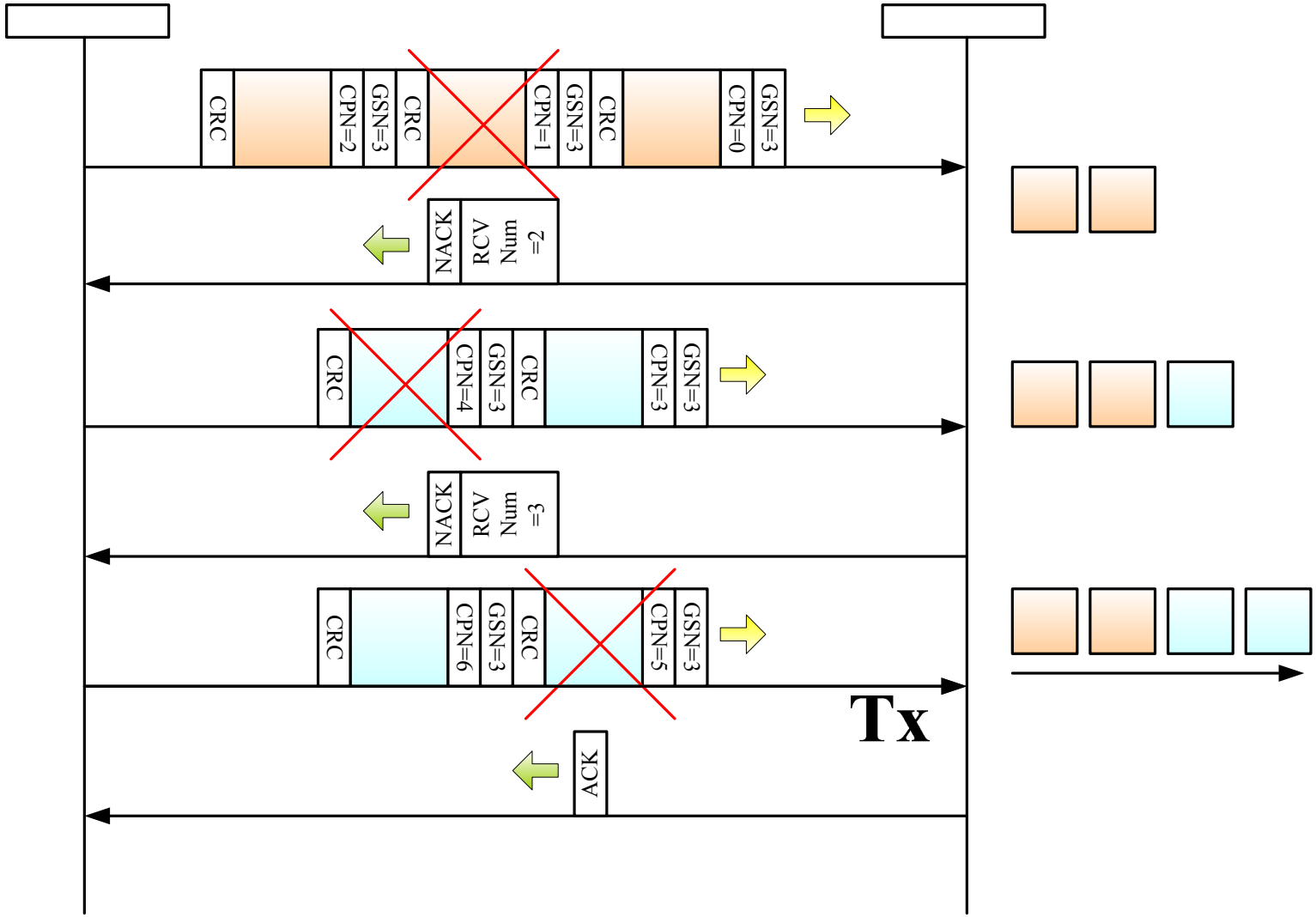
- Traffic aggregation occurs on relay links, which requires the relay links to deliver high capacity, low delay and high reliability.
- Current ARQ protocol suffers from several ailments, and cannot meet the stringent requirements.
  - Window Lock
  - Over-sensitivity to CINR estimation.
- Our Key solution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

A²RQ: Basic Data Flow



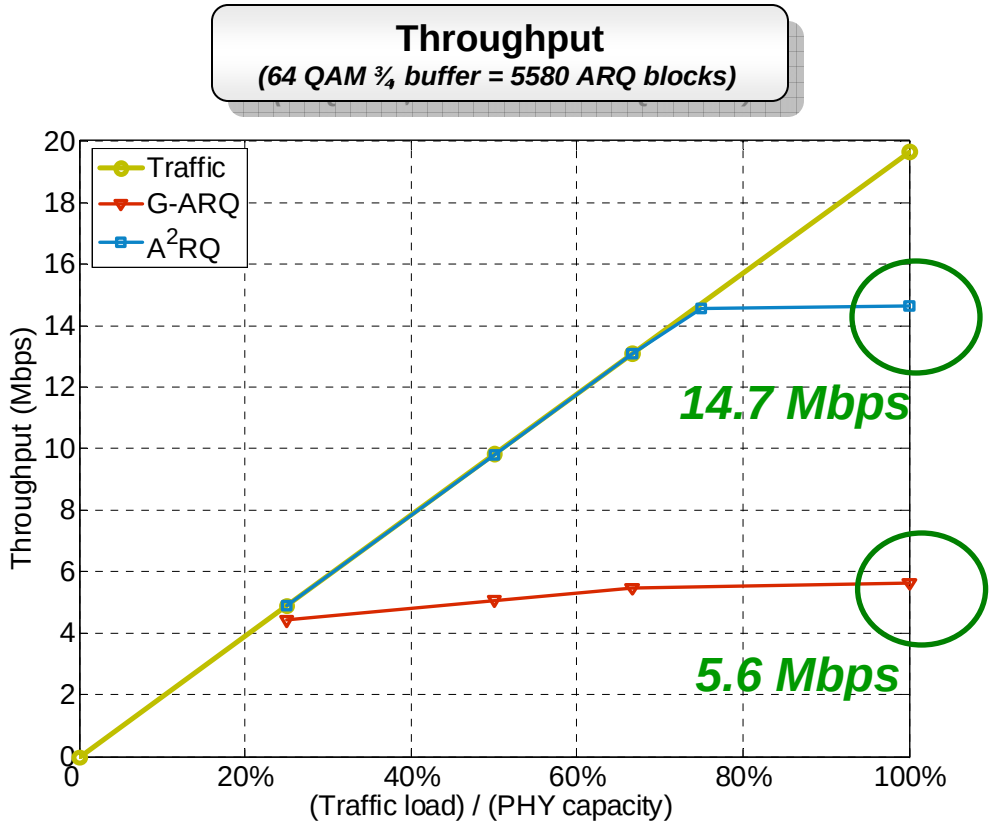
A²RQ: Sequence of Acknowledgement

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



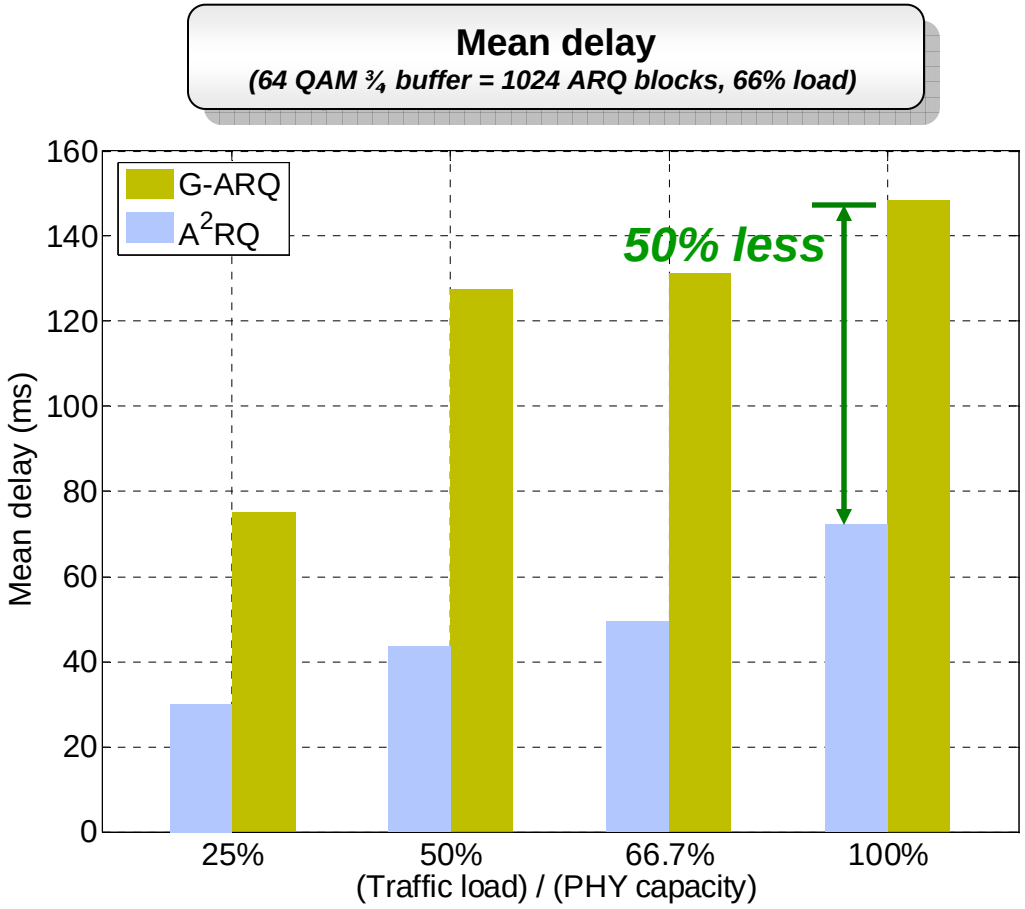
A²RQ: Throughput Performance

- **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.

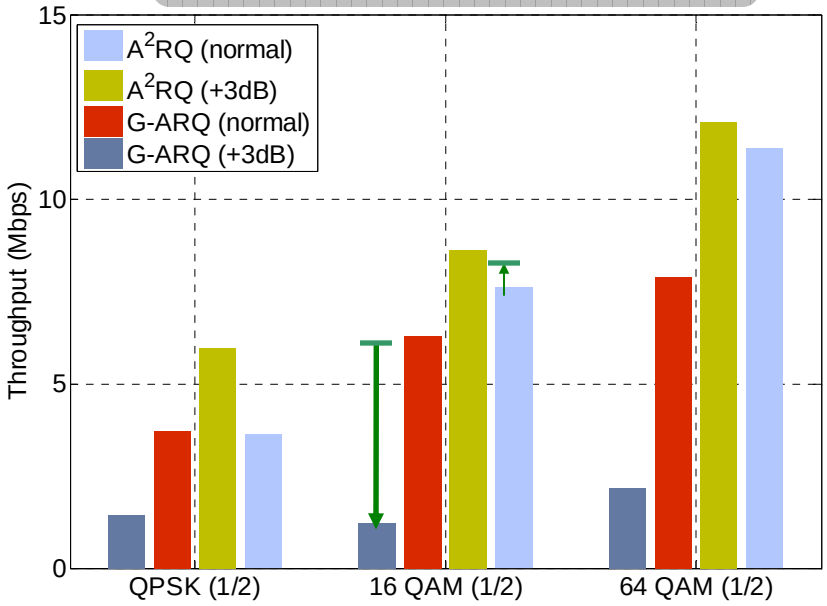


A²RQ: Sensitivity to CINR Estimation

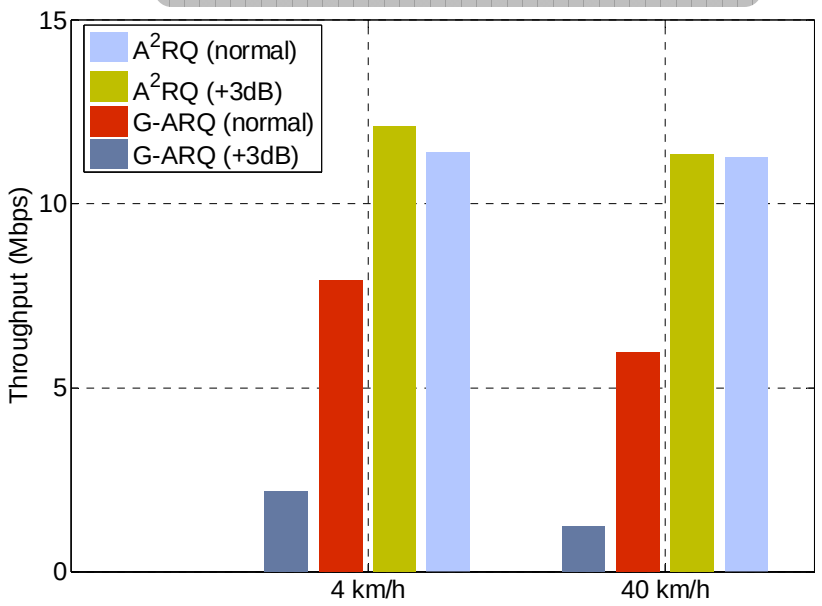
- **Major findings** (ACK period = 10 frames):
  - A²RQ dampens the undesirable sensitivity to CINR estimation shift
  - When we have 3dB offset, throughput of G-ARQ decreases sharply, while A²RQ maintains a stable performance.

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

Sensitivity to CINR estimation
(AMC)



Sensitivity to CINR estimation
(Mobility)



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.

References

1. “IEEE Standard for Local and Metropolitan Area Networks – Part 16: Air Interface for Fixed Broadband Wireless Access Systems,” IEEE Computer Society and the IEEE Microwave Theory and Techniques Society, October 2004.

2. “IEEE Standard for Local and Metropolitan Area Networks – Part 16: Air Interface for Fixed Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands,” IEEE Computer Society and the IEEE Microwave Theory and Techniques Society, February 2006.

3. “Harmonized definitions and terminology for 802.16j Mobile Multihop Relay,” IEEE 802.16j-06/014r1, October 2006.

4. 3GPP R1-060910, “Performance improvement of the rate-compatible LDPC codes”, March, 2006.

5. T.Kuze, S.Uchida, K.Sawa, A.Otsuka, F.Ishizu, ”A Study of Channel Creation Technology for Cognitive Radio Communication”, Proc. Commun. Conf. IEICE, ’06, B-17-14, pp524, Sept.2006.

6. S.Uchida, T.Kuze, A.Otsuka, F.Ishizu, ”A Study on Reliable Data Transfer with Erasure Correction Code”, Proc. Commun. Conf. IEICE ’06, B-17-15, pp525, Sept.2006.