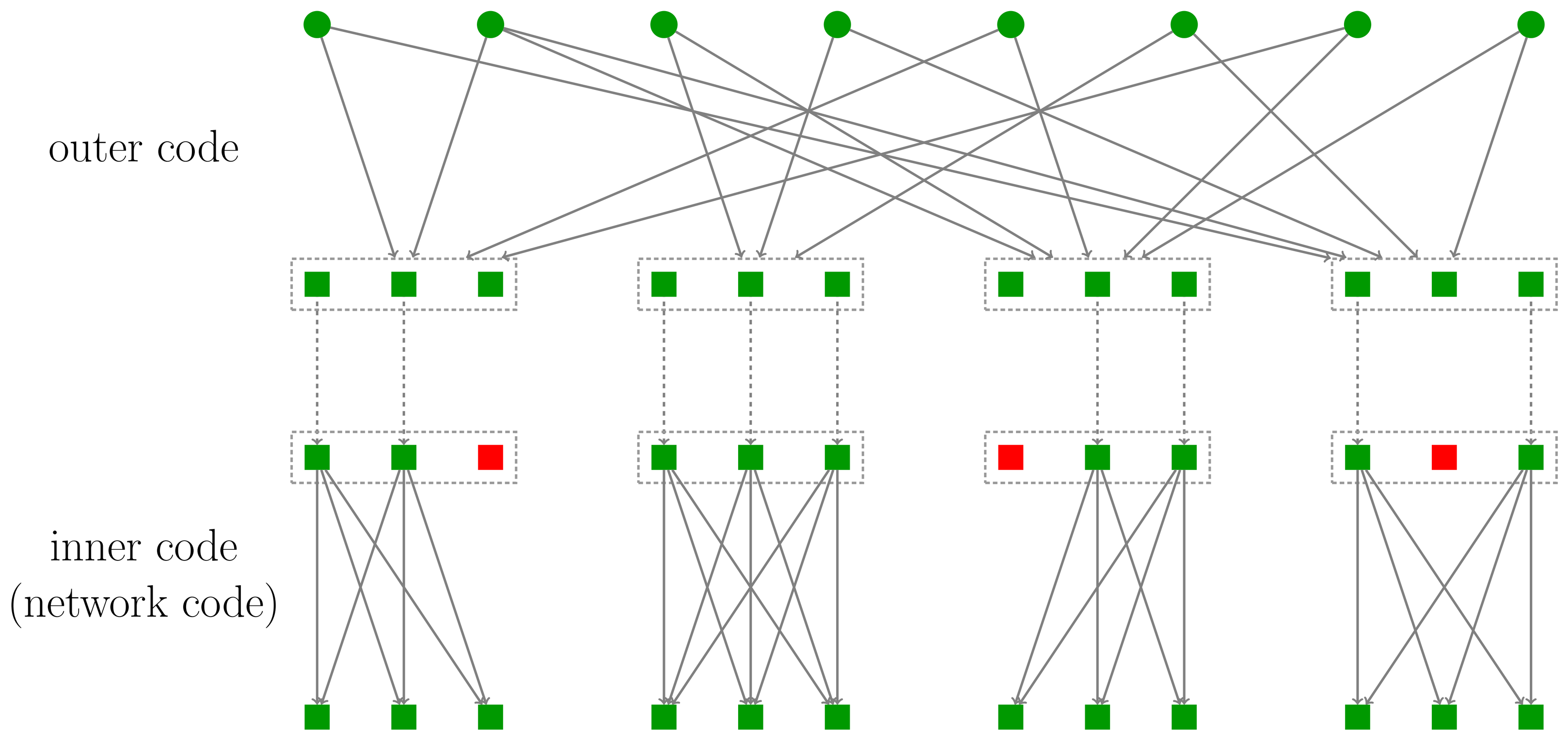
BATS: Network Coding in Action

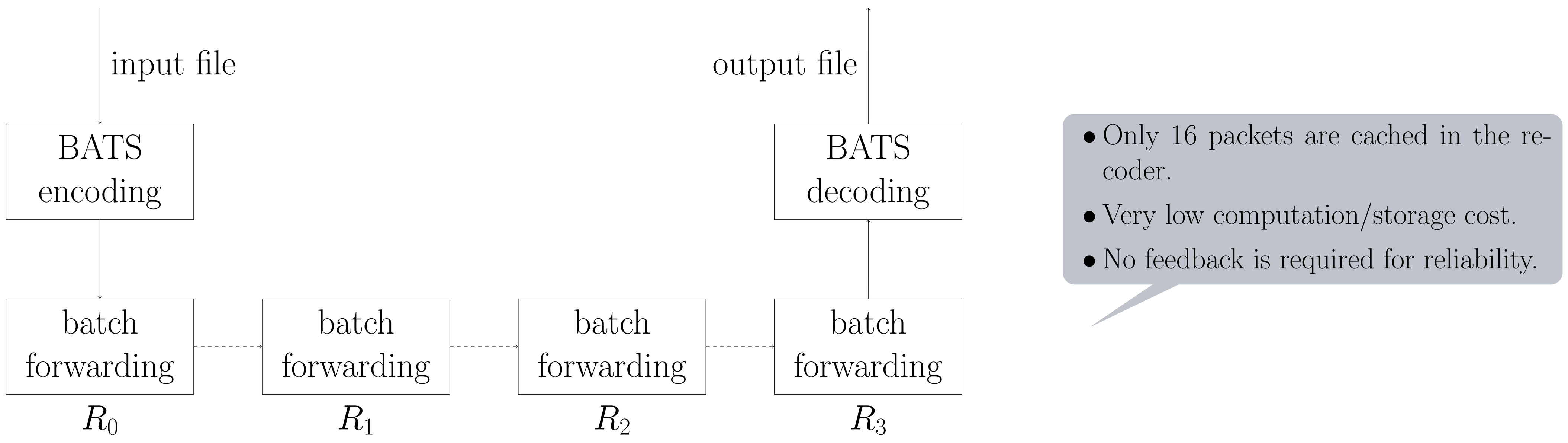
S. Yang*, R.W. Yeung†, J.H. Cheung† and H.H. Yin†

*Tsinghua University, †The Chinese University of Hong Kong

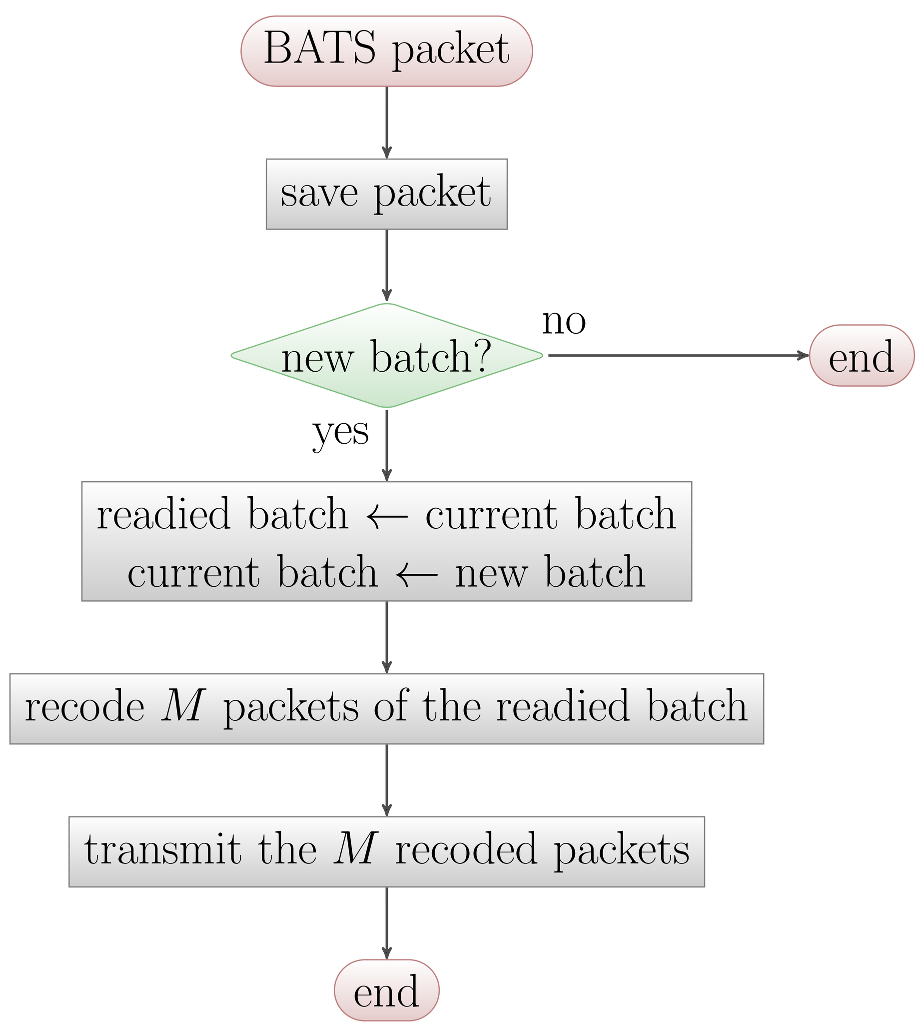
BATS Codes



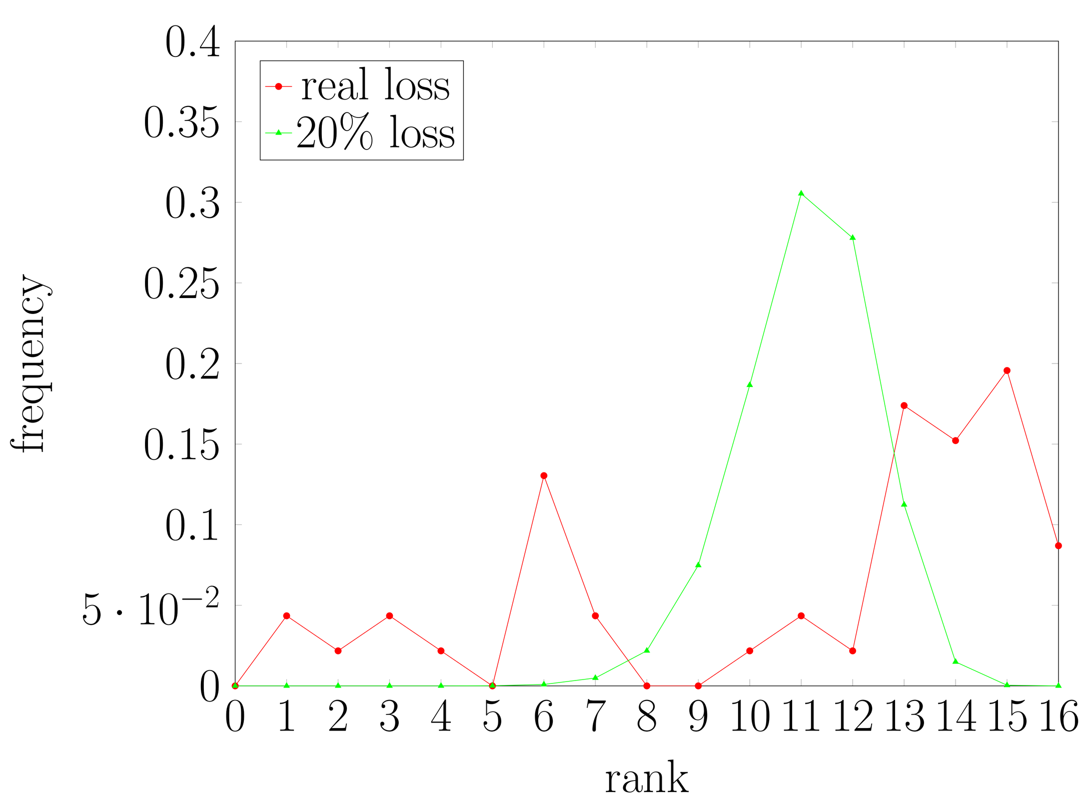
Protocol



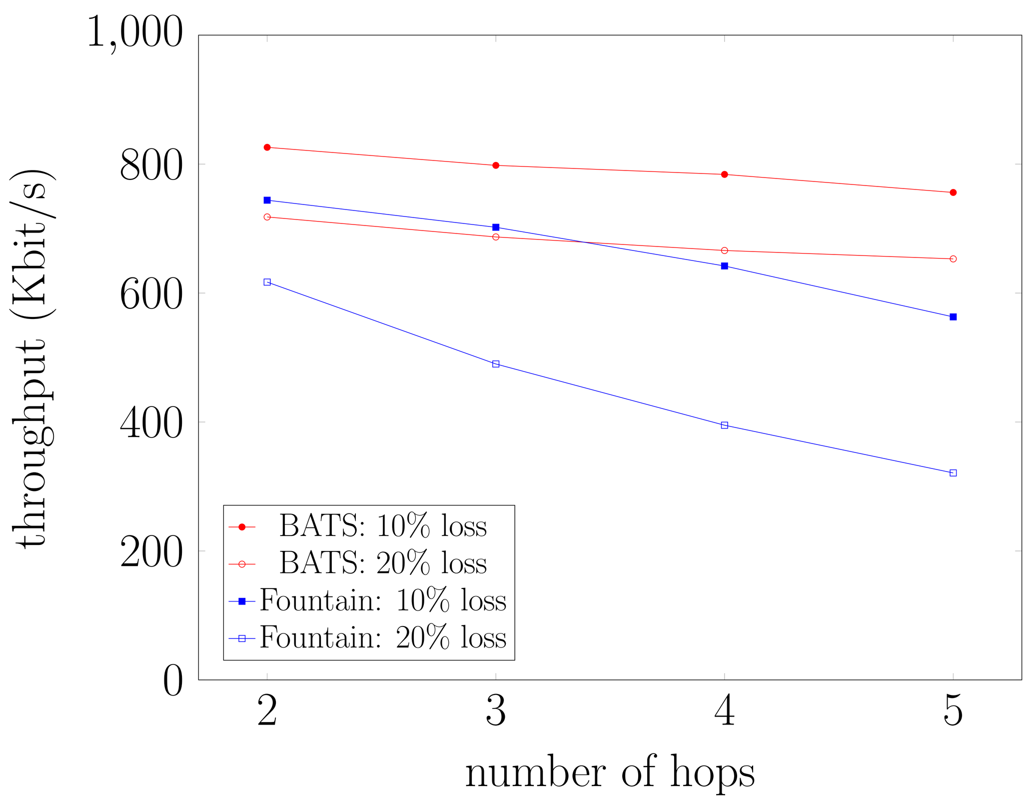
Recoder in BATSpro-1



Burst Loss



Experiment Results:



Real-World Packet Loss

- $K = 512$, $q = 2^8$, $T = 1024$, and $M = 16$.
- Source node transmission rate: 500 Kbit/s.

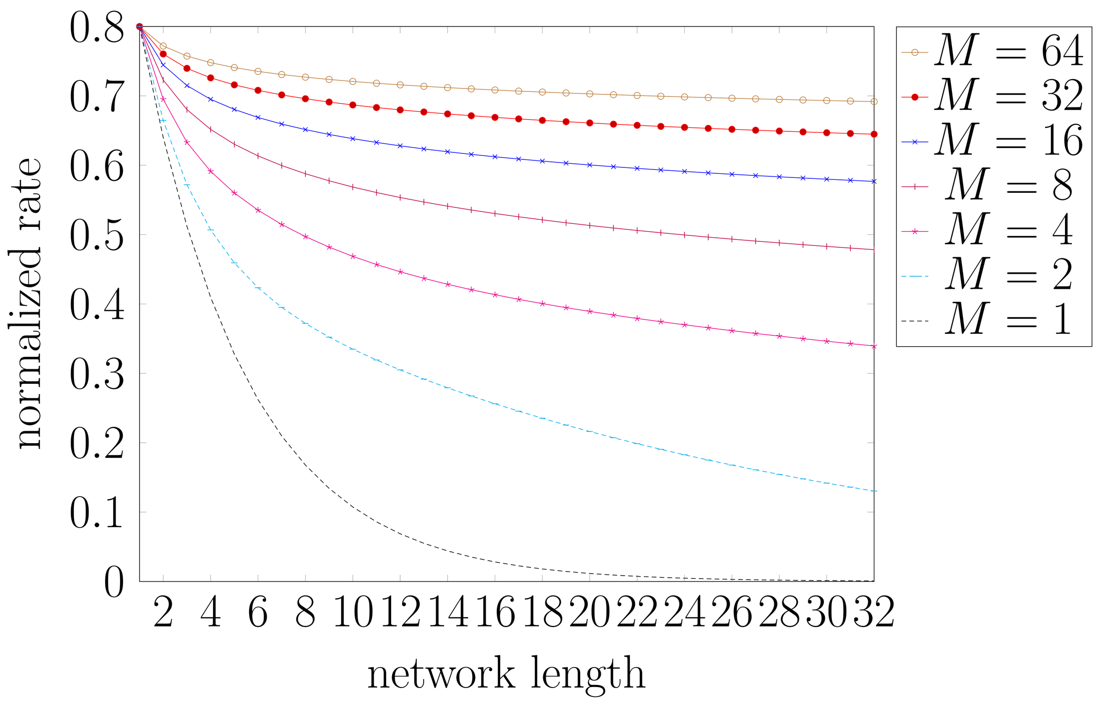
	Fountain codes	BATS codes
trials	279.45	291.45
	241.42	314.10
	315.36	319.78
	237.53	362.61
	260.61	296.41
mean	266.87	316.87

Random Linear Network Coding

- *Random linear network coding* achieves the capacity of a large range of multicast networks with packet loss.
  - w/o link-level erasure correcting codes
  - w/o network topology knowledge
- Difficult to implement
  - Computation/storage cost
  - Coefficient vector overhead

Advantages of BATS Codes

- Linear complexity for encoding/decoding/network coding.
- Constant (very small) storage and computation requirement at the intermediate network nodes.
- Near optimal throughput in both theoretical analysis and experiments.
- No feedback, secure, ...



Adaptive Recoding

- Transmit more packets for a batch with higher rank.
- Priority function of a batch b:

$$F(b) = r_b \frac{M+1}{M} - t_b,$$

where
  - r_b: the rank of the packets received,
  - t_b: the number of packets transmitted.
- Transmit a coded packet of the batch with the highest priority.
- Interleaving the batches.

Summary and Ongoing Works

- Ready-to-use network coding gain!
- BATSpro-2 is under development.
- Significant peformance gain has been observed in simulation.
- Implementation in mobile devices.
- FPGA for high-speed recoding processing.

References

- S. Yang and R.W. Yeung, "Batched sparse codes," IEEE Trans. Inform. Theory, vol. 60, no. 9, Sep. 2014.
- S. Yang, R.W. Yeung, J.H. Cheung and H.H. Yin, "BATS: Network coding in action", Allerton conference, 2014.