OPENFABRICS ALLIANCE

Completion Queue Handler Group for User Verbs Applications

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Oracle

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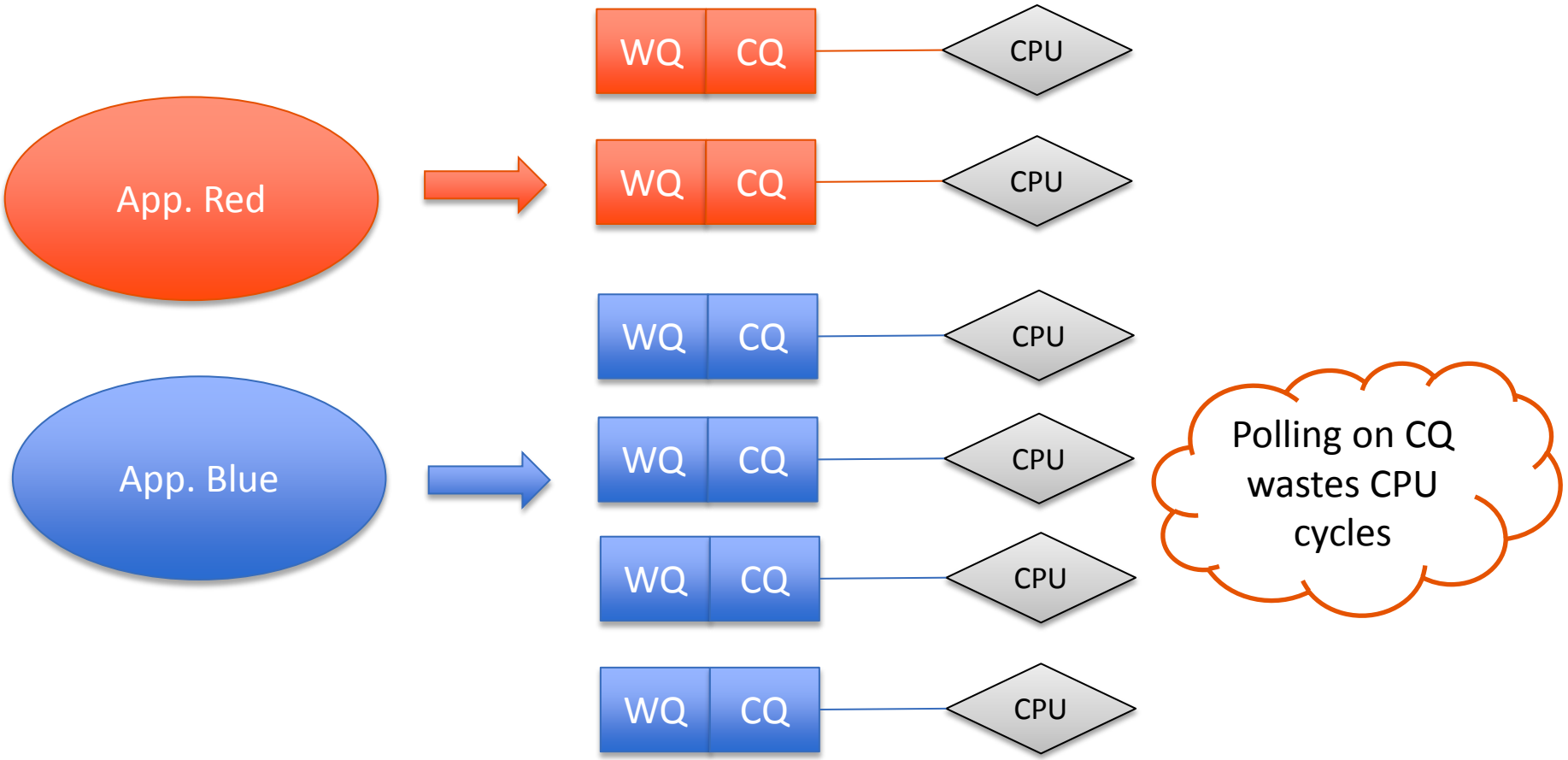
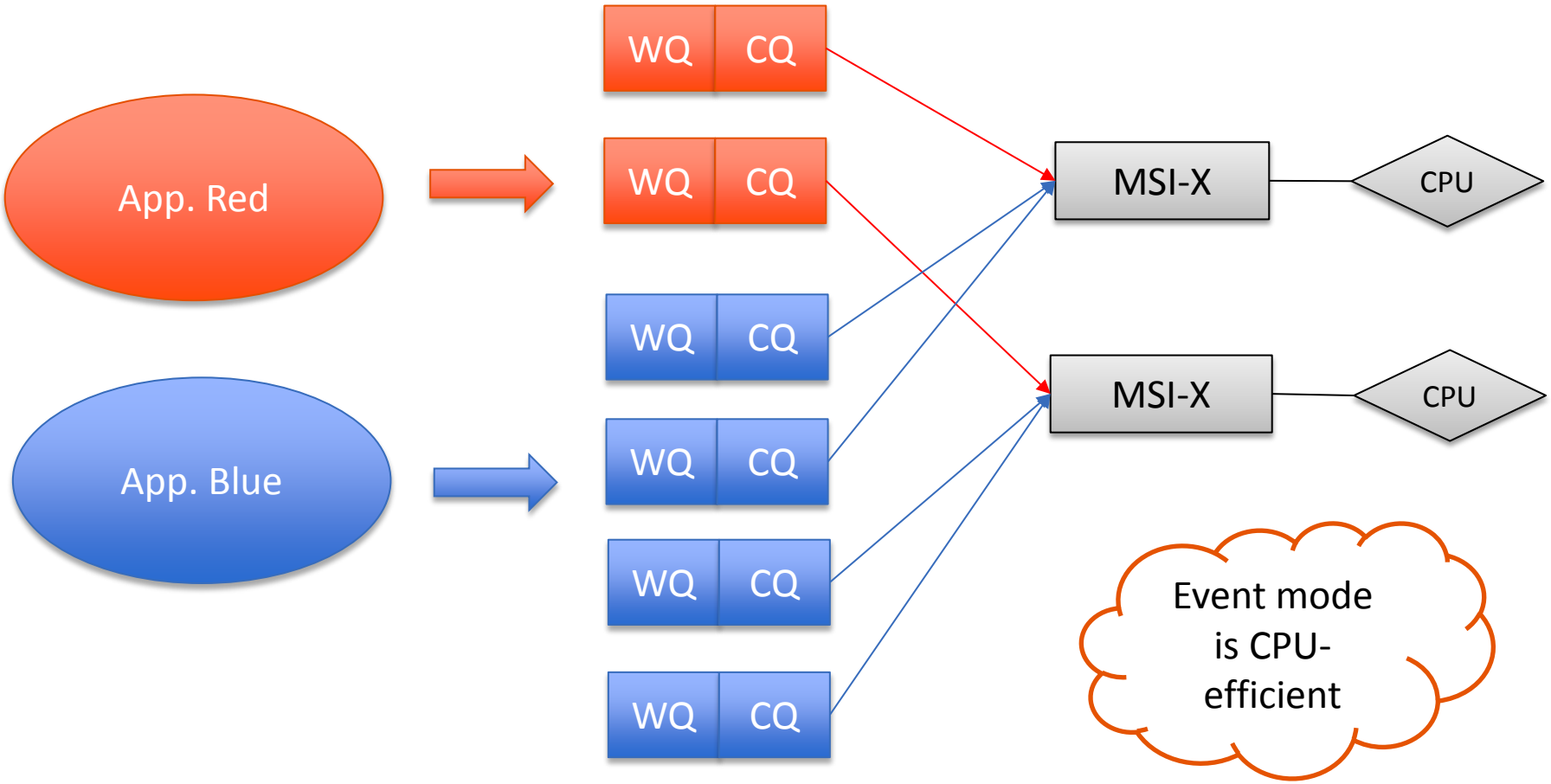
Introduction

- InfiniBand (IB) Unified I/O Architecture
  - IB support running a large number of protocols concurrently on the same physical device
- OS must act as a nice arbitrator
  - It needs to allocate resources properly among protocols to ensure fairness and Quality of Service (QoS)
- However, OS cannot arbitrate completion event (device interrupt) based on IO protocol itself

Introduction: Polling on CQ

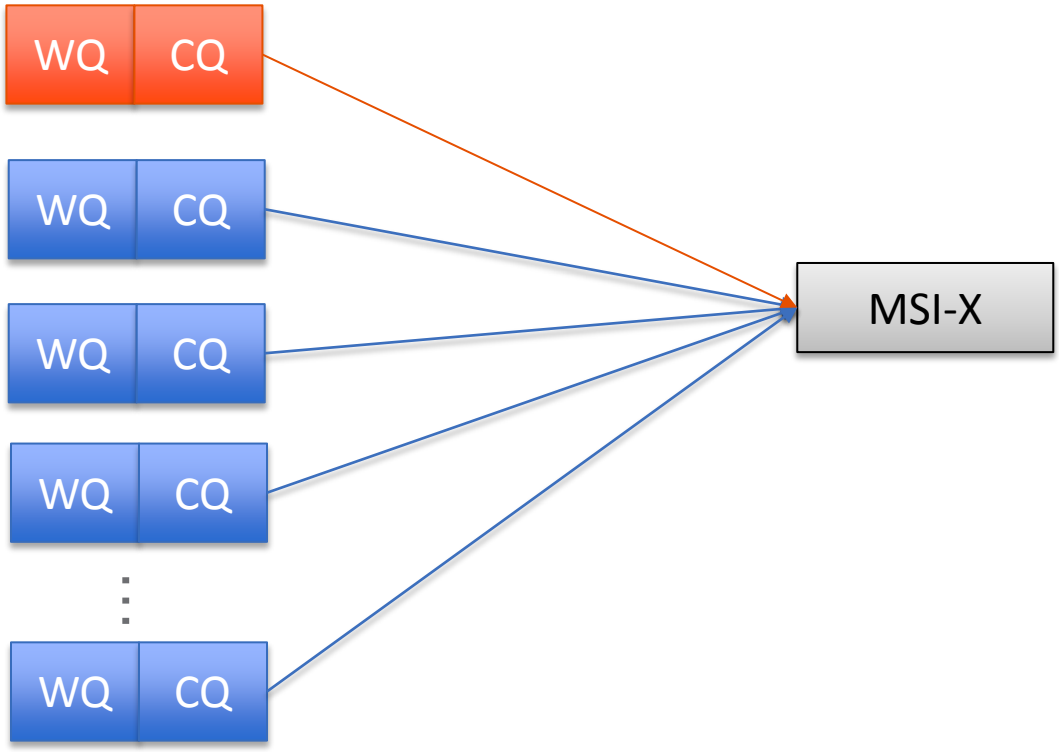


Introduction: Event mode



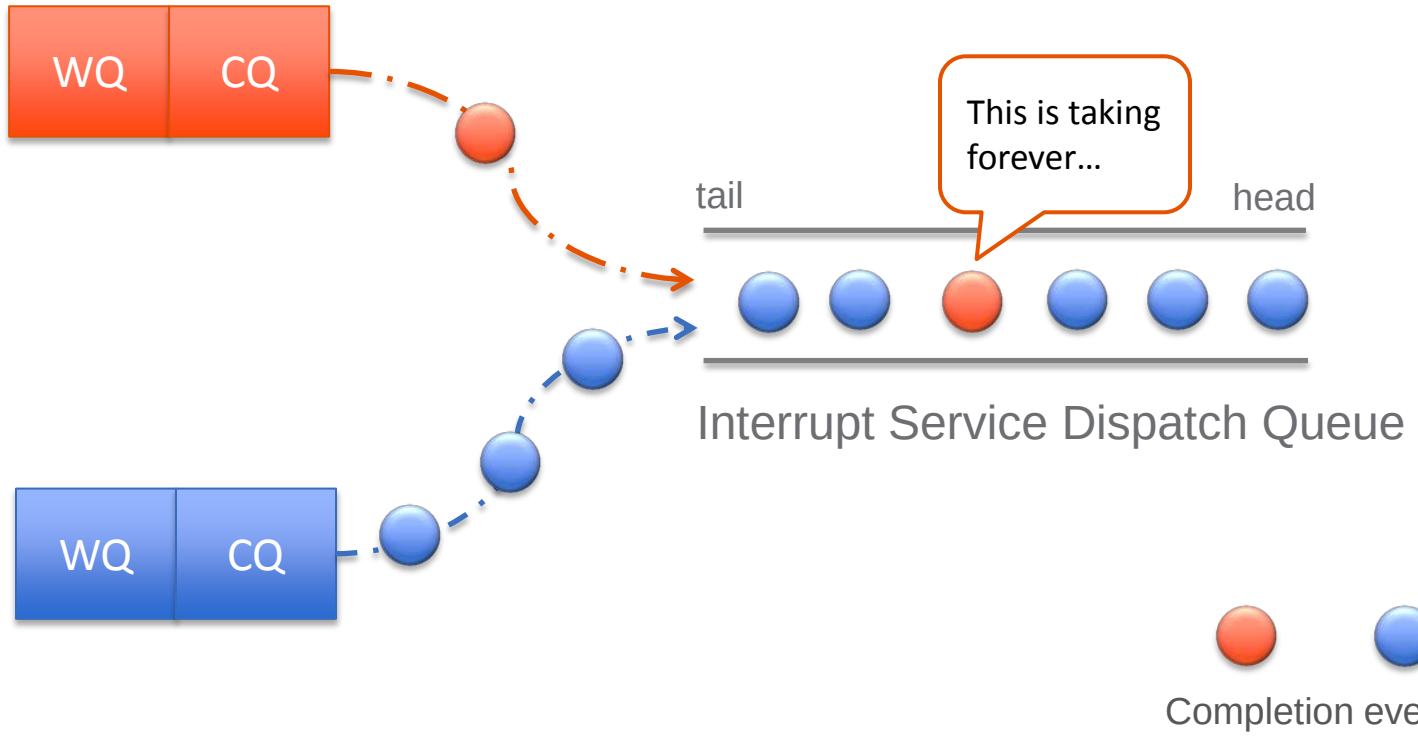
Introduction: Problem with random interrupt assignment

- Evil app #1: Massive QP creator



Introduction: Problem with random interrupt assignment

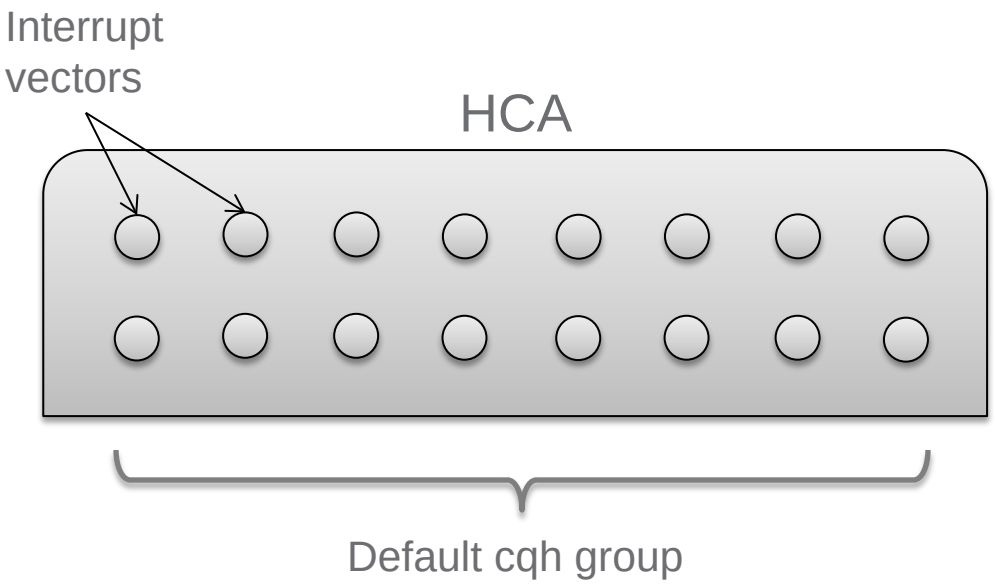
- Evil app #2: High frequency event generator



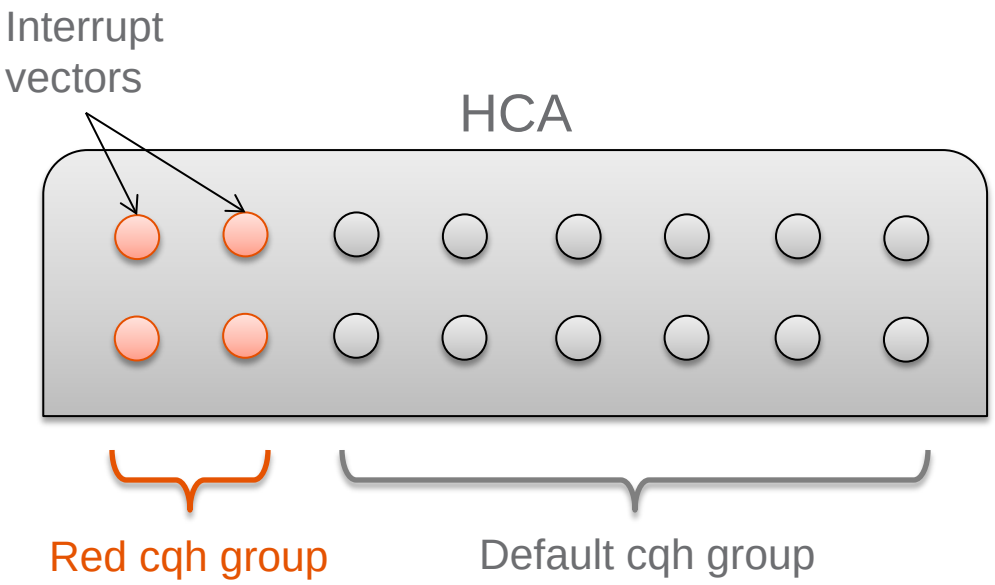
CQ Handler (CQH) Group: Concept

- Group a set of vectors for a given type of IO.
- When there is a completion event, IB device will use only the interrupt vectors in its group.
  - Implemented in Oracle Solaris for kernel ULPs

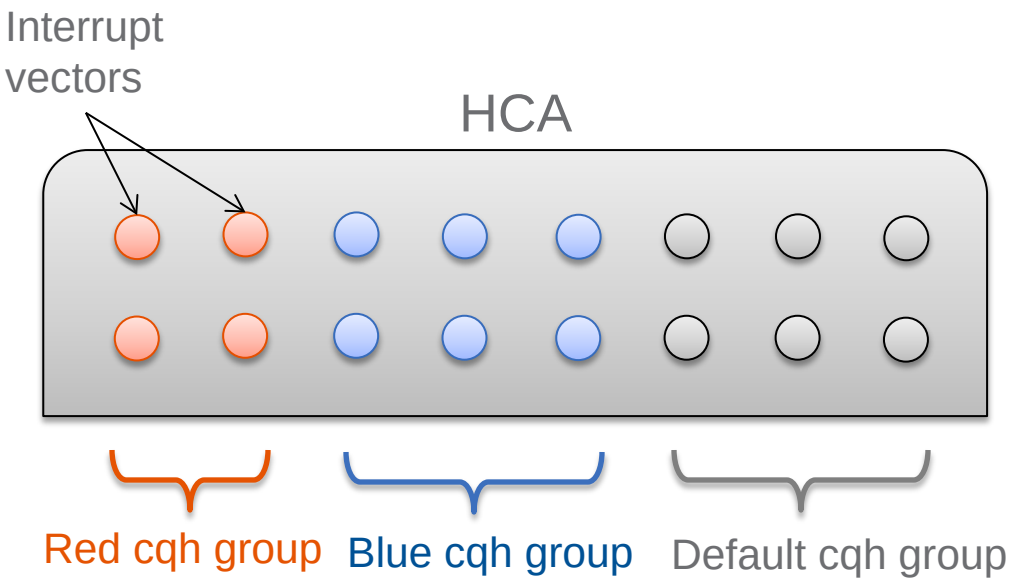
CQ Handler (CQH) Group: Concept



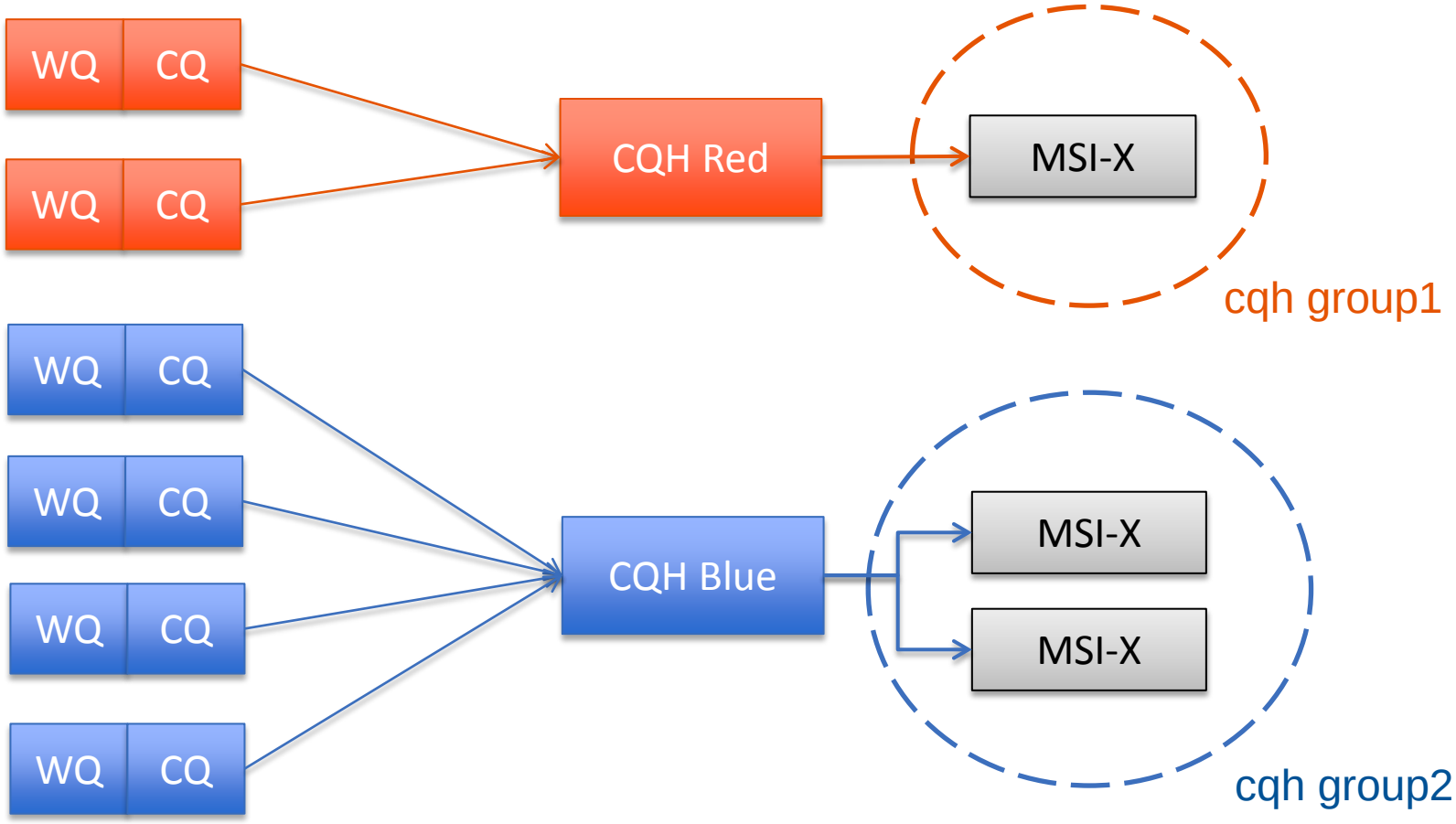
CQ Handler (CQH) Group: Concept



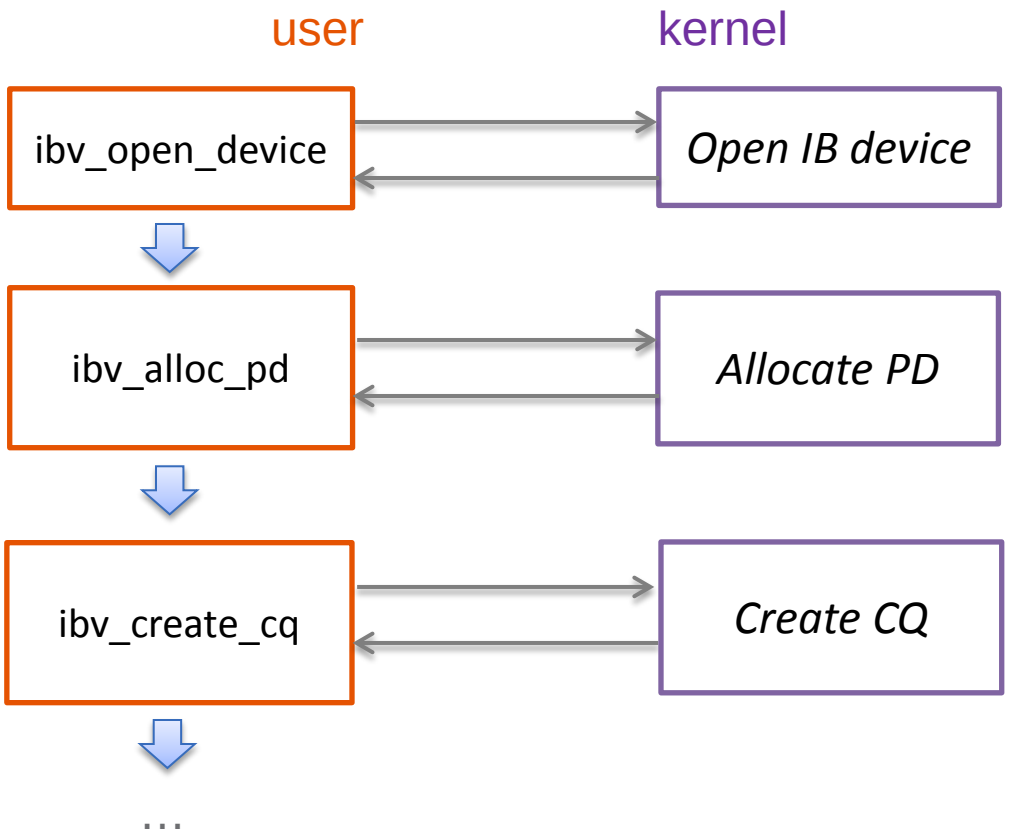
CQ Handler (CQH) Group: Concept



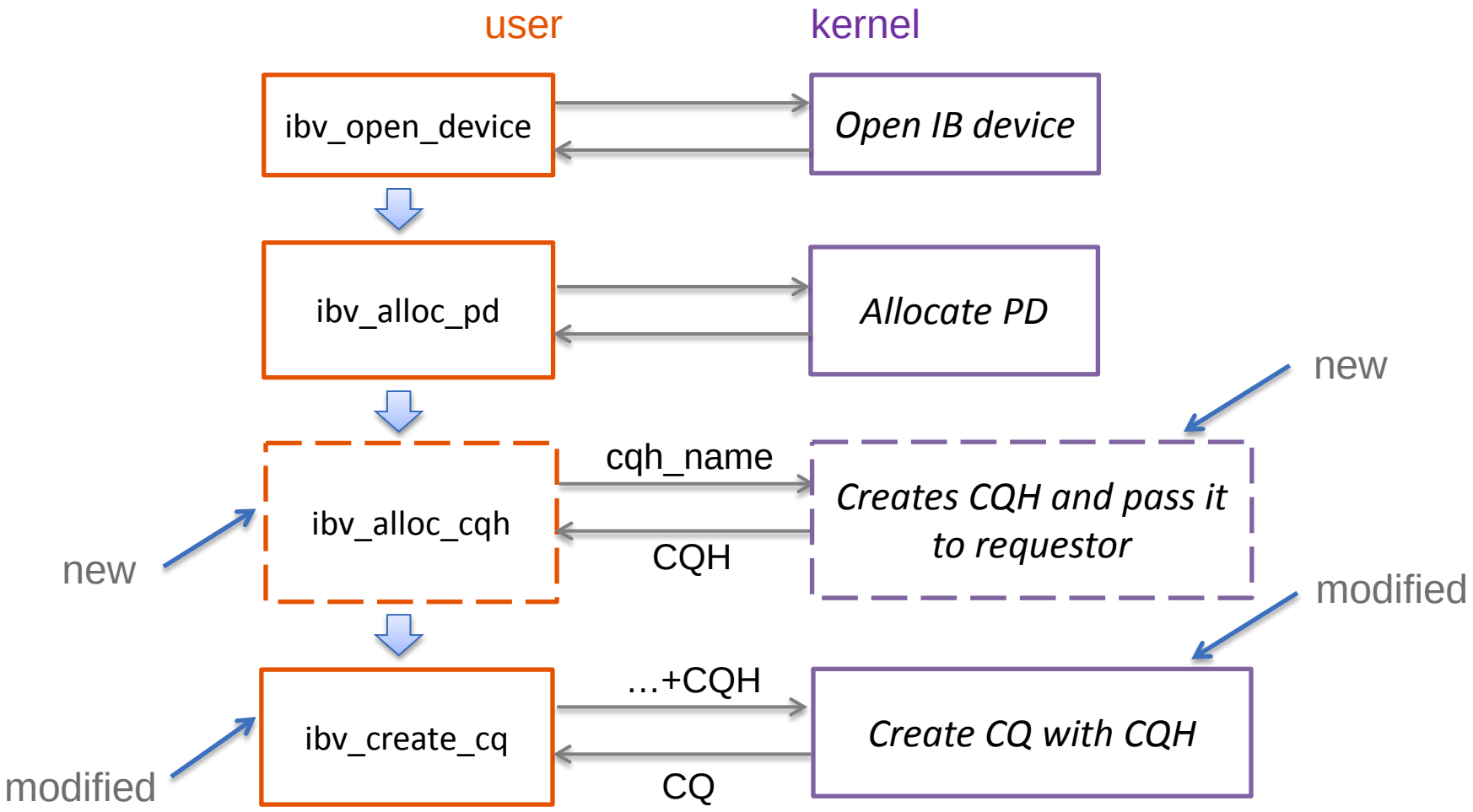
CQ Handler (CQH) Group: Concept



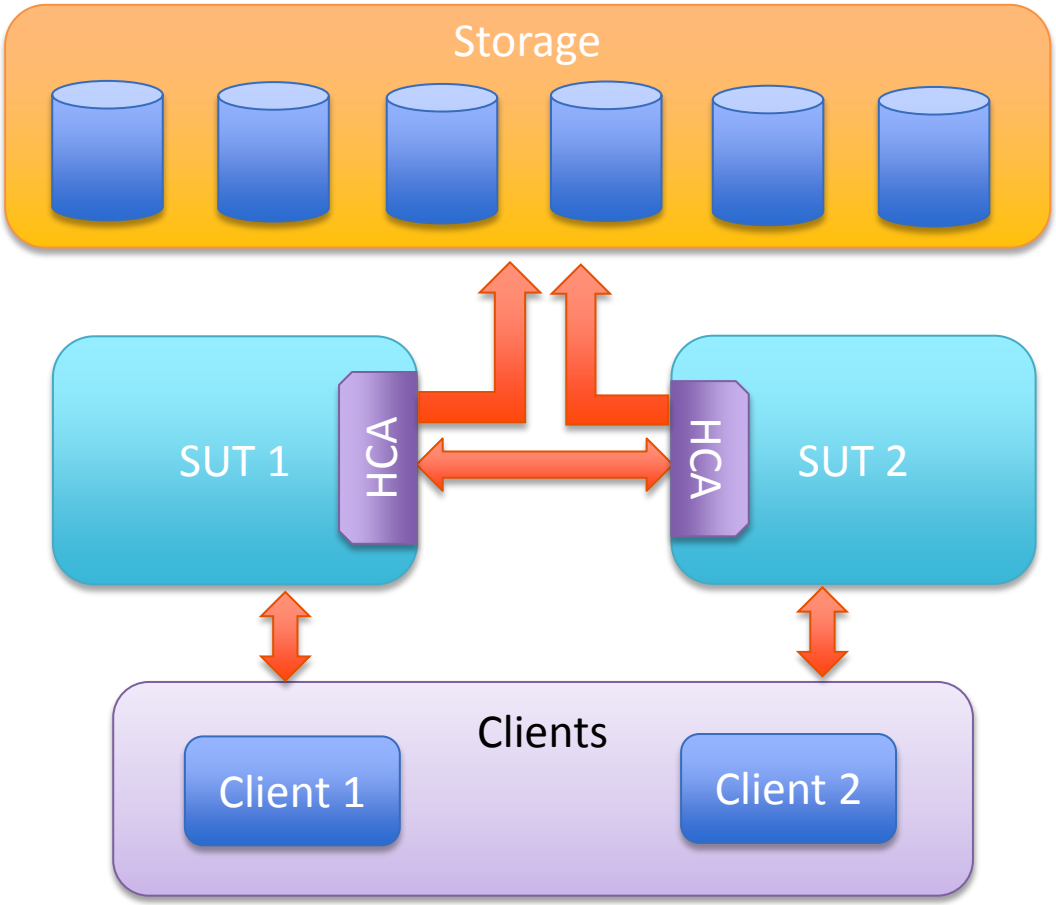
CQH: Implementation



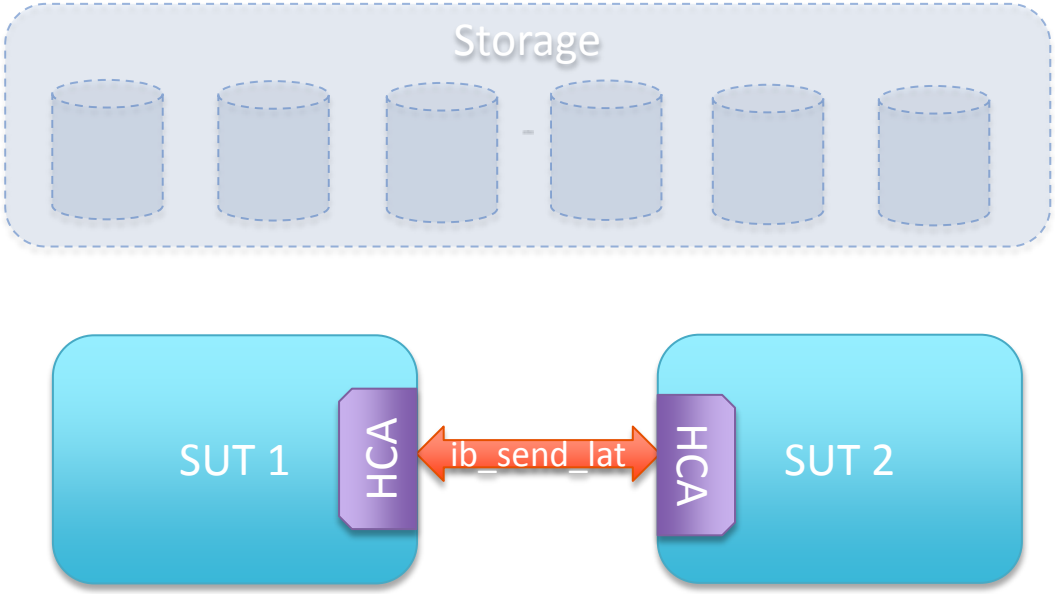
CQH: Implementation



Experiment: Setup

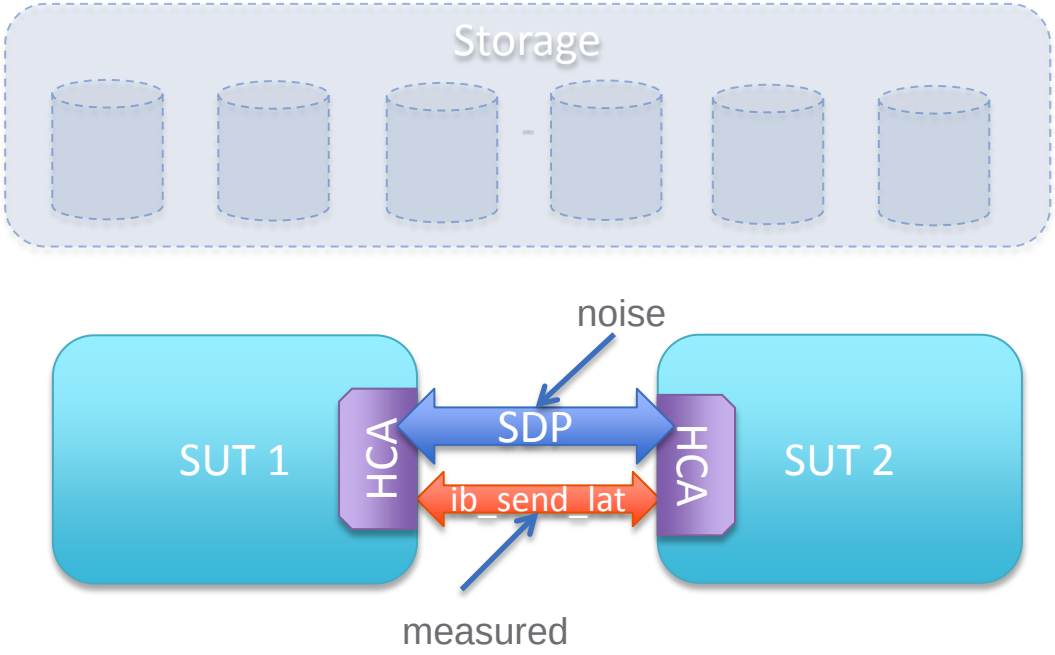


Experiment: ib_send_lat



Baseline (ib_send_lat latency on idle systems).

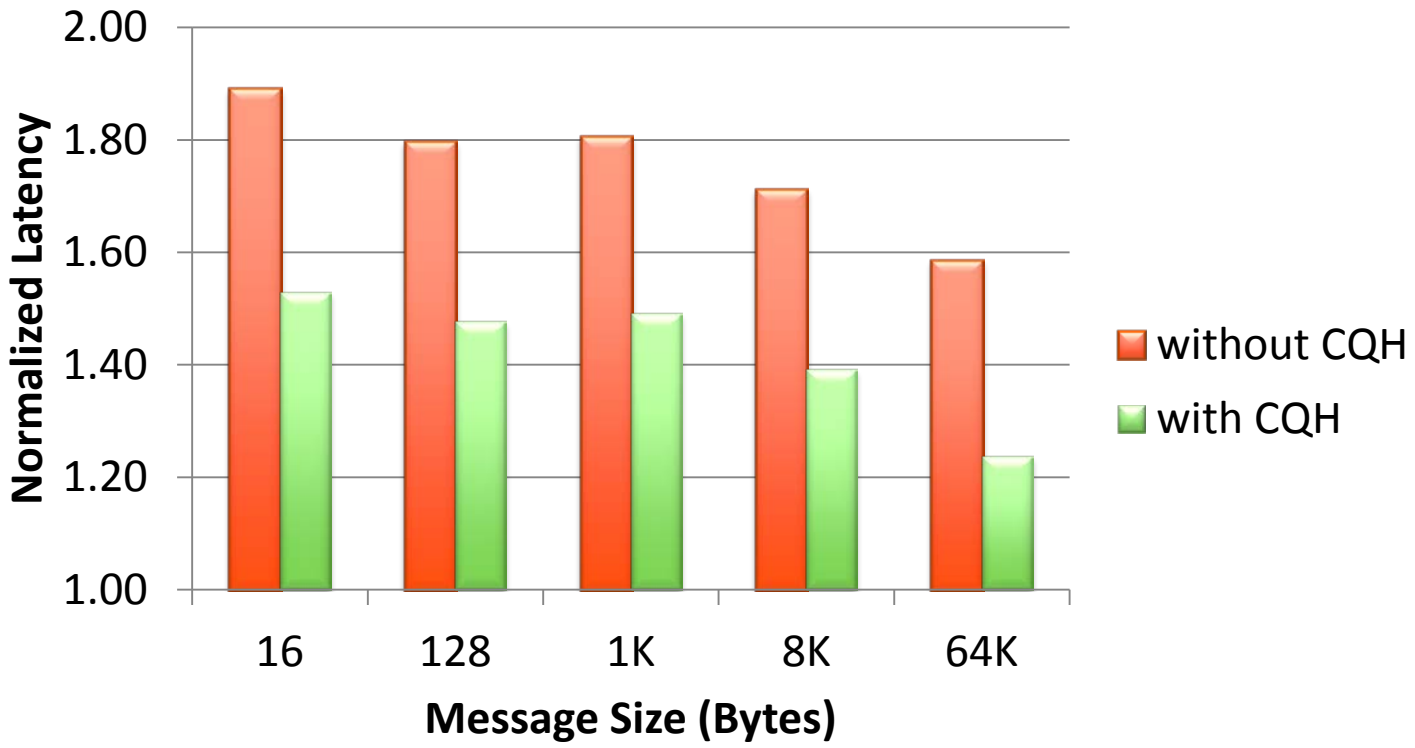
Experiment: ib_send_lat



Latency numbers are normalized to the baseline

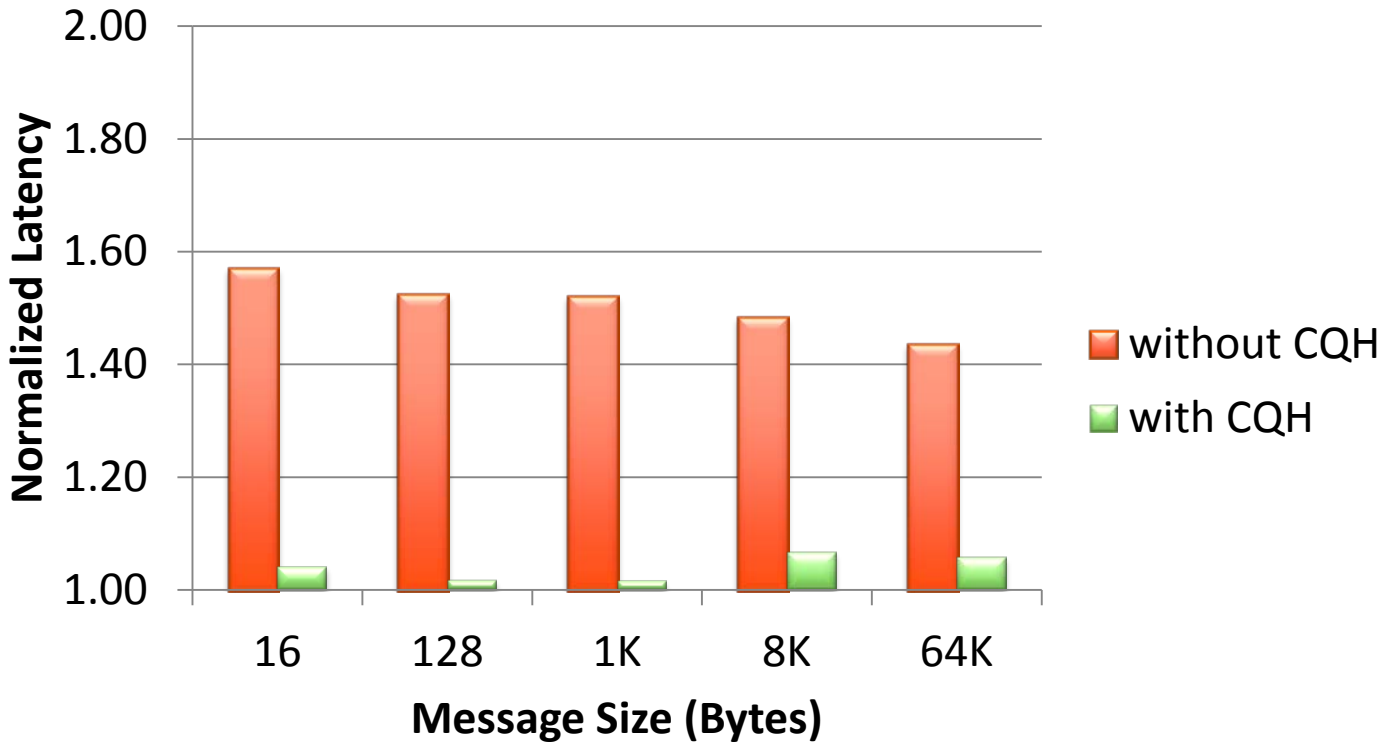
Experiment: ib_send_lat result

- No CPU Binding

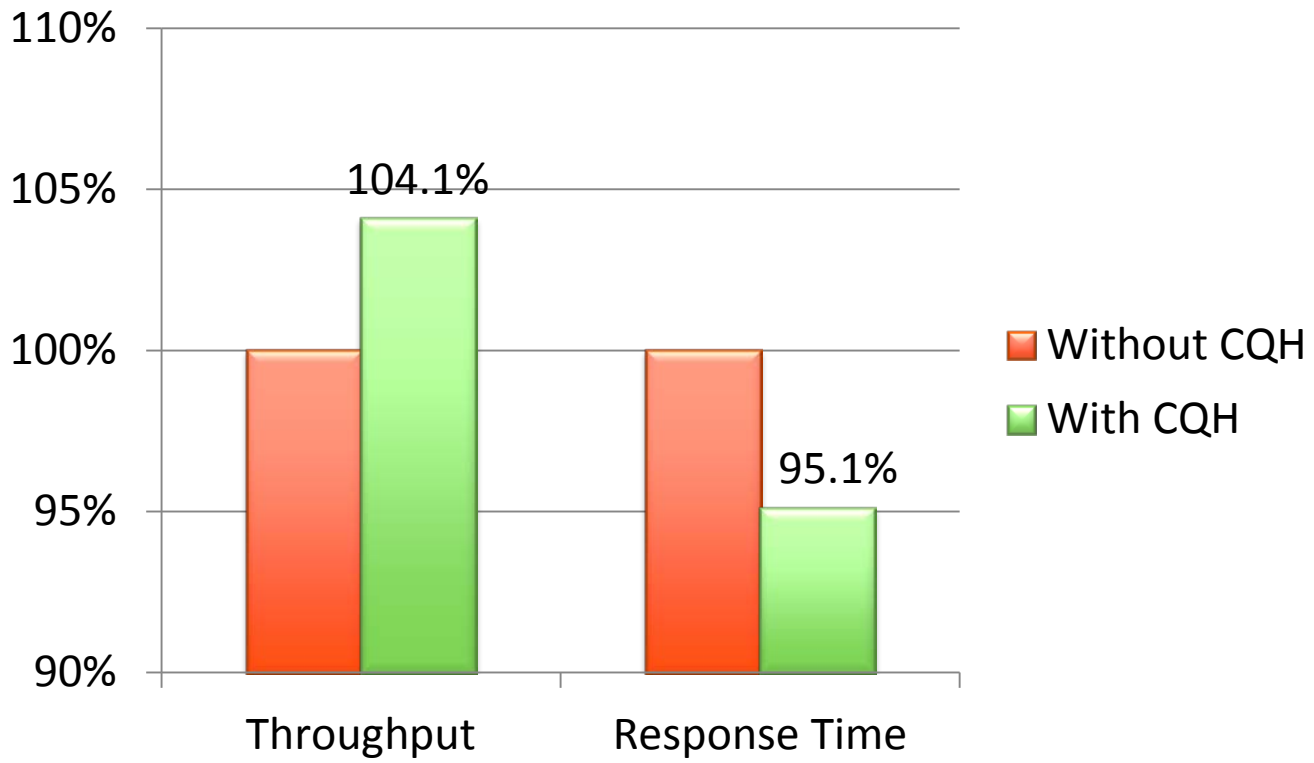


Experiment: ib_send_lat result

- Assign exclusive CPUs to ib_send_lat



Experiment: OLTP result



Conclusion

- CQ handler group is an efficient approach to guarantee QoS and fairness among different types of IO protocols running concurrently on the same IB device.
- Normalized latency improved by ~50% in OFUV u-benchmark when running with 100 QP (connection) SDP
- 4%~5% improvement seen in OLTP benchmark.

Thank You