Diffusion

Anatomy of a high-performance Java server

Philip Aston

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Philip Aston

Product Architect at Push Technology

- paston@pushtechnology.com

Ex-BEA, ex-Oracle

- WebLogic Server / Coherence / Oracle Event Processing
- *Professional Oracle WebLogic Server* (Wrox 2009)
- *J2EE Performance Testing* (Expert Press 2002)

The Grinder

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The Product Slide

Push Technology

- Real-time data distribution for web, mobile, and IoT

Diffusion

- Real-time messaging at scale
- Java server
- Android, iOS/OS X, JavaScript, .NET, C, and Java SDKs

Reappt

- Diffusion As A Service on IBM BlueMix and AppDirect

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What's coming up?

High Performance Broadcast, in Java

Publish and Subscribe

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High Performance Broadcast

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Applied "Mechanical Sympathy"

Martin Thompson

mechanical-sympathy mail list

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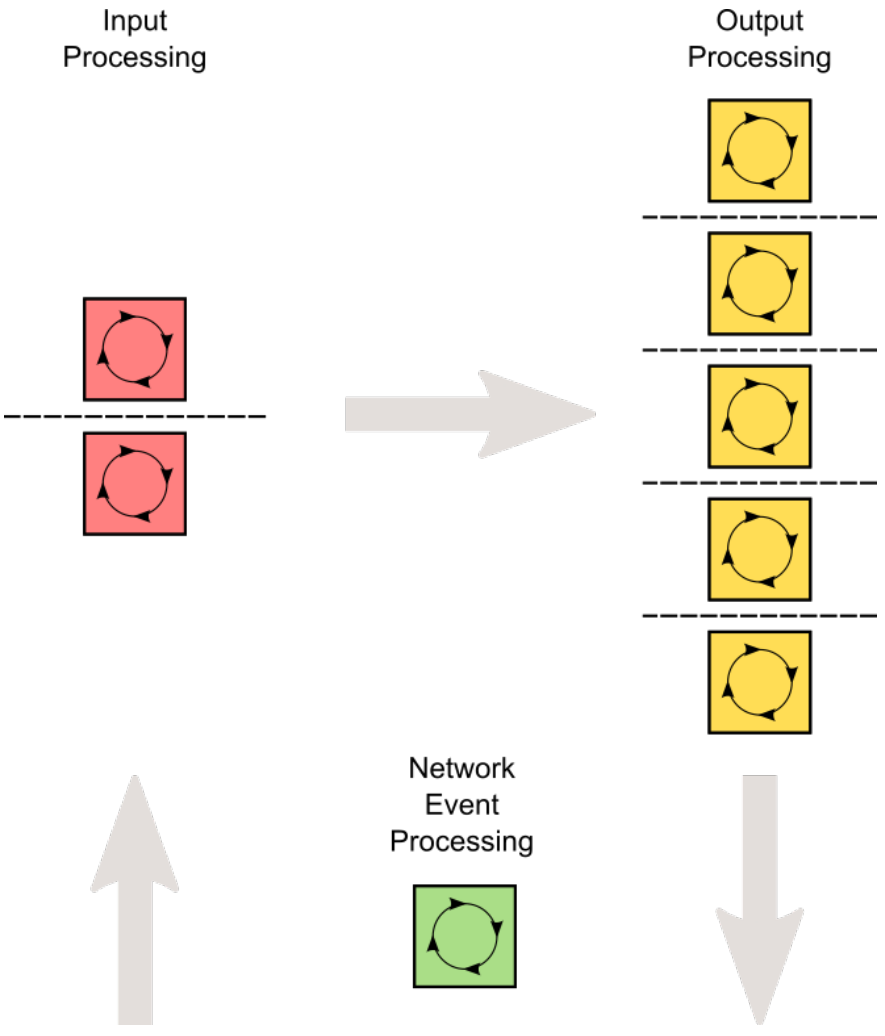
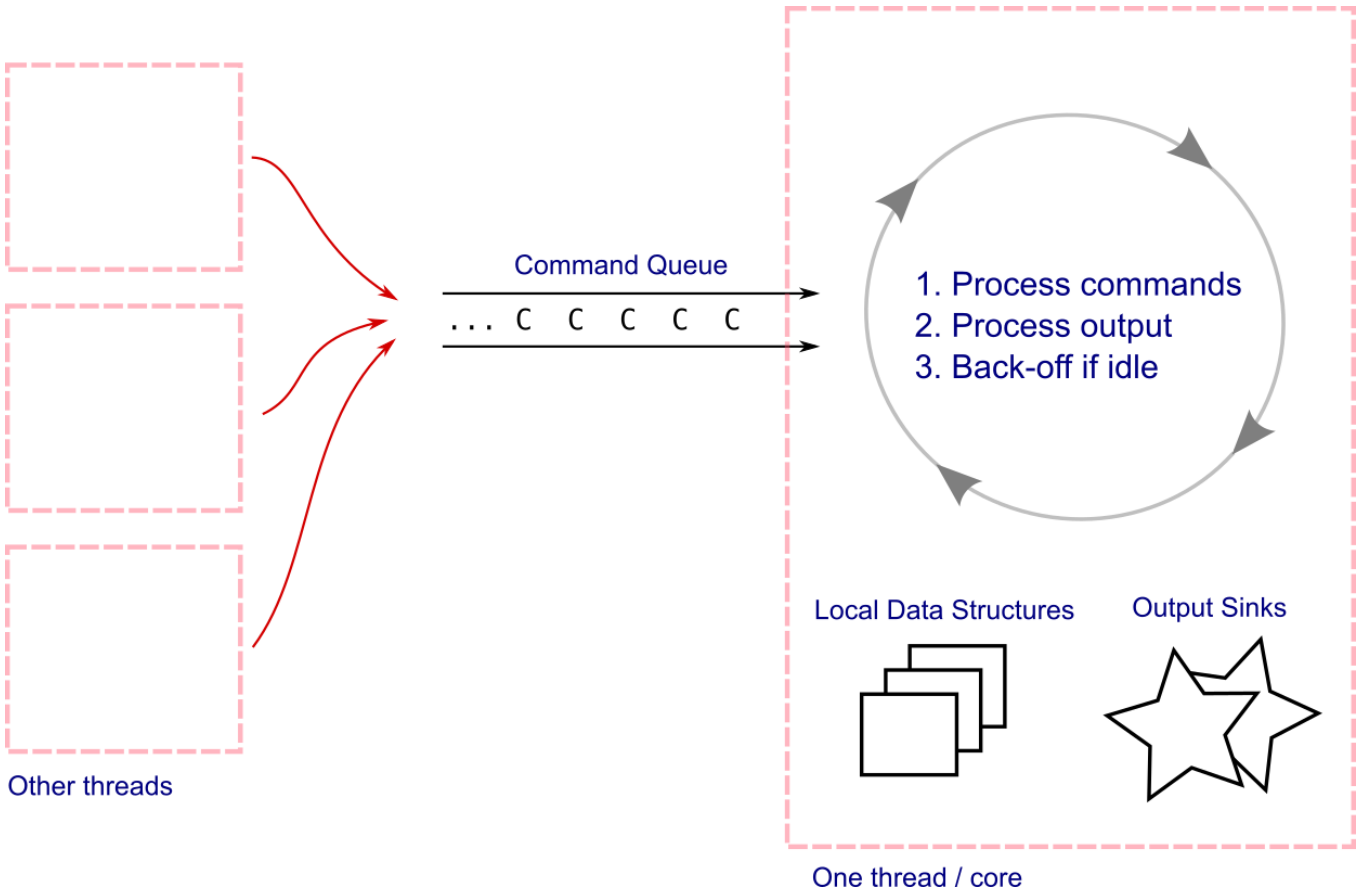
The big picture



Actor - a processing pattern



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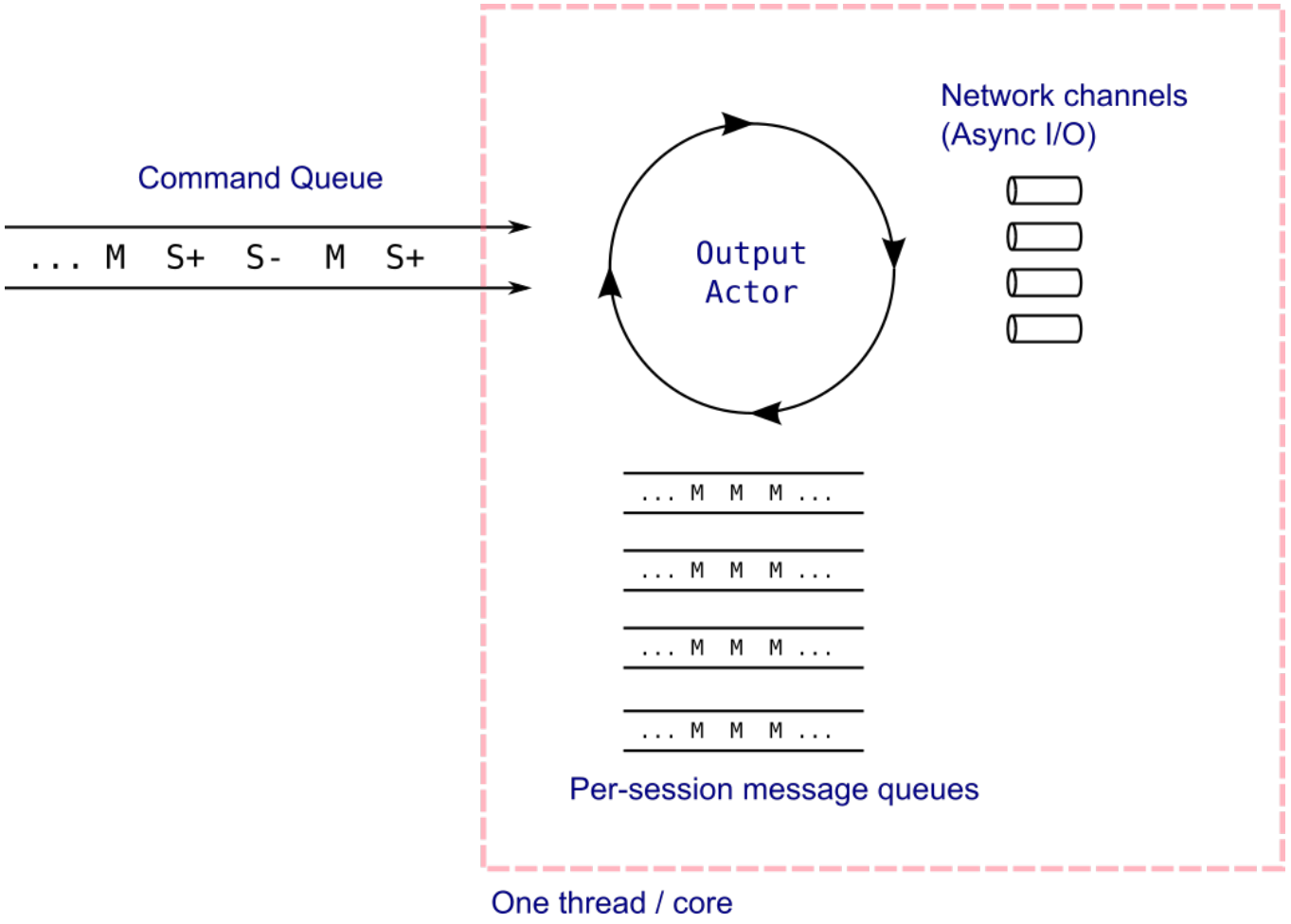
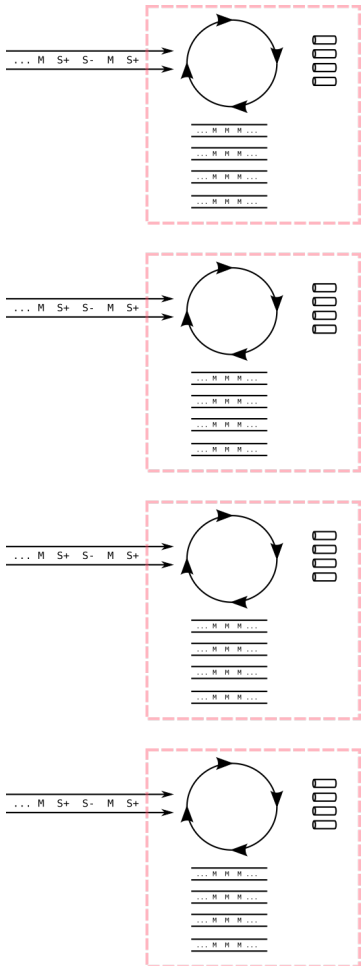
Output processing



Benefits



Simple sequential programming

- Non-thread safe data structures
- Consistent order

Memory hierarchy friendly

- Hot threads bound to single cores
- Thread-exclusive data structures

Parallel

- Scales across cores and sockets
- Pipelining

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Java NIO Constraints

Selector

- Selected key set is not thread-safe
- Easiest if registration for `CONNECT`, `ACCEPT`, `READ`, `WRITE`, and close all occur on a single thread

Channel

- For consistent, ordered processing
  - Read from single thread
  - Write from a single thread

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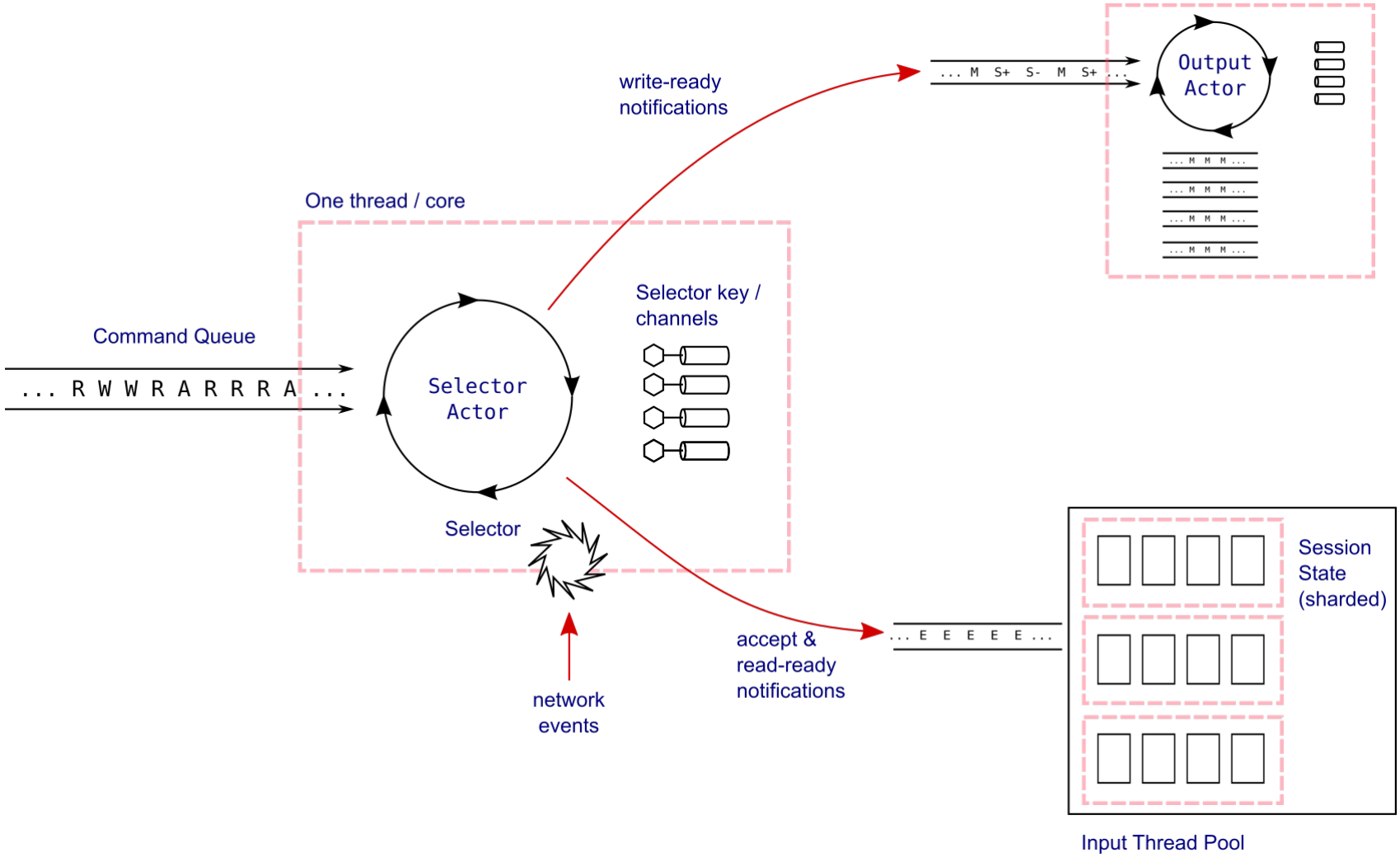
Selector Actor



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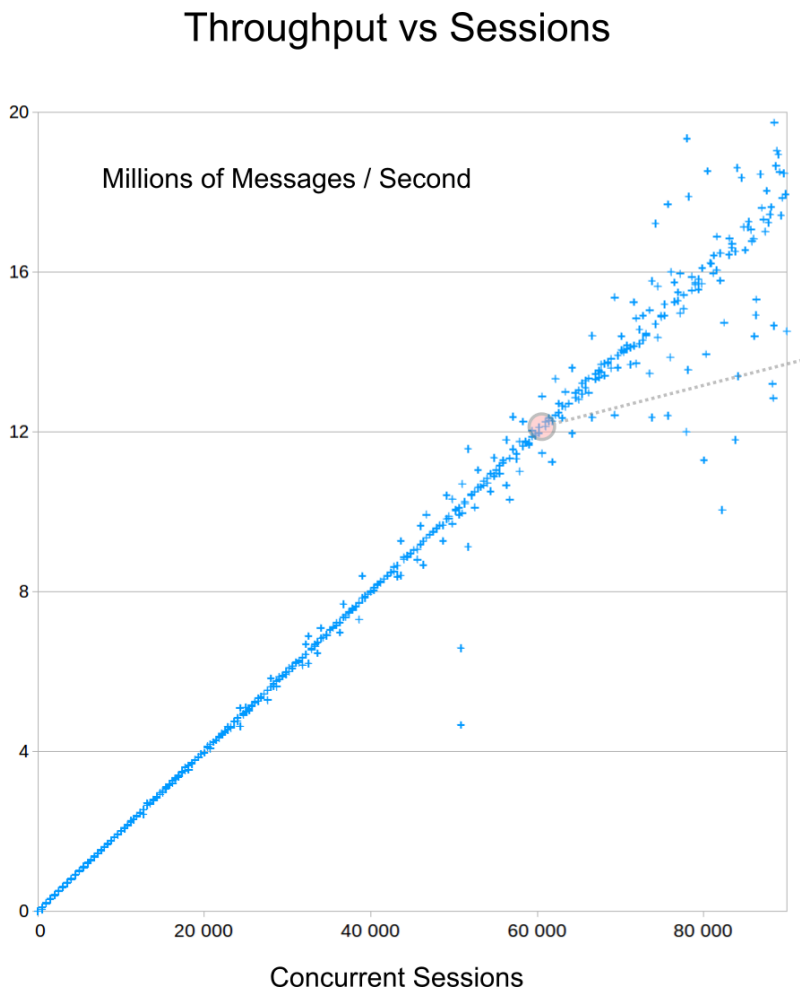
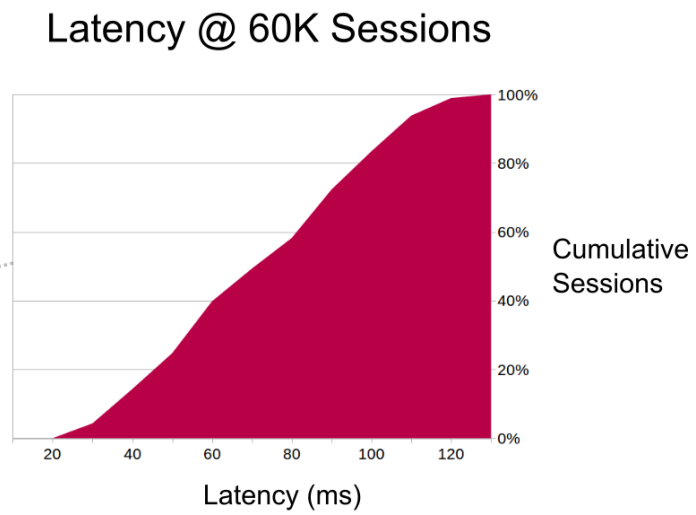
Benchmark results





Dell Power Edge R720
Dual socket Xeon E5-2630 6-core hyper-threaded
32GB RAM
10G network interface

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Inter-thread communication

Choosing a concurrent, in-memory queue

JDK options don't cut it

- `ArrayBlockingQueue`
  - Single lock synchronises producers and consumers
- `ConcurrentLinkedQueue`
  - allocates for each `offer`
  - is unbounded

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JCTools

Nitsan Wakart

- PsyLobSaw blog
- JCTools

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JCTools

`MpscArrayQueue`

- Multi-producer, single consumer, bounded queue
- Lock-free

Details

- Separate consumer and producer fields
  - False sharing avoidance
  - Optimised memory barriers
- Producers use CAS to update fields
- Consumer uses *Fast Flow* method

See Lock Free Queues or Queue Evolution: from 10M to 470M ops/sec for much more.

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Publish and Subscribe

Diffusion pub/sub - it's different

1. Value-based interface
   - Developers focus on application data, not messages
   - SDKs provide idiomatic native API
2. Stateful topics - the *inverted data grid*
   - The server maintains current value for each topic
   - Clients synchronised with topic value on subscription
   - Deltas follow
3. Interest-based subscription
   - Clients provide topic selectors
   - Server matches selectors against topics and authorisation

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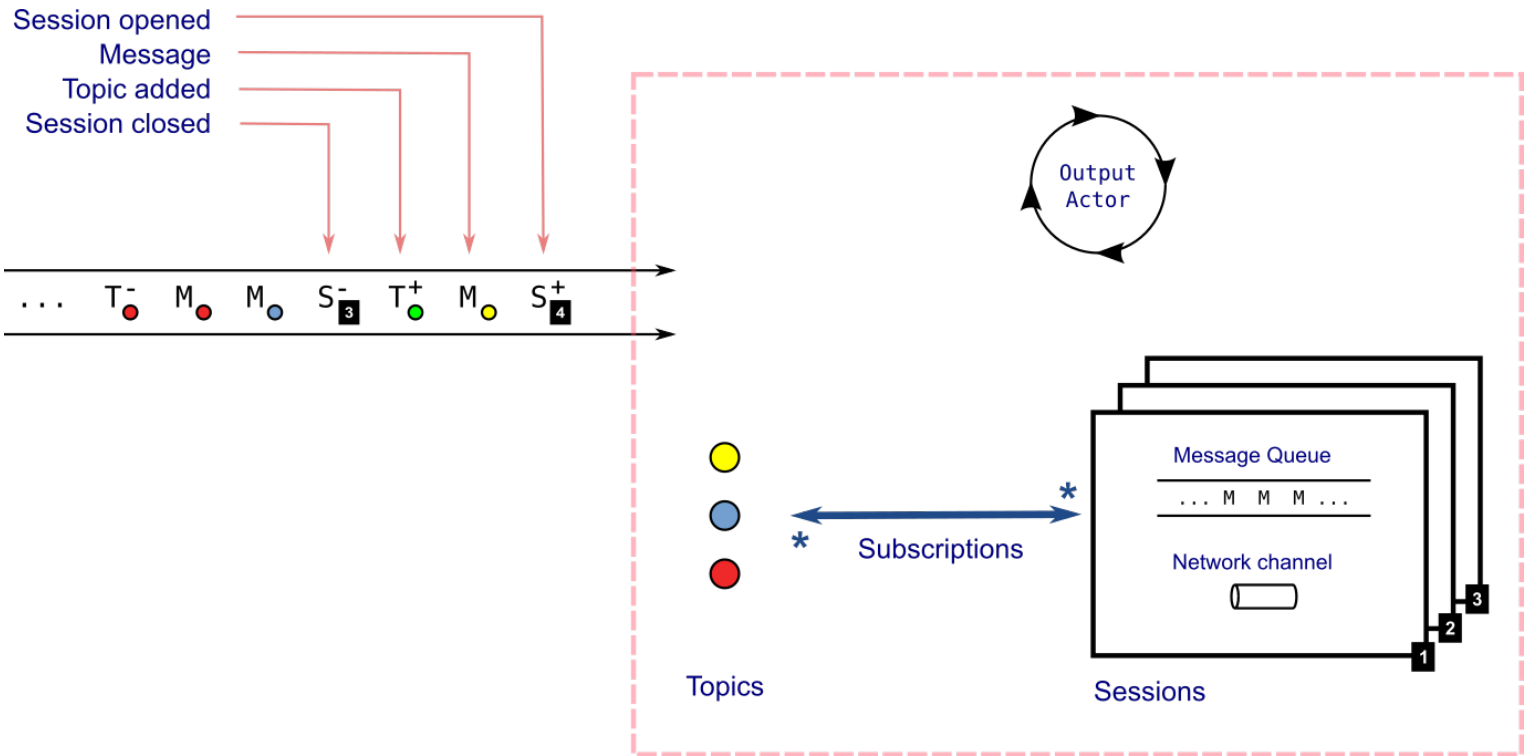
Subscriptions



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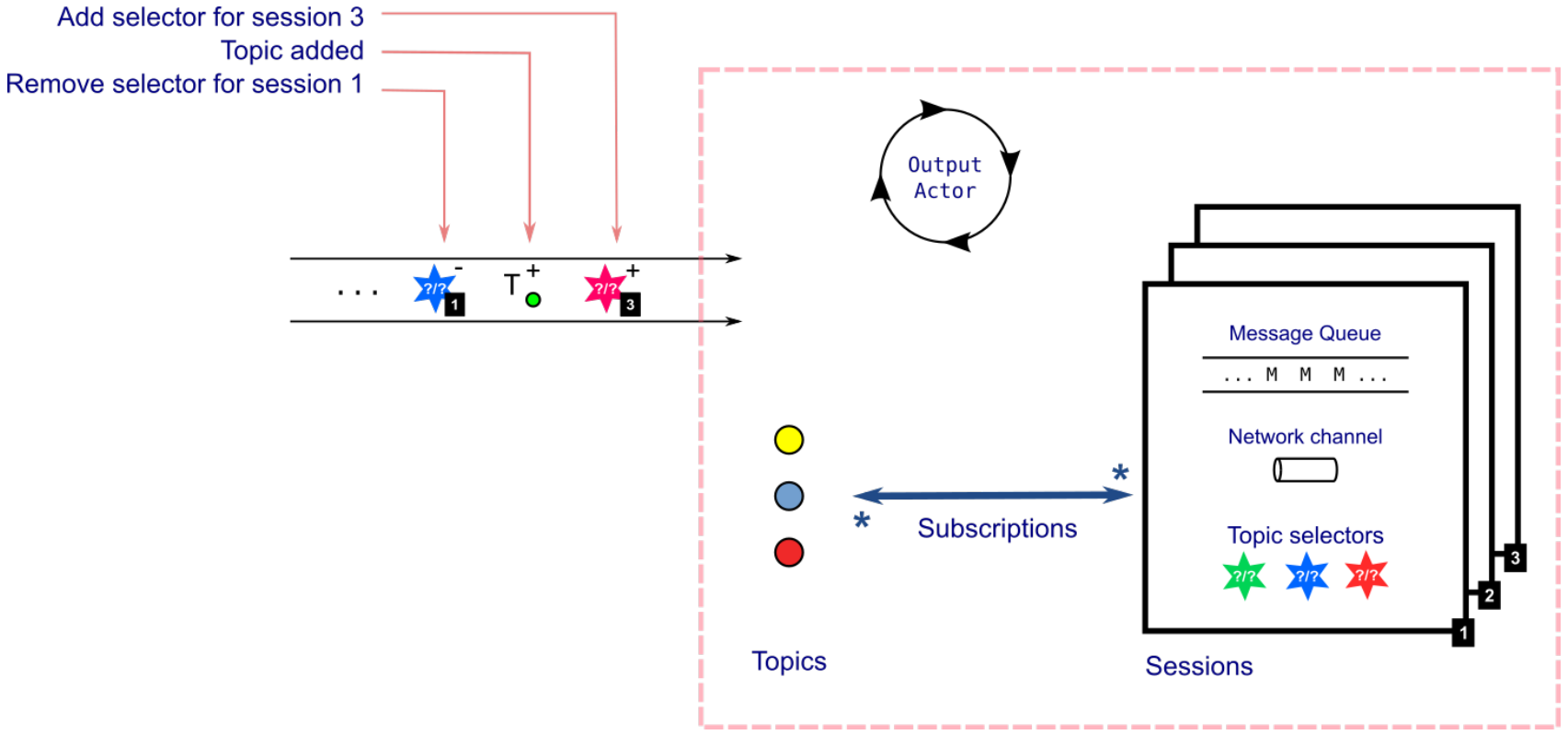
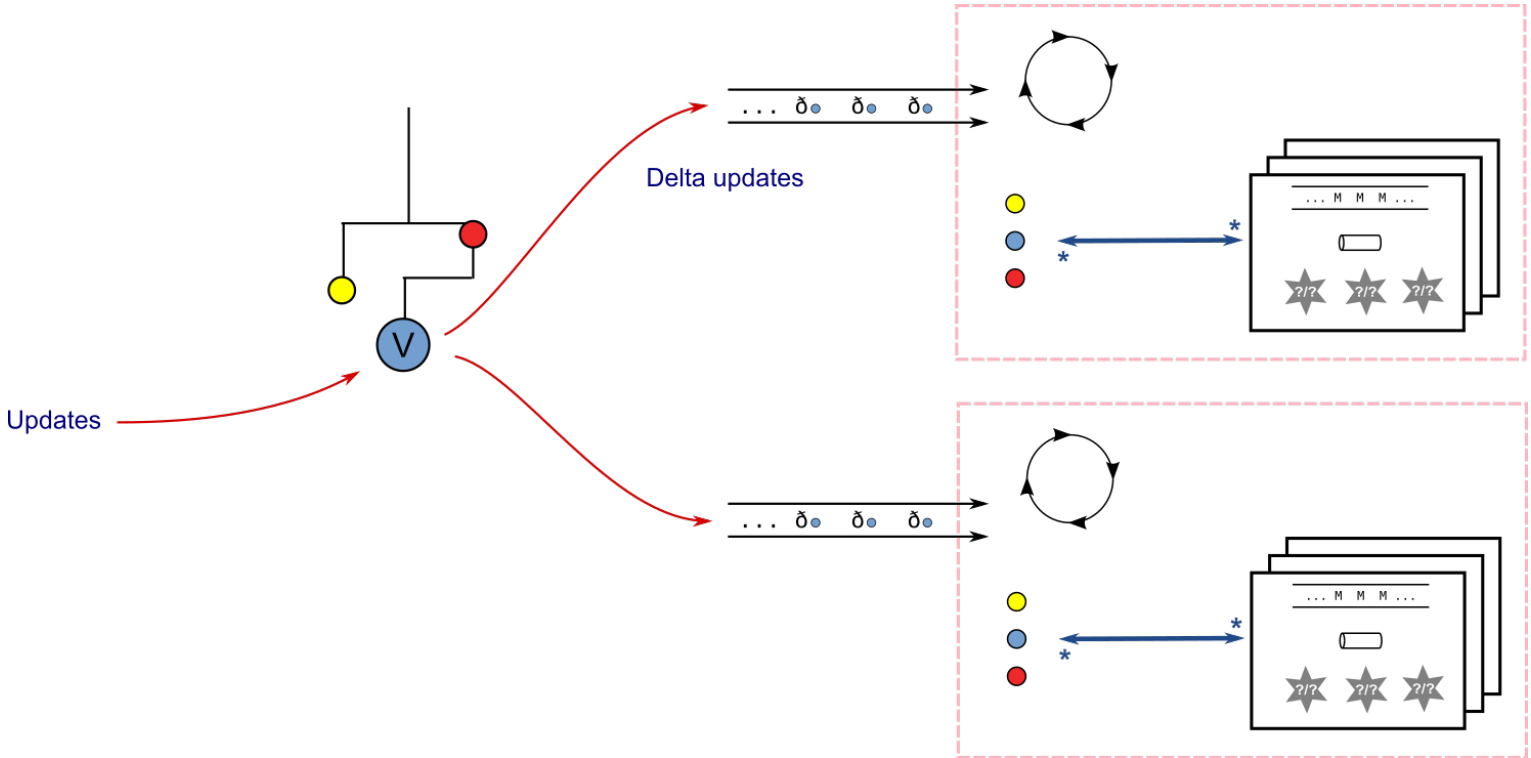
Matching

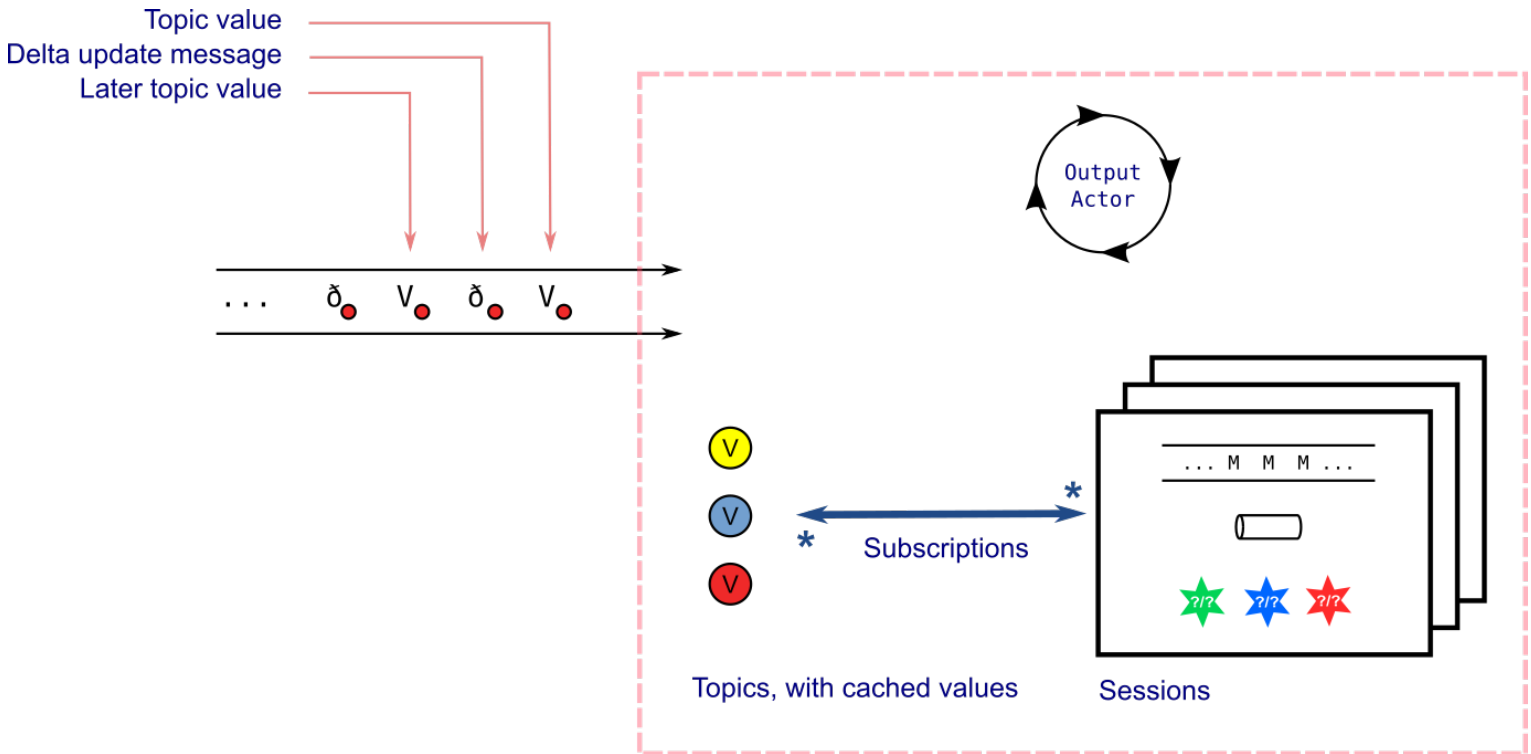


Streaming updates



- Server is streaming deltas to subscribers
- But a new subscription needs the current value???

Latest value caching



Take aways

1. Event-oriented / non-blocking throughout
2. Threads aligned to processing flow
   - Separate input and output processing
   - Minimal inter-thread communication via queues
3. Thread-excluisive data
   - Sessions partitioned across threads
   - Processing batched where possible
   - Global state shared as immutable snapshots

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Thank you - Any Questions?

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