

HOW TO DESIGN & IMPLEMENT A MODERN COMMUNICATION MIDDLEWARE BASED ON ØMQ

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- Networking library & concurrency framework
- Simple socket style API
- Supports inter-thread, inter-process and inter-host
- Provides several socket patterns
- Fast & scalable
- Open source (currently LGPLv3 but moving to MPLV2)

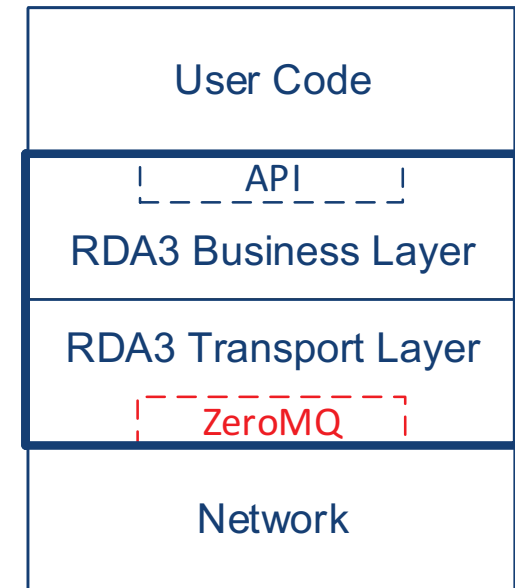
A. Dworak *et al.*, "Middleware trends and market leaders 2011", ICALEPCS 2011.
<http://cern.ch/go/G9RC>

RDA - Remote Device Access

RDA2	RDA3
CORBA based	ZeroMQ based
Few unit/integration tests • Big Ball of Mud	Test Driven Development (TDD) • Clean, maintainable code
Non-Scalable by design • Synchronous & Locks • Array call	Scalable by design • Asynchronous & Lock-Free • ZeroMQ batching
API issues • Singletons • API exposes raw C++ pointers	Modern API • No singletons • API exposes smart C++ pointers

RDA3 architectural overview

- Transport Layer
 - Abstraction of underlying network library
- Business Layer
 - Agnostic of network library
 - Implements the device-property model
 - Request/Reply: *Get* (read) and *Set* (write)
 - Publish/Subscribe

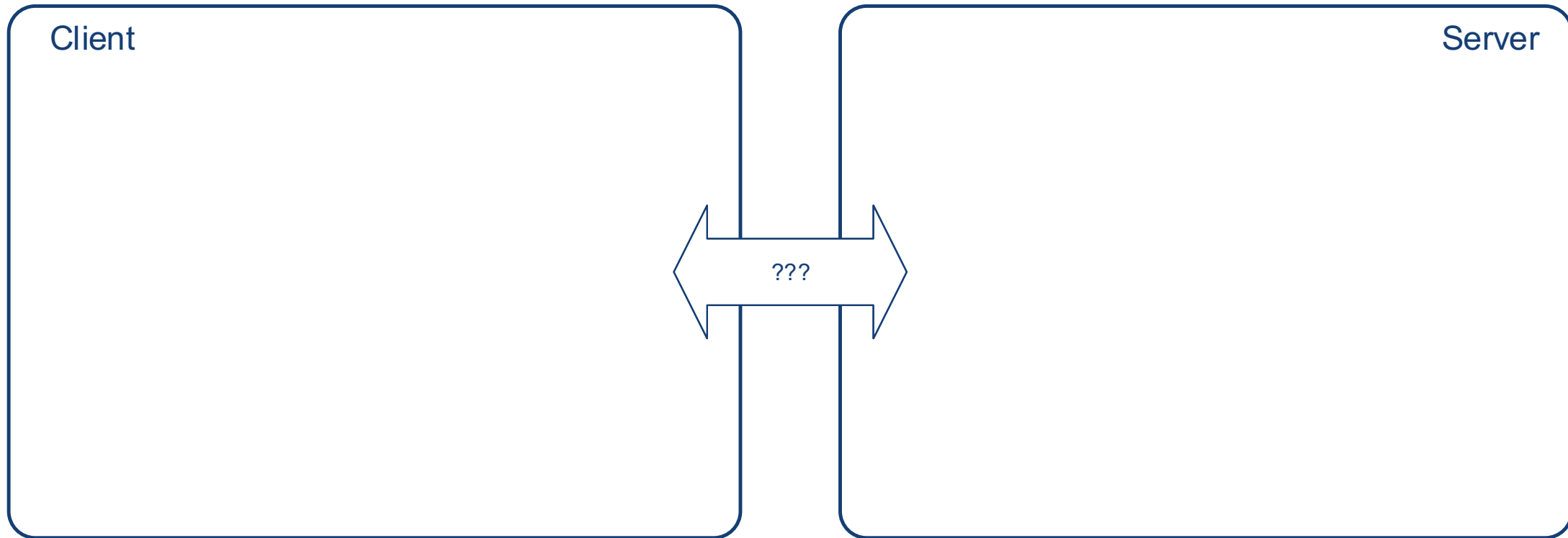


N. Trofimov *et al.*, “Remote Device Access in the new CERN Accelerator Controls middleware”,
ICALEPCS 2001.

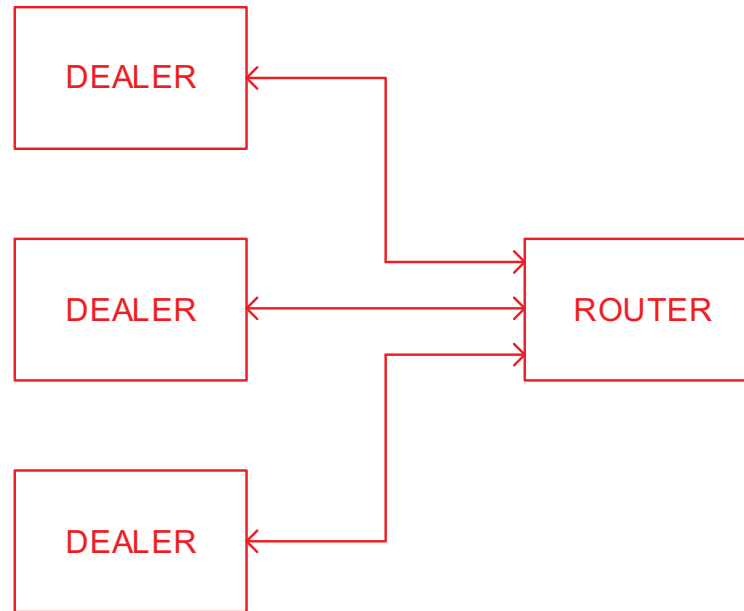
<http://cern.ch/go/9MSk>

Client-server communication

— RDA3
— User
— ZeroMQ



ZeroMQ DEALER/ROUTER pattern



Client-server communication

— RDA3
— User
— ZeroMQ

Client

Server

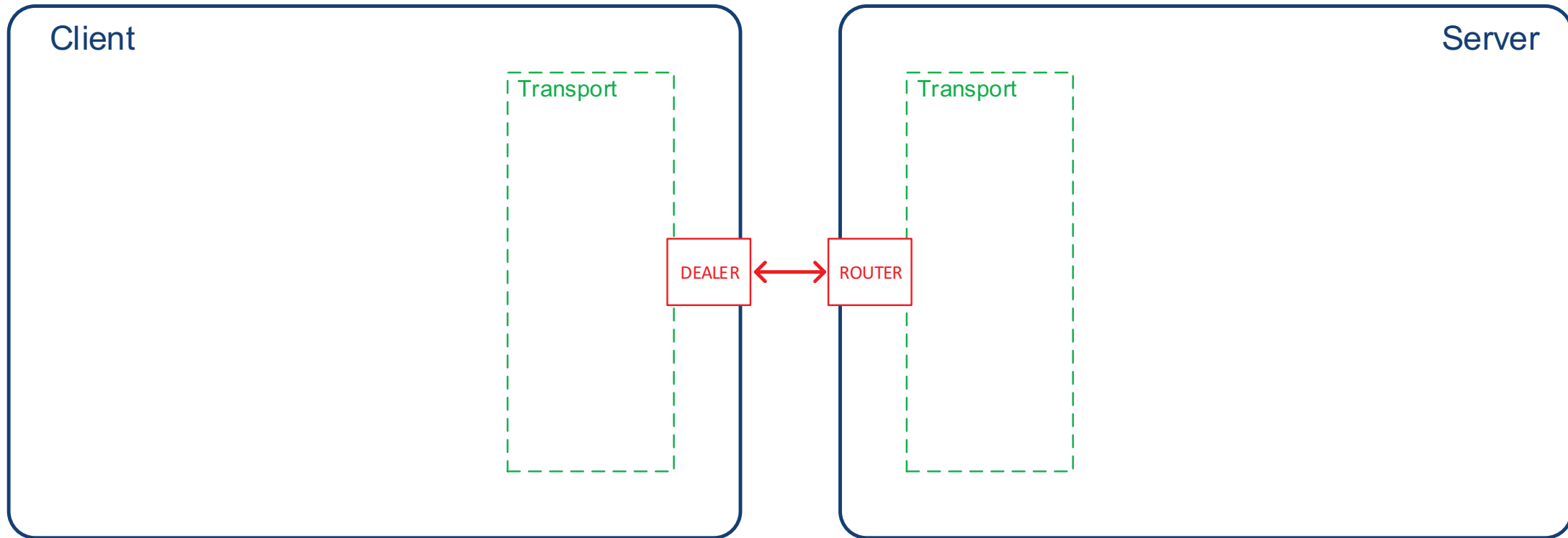
DEALER



ROUTER

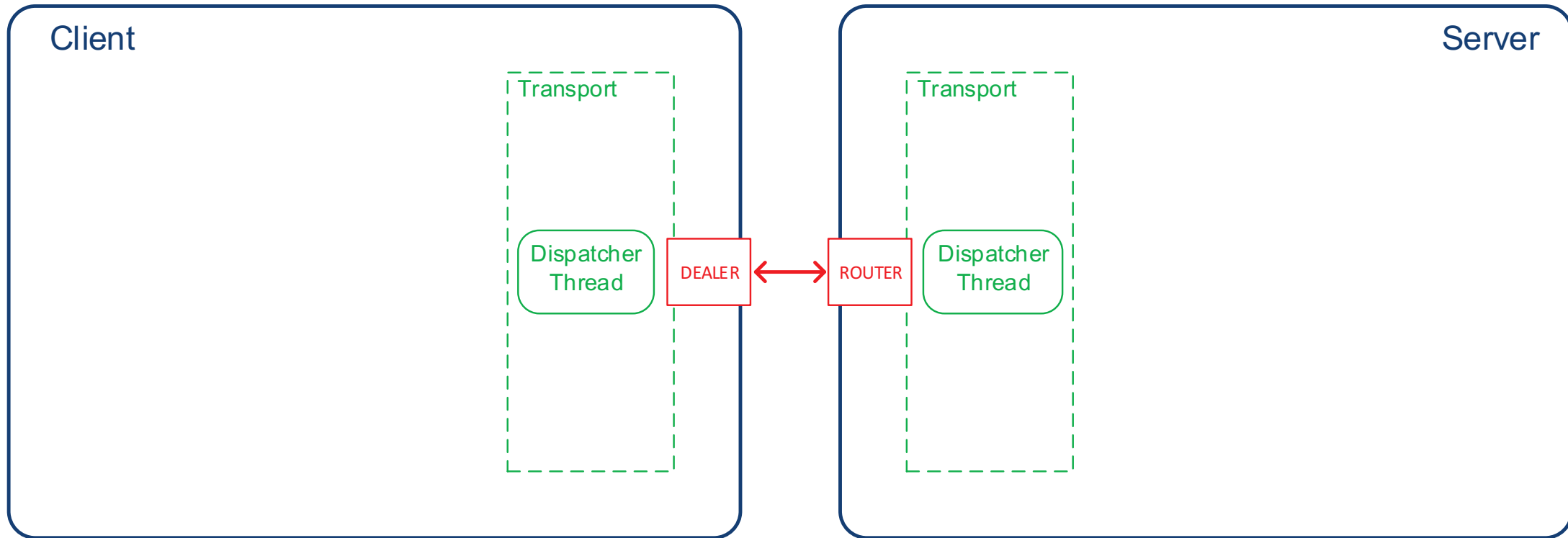
Transport layer

— RDA3
— User
— ZeroMQ

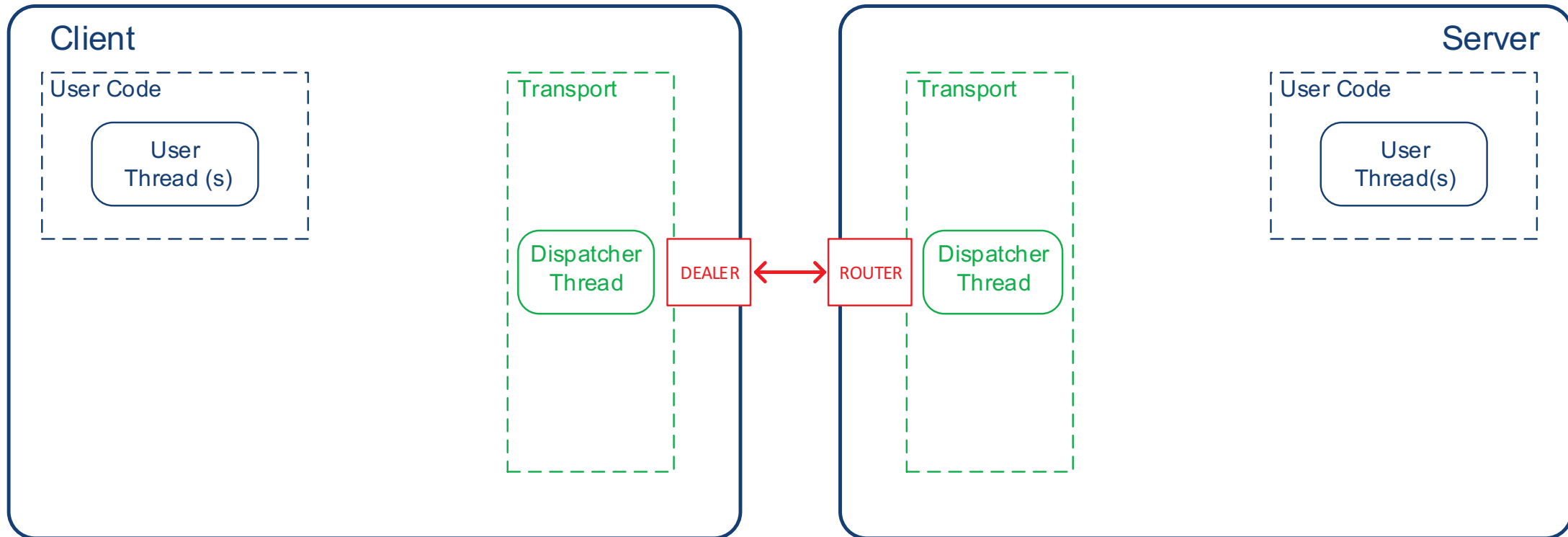
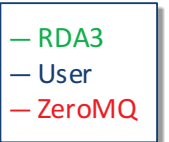


Transport layer

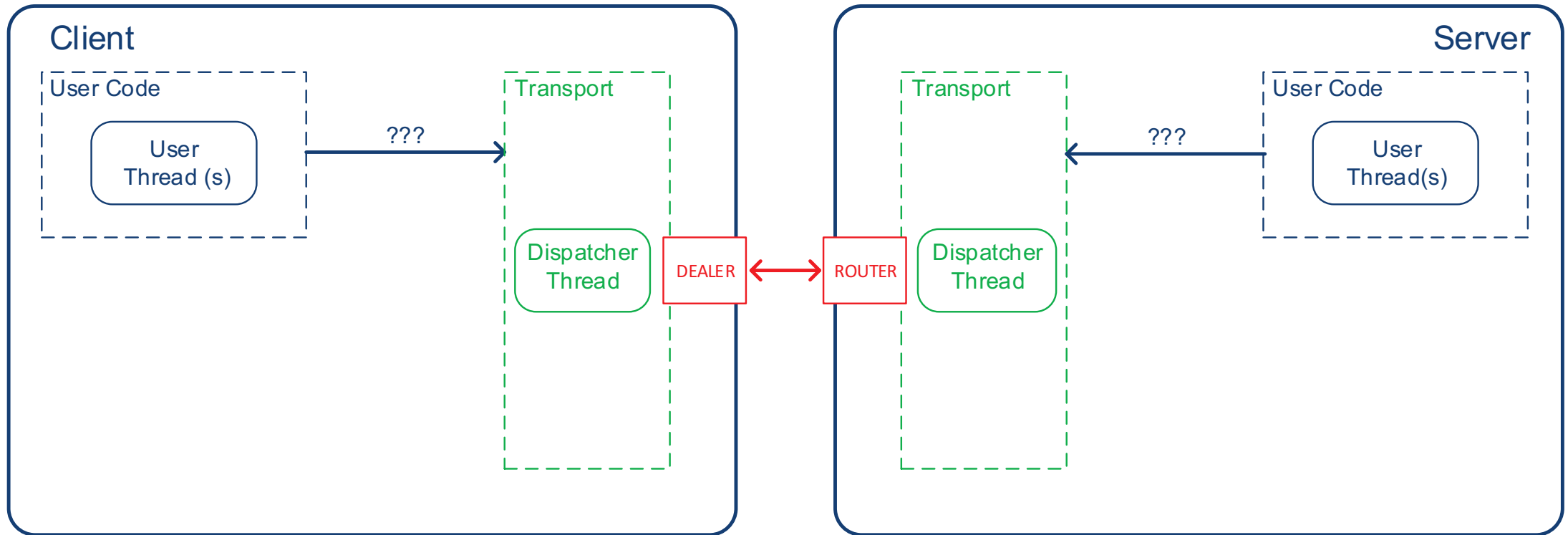
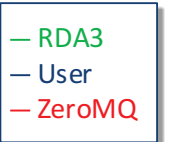
— RDA3
— User
— ZeroMQ



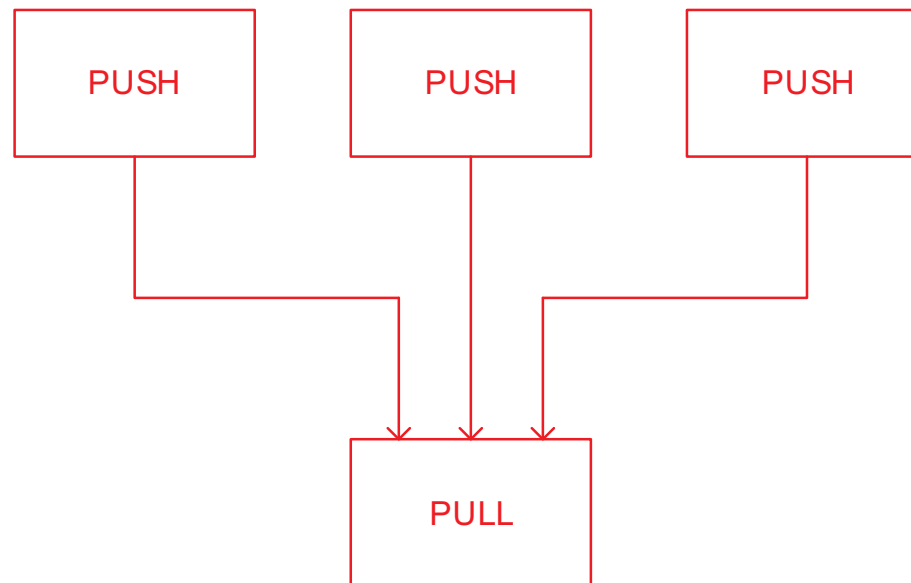
User layer



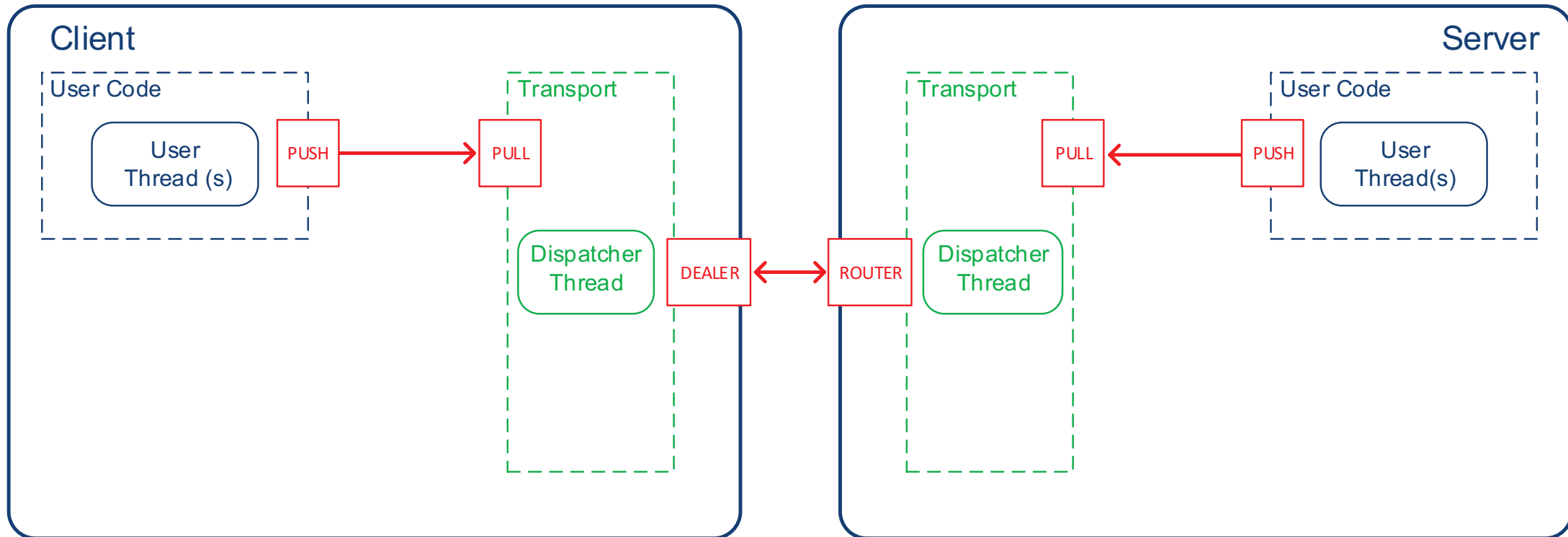
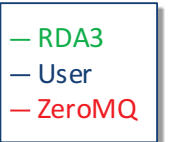
User layer



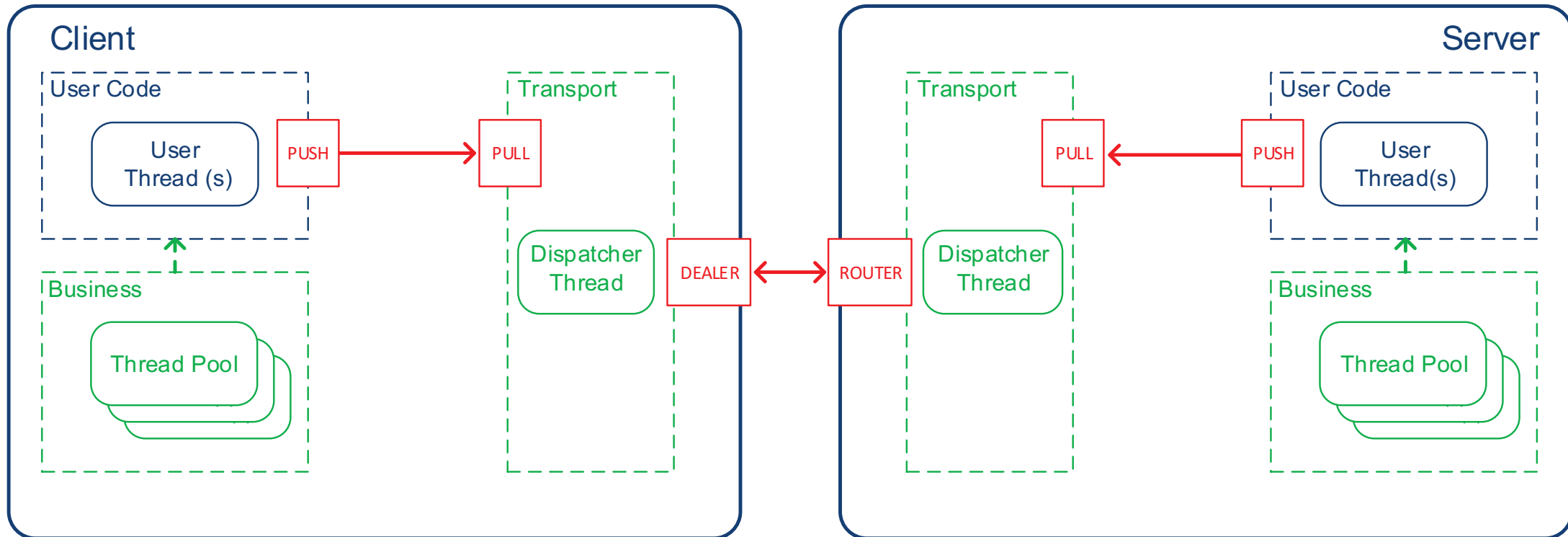
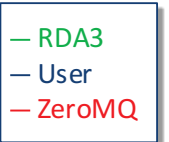
ZeroMQ PUSH/PULL pattern



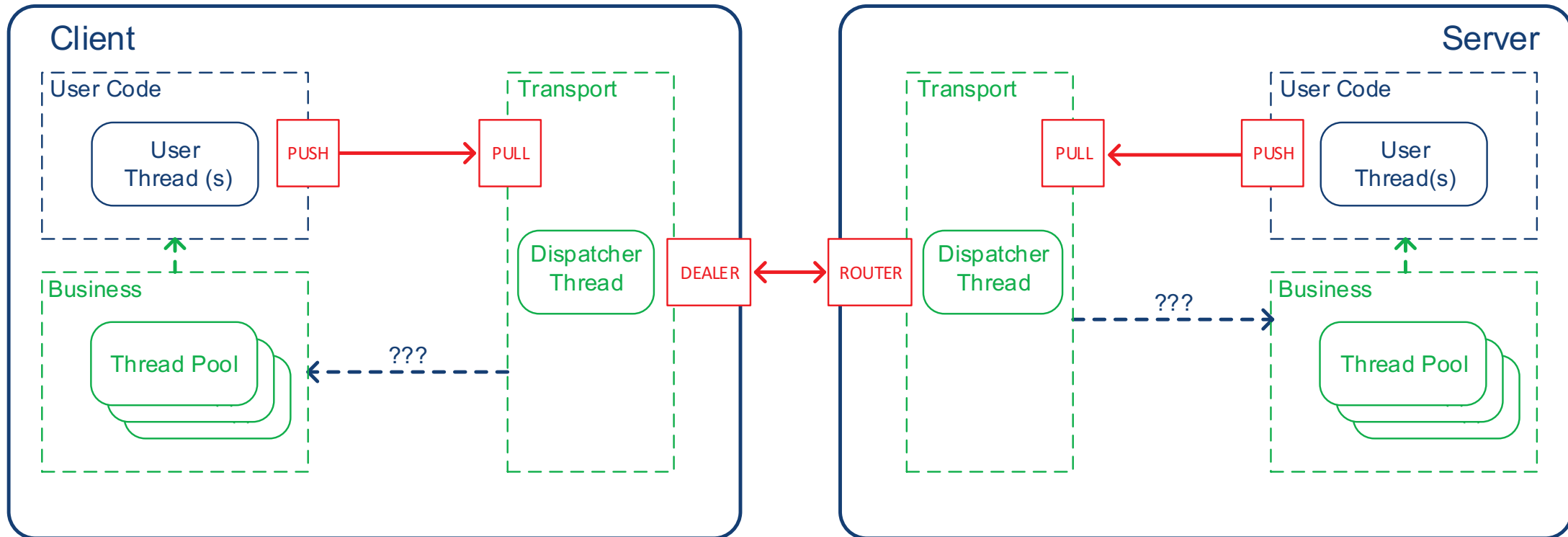
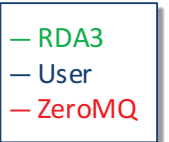
User layer



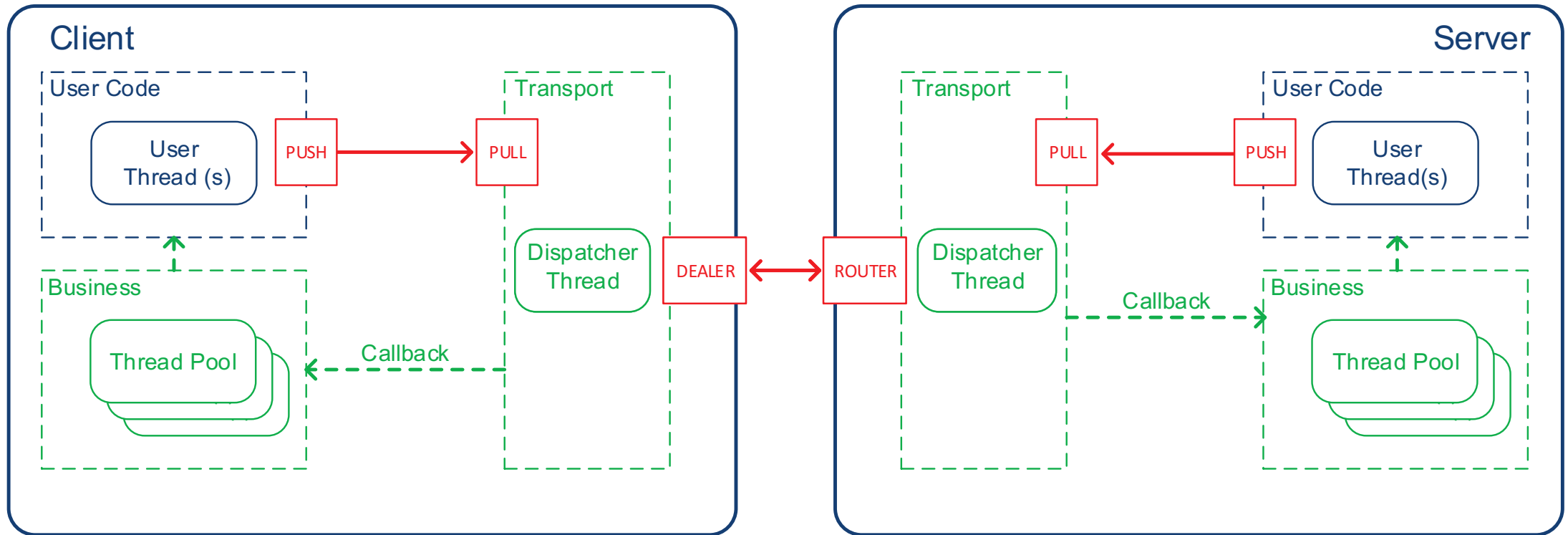
Business layer



Business layer

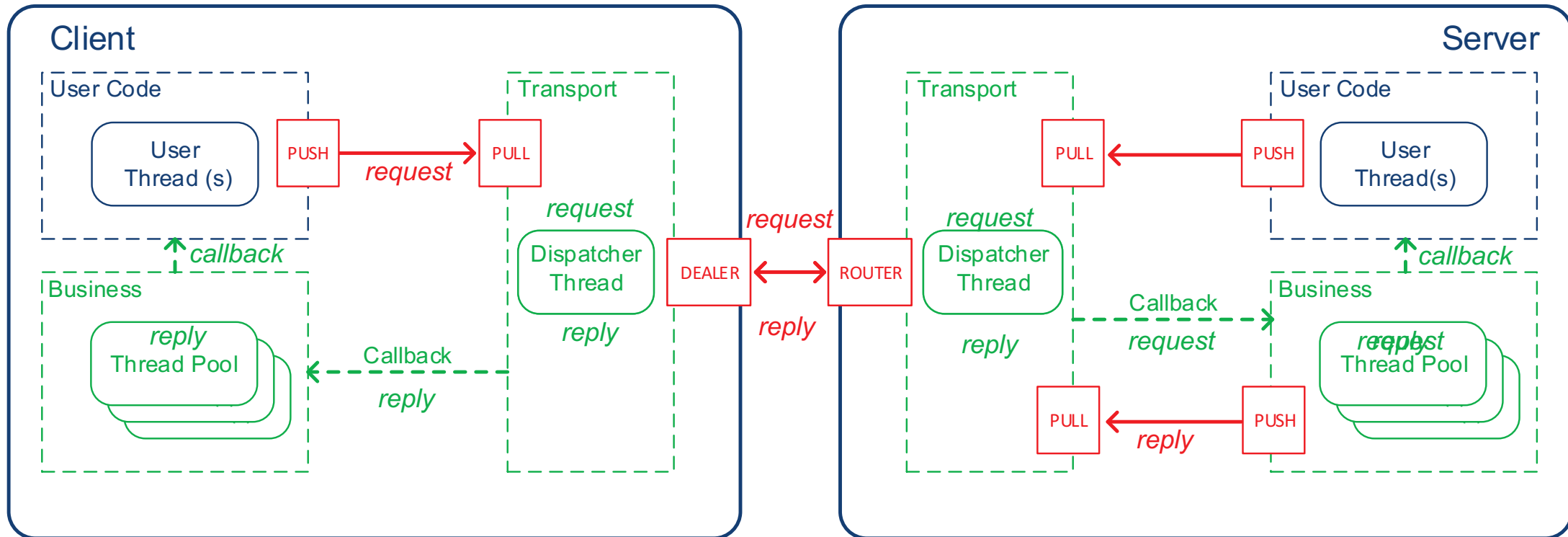


Business layer

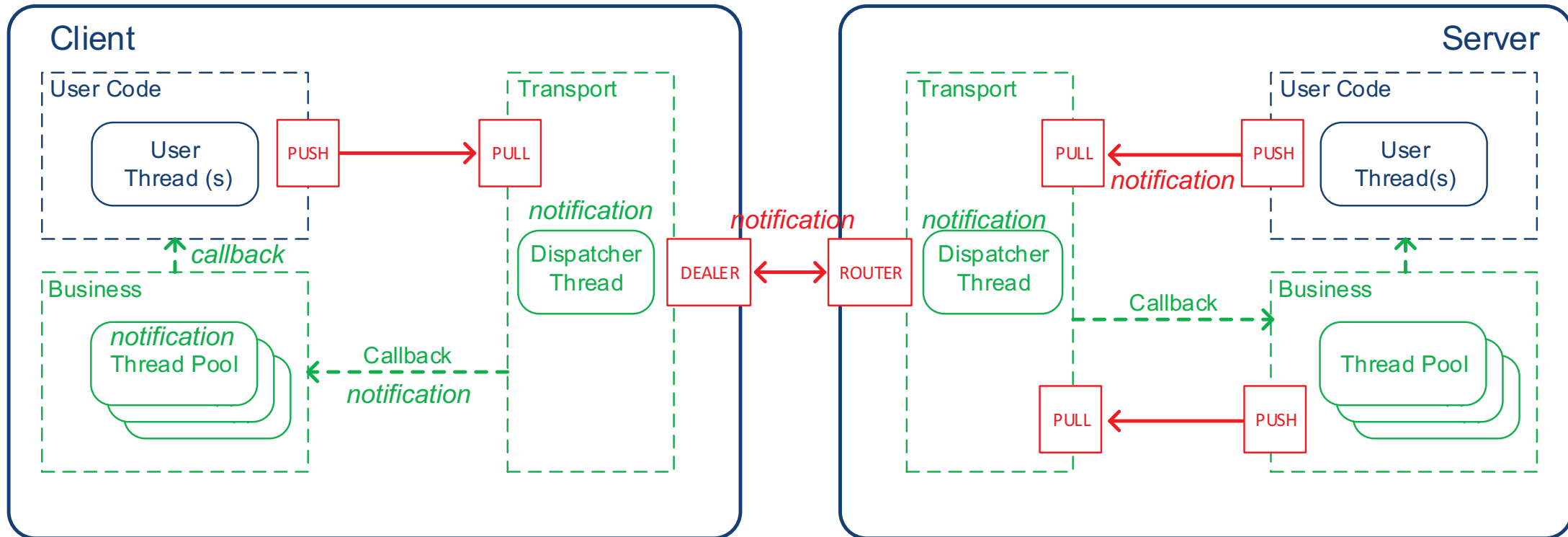


Request/Reply (e.g. *Get* call)

— RDA3
— User
— ZeroMQ



Publish/Subscribe: Sending a notification



Conclusions

- RDA3 is in operation for all CERN accelerators for 3 years
 - Very good operational experience
 - Outstanding scalability & reliability
 - Proposed architecture proved to be efficient
- RDA3 was developed in collaboration with GSI
 - Already used @ GSI; will be deployed for the FAIR complex
- Migrating to ZeroMQ was the right decision
- Development process was a key success factor

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