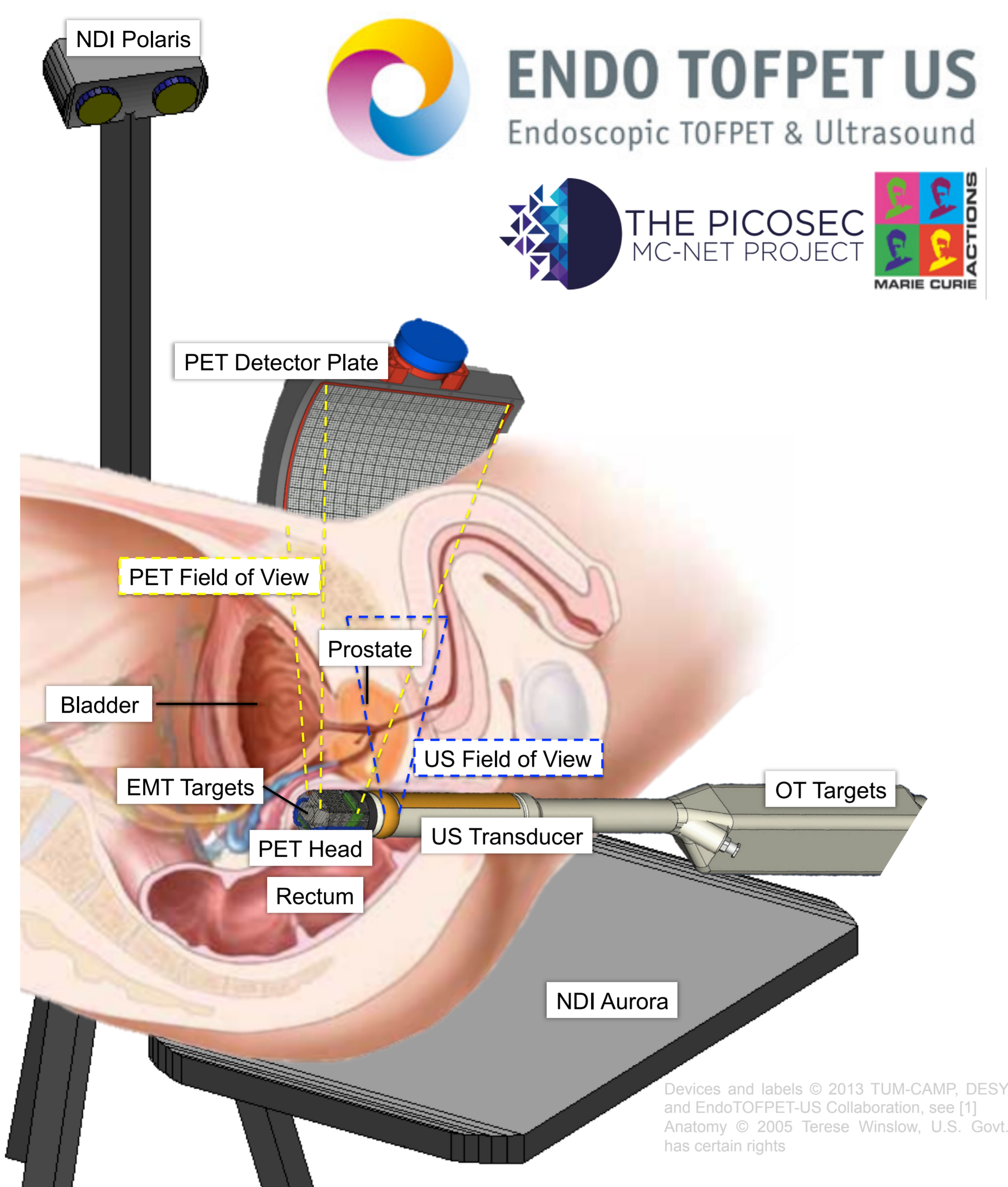


A. Schoch, B. Fuerst, F. Achilles, S. Demirci and N. Navab  
Computer Aided Medical Procedures (CAMP), TU Munich, Germany

## Introduction



## Motivation

- Multimodal and Intra-Operative Imaging (EndoTOFPET-US) [1]
- Collaboration of researchers from areas:
  - computer science (GUI, tracking, reconstruction)
  - physics (crystals, optics, attenuation and scatter correction)
  - medicine (tracers, pre-op imaging)
  - electronics (photo electronics, read-out, DAQ cards)
- Full monitoring and centralized control of system required

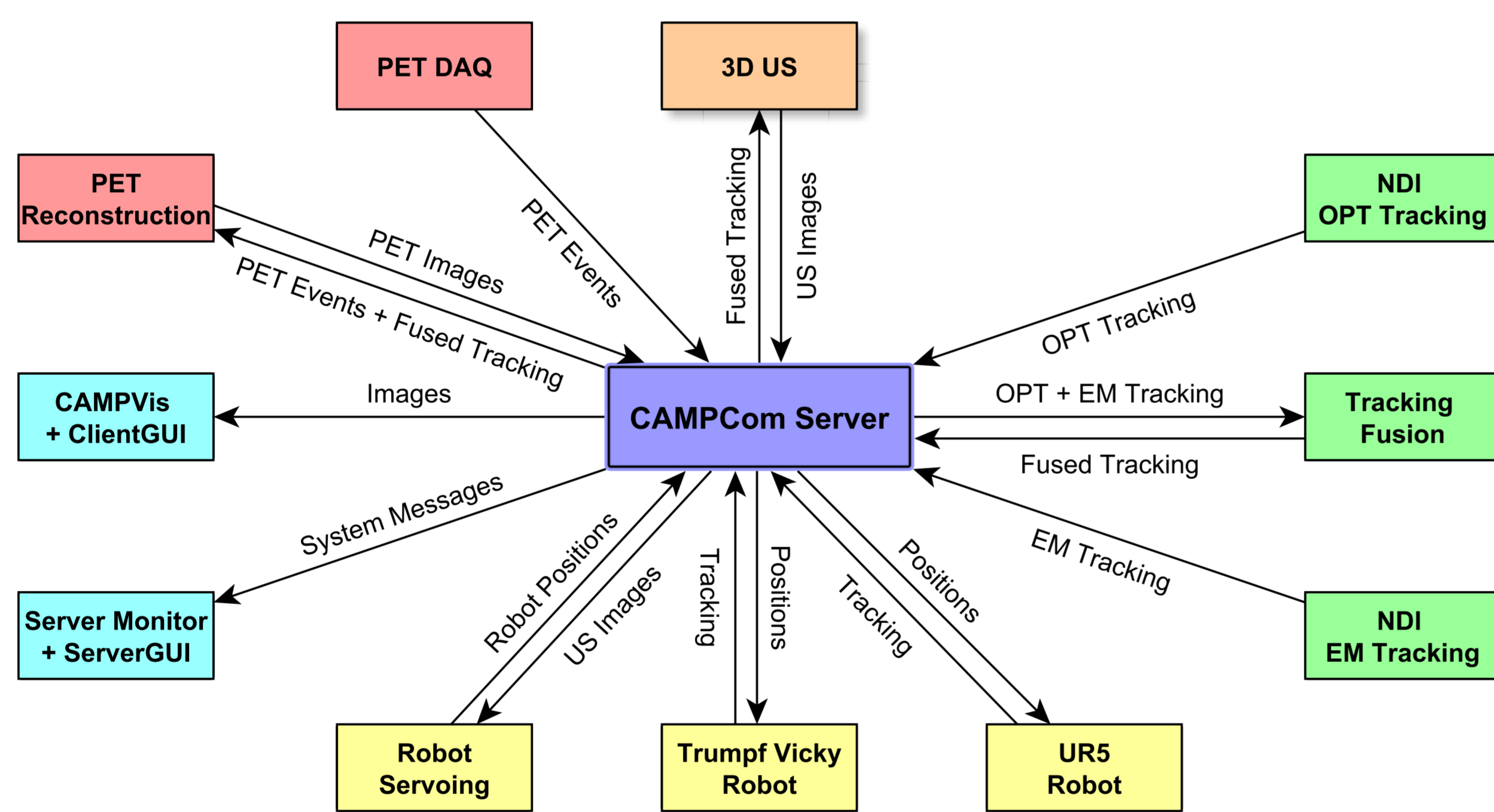
## Goal

- Simple to use communication framework (“one header only”)
- Plug-Ins for visualization (CAMPvis)
- Open-source: <https://campar.in.tum.de/Main/CAMPCom>
- Control & Data Flow:** communicate data and system messages between various components
- Efficiency:** lightweight & efficient communication
- Platform Independency:** serialization and transmission
- Abstraction & Extensibility:** support extension, general interface
- Prioritization:** asynchronous function to support efficiency

## Methods

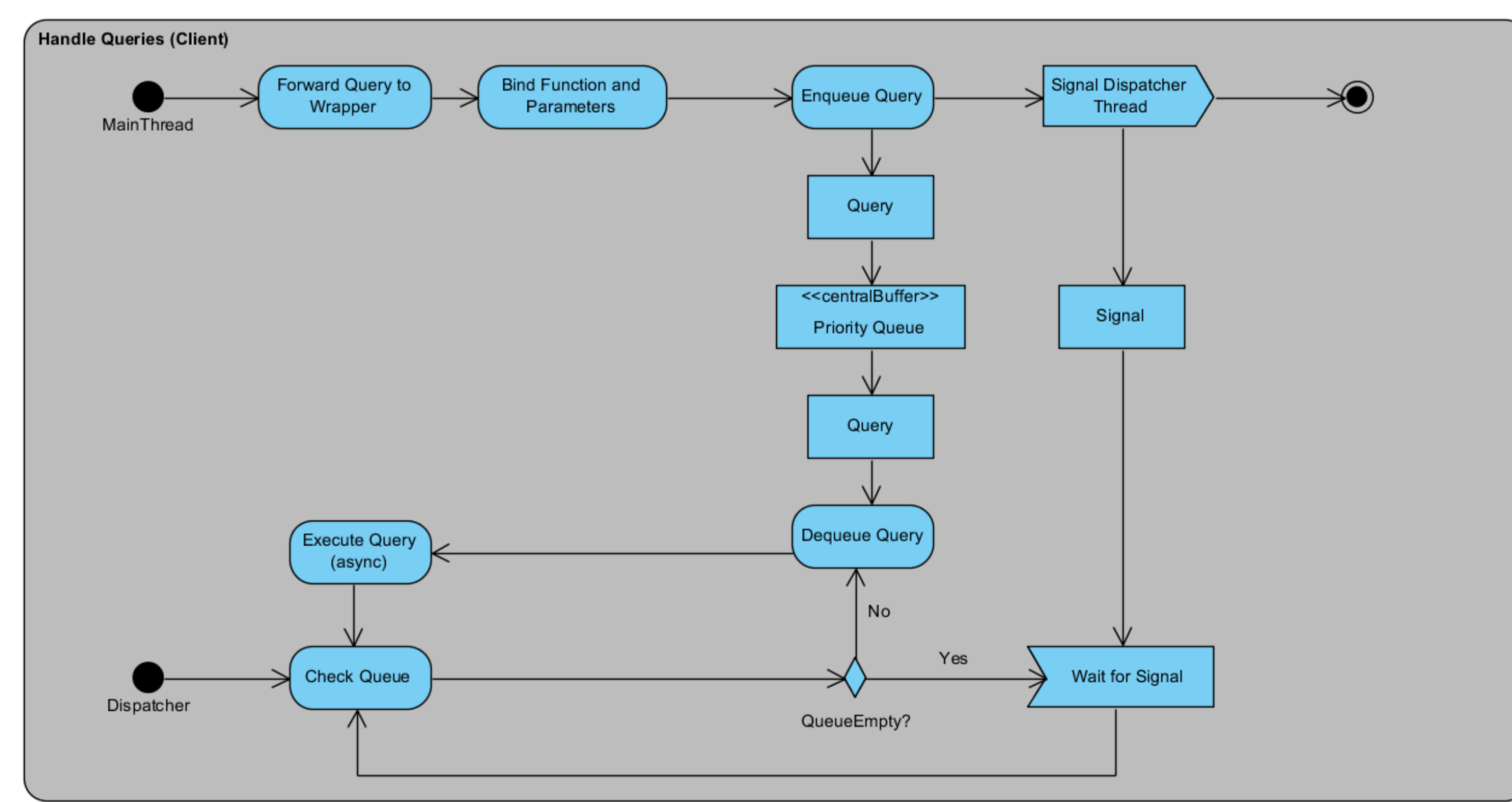
### Inter-Device Communication

- Sample setup for EndoTOFPET-US Project
- Server handles connections based on subscription model



### Query Handling & Prioritization

- Activity diagram for client library
- Simplified (without dispatcher thread pool)



## Evaluation

### Client/Server Communication Stability and Reliability

- 24h random data test
- No data loss, connection issues, memory leaks, or CPU loads
- Server memory approx. 1.4MB, CPU < 3%

### Prioritization and Compression

- zlib based compression of MNI BITE dataset [3, 4]
- 67.60% compression → overall transfer rate 3.35MB/sec
- 19.52% overall improvement compared to no compression

### Transfer rates

- Average transfer rate 90% of SMB; Compared to [2]
- 6 Experiments: different 100MB data packages

	Loading data	Serialization	Sending	Receiving	Deserialization	Total
OpenIGTLink						
Duration [sec]	16.464	0.728	8.837	11.258	0.052	37.311
Transfer rate [MB/sec]	6.074	137.269	11.316	8.883	4035.152	2.680
CAMPCom (Compression and Prioritization off)						
Duration [sec]	14.026	0.666	9.272	12.247	0.882	37.094
Transfer rate [MB/sec]	7.129	150.039	10.785	8.165	113.399	2.696

## Conclusion

- Stable, fast, reliable framework for IGT
- Easy integration, complex communication process hidden
- Similar performance compared to state of art
- Added features: prioritization, compression, subscription, thread pool, memory efficiency, simple integration

[1] Erika Garutti. **EndoTOFPET-US: a Novel Multimodal Tool for Endoscopy and Positron Emission Tomography**. arXiv preprint arXiv:1303.4503, 2013.  
 [2] Junichi Tokuda, Gregory S Fischer, Xenophon Papademetris, Ziv Yaniv, et. al. **OpenIGTLink: an open network protocol for image-guided therapy environment**. INT J MED ROBOT COMP, 5(4):423–434, 2009.  
 [3] <http://zlib.net/feldspar.html>  
 [4] Laurence Mercier, Rolando F Del Maestro, Kevin Petrecca, David Araujo, Claire Haegelen, and D Louis Collins. **Online database of clinical MR and ultrasound images of brain tumors**. Med. Phys, 39:3253, 2012.

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