OpenIGTLink

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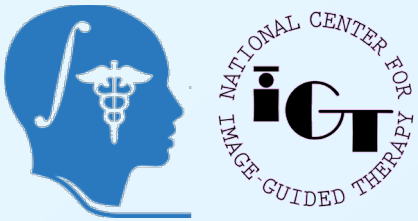


Acknowledgement

- Support for Open IGT Link comes from
  - National Institutes of Health
    - National Center of Image Guided Therapy (PI: Jolesz)
    - National Alliance on Medical Image Computing (PI: Kikinis)
  - NSF ERC CISST (PI: Taylor)
  - NEDO, Japan
  - Dr. Kiyoyuki Chinzei, AIST, Japan

IGT system: academic perspective

- Hardware/software components
  - MR/CT/Ultrasound scanners
  - Position tracking devices
  - Robotic devices
  - Navigation software

- Data types exchanged among the IGT system
  - Images
  - Positions / Transforms
  - Commands
  - Software / hardware status, etc…

Related standards / works

- Communication standards used in medical area
  - Device connection
    - IEEE 1073 -- Medical Device Communication
    - ISO 11898 -- Controller Area Network (CAN)
  - Picture archiving and communication system
    - Digital imaging and communication in medicine (DICOM)

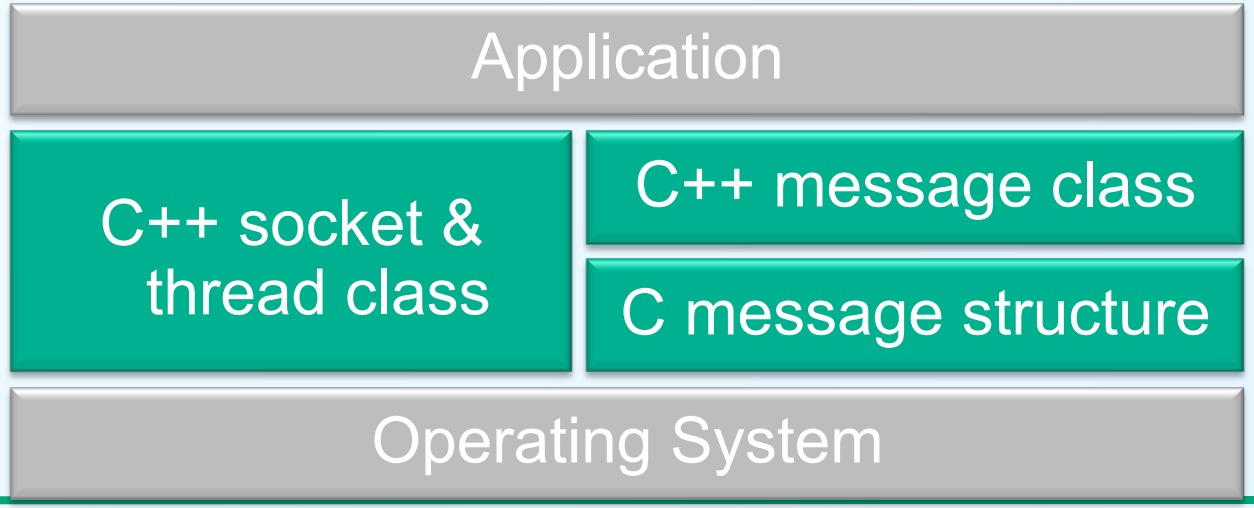
- Network communication framework for IGT
  - CORBA [Schorr-2000]
  - OpenTracker [von Spiczak]

Our goals

- Availability: research and commercial
- Simplicity: from embedded system to HPC
- Extensibility: variety of data types
- Reliability: data verification mechanism

Our solution: OpenIGTLink

- Community-oriented Development
  - The project was launched in US national level meeting 2008 (NA-MIC, all hands mtg, January 2008, Slat Lake City, UT).
- Platform-independent
  - Multi-platform C/C++ library for Windows/Linux/Mac



The OpenIGTLink Protocol

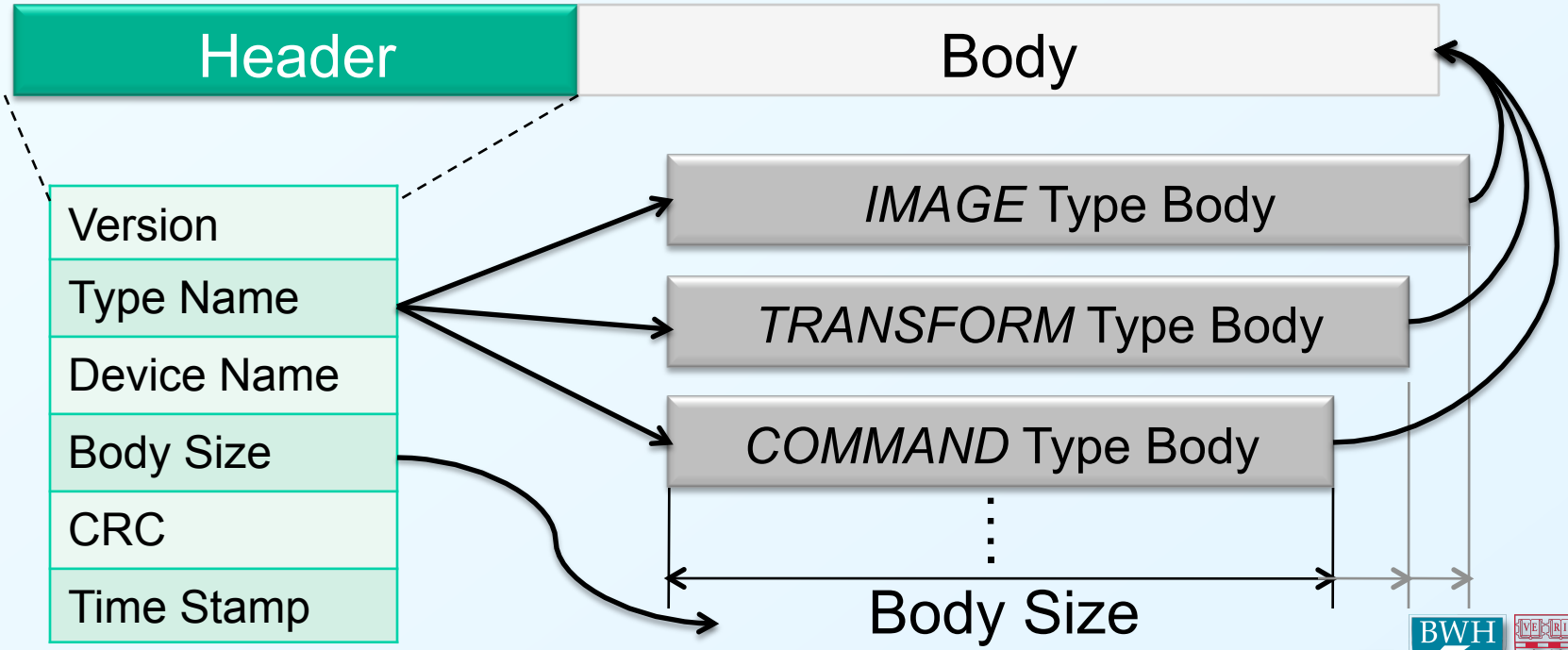
- Code snippet
  - Nine lines to send linear transform data

```
igtl::ClientSocket::Pointer socket;
socket = igtl::ClientSocket::New();
socket->ConnectToServer("192.168.0.1", 18944);

igtl::TransformMessage::Pointer transMsg;
transMsg = igtl::TransformMessage::New();
transMsg->SetDeviceName("Tracker");
transMsg->SetMatrix(matrix);
transMsg->Pack();
socket->Send(transMsg->GetPackPointer(),
             transMsg->GetPackSize());
```

The OpenIGTLink Protocol

- Message-based protocol
  - No session / messages are independent
  - Allows defining new message types



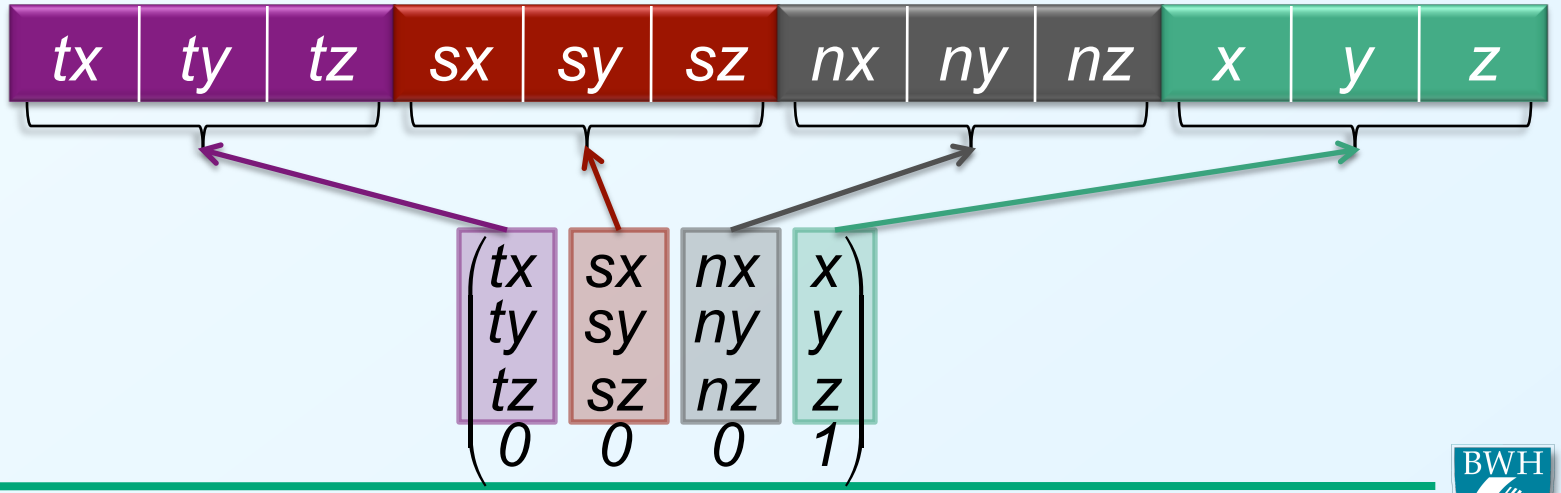
Protocol

- Device name
  - Multi-channel or multi-device
- Body size
  - Allows receivers to skip data, even if type is unknown.
- CRC
  - Data integrity check in the receiving program
- Time stamp
  - Required in real-time application

Standard Data Types

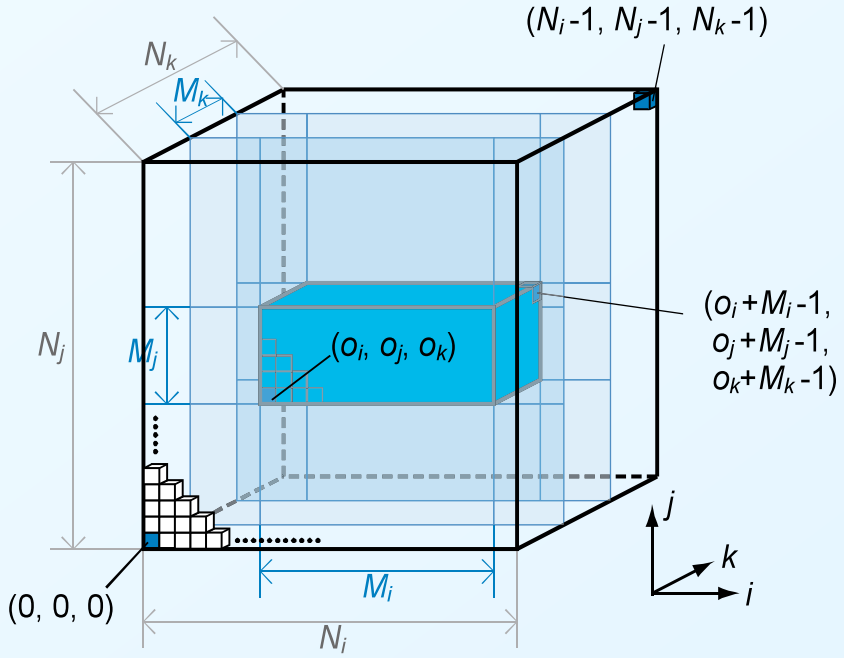
- Position (tracking / device positioning)

- Transformation (tracking / registration)



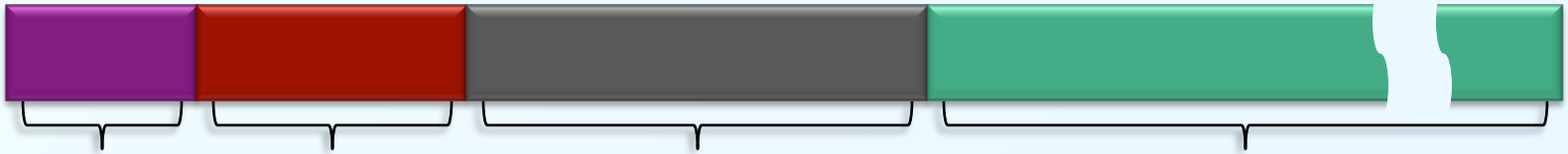
Standard Data Types

- Image
  - 2D / 3D
  - Scalar / vector
  - Affine transform
  - Partial volume update



Standard Data Type

- Status



Code	Description	Code	Description
0	Invalid packet	10	Configuration error
1	OK	11	Resource error
2	Unknown error	12	Unknown instruction
3	Panic	13	Device not ready
4	Not found	14	Manual mode
5	Access denied	15	Device Disabled
6	Busy	16	Device not present
7	Time out	17	Unknown device version
8	Overflow	18	Hardware failure
9	Checksum error	19	Shutdown in progress

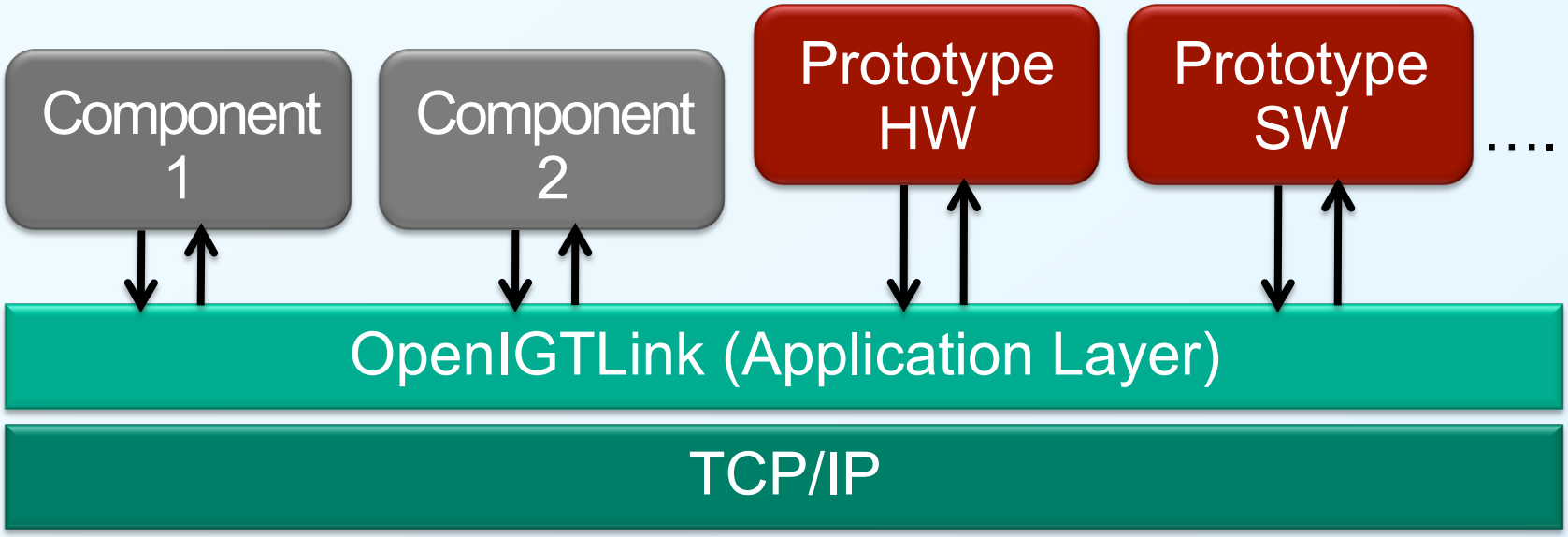
Applications

- Three highlighted scenarios

1. Prototyping clinical system
2. Research-commercial technological transition
3. Clinical Research Bridging

1. Prototyping Clinical System

- Connect prototype hardware / software to the system



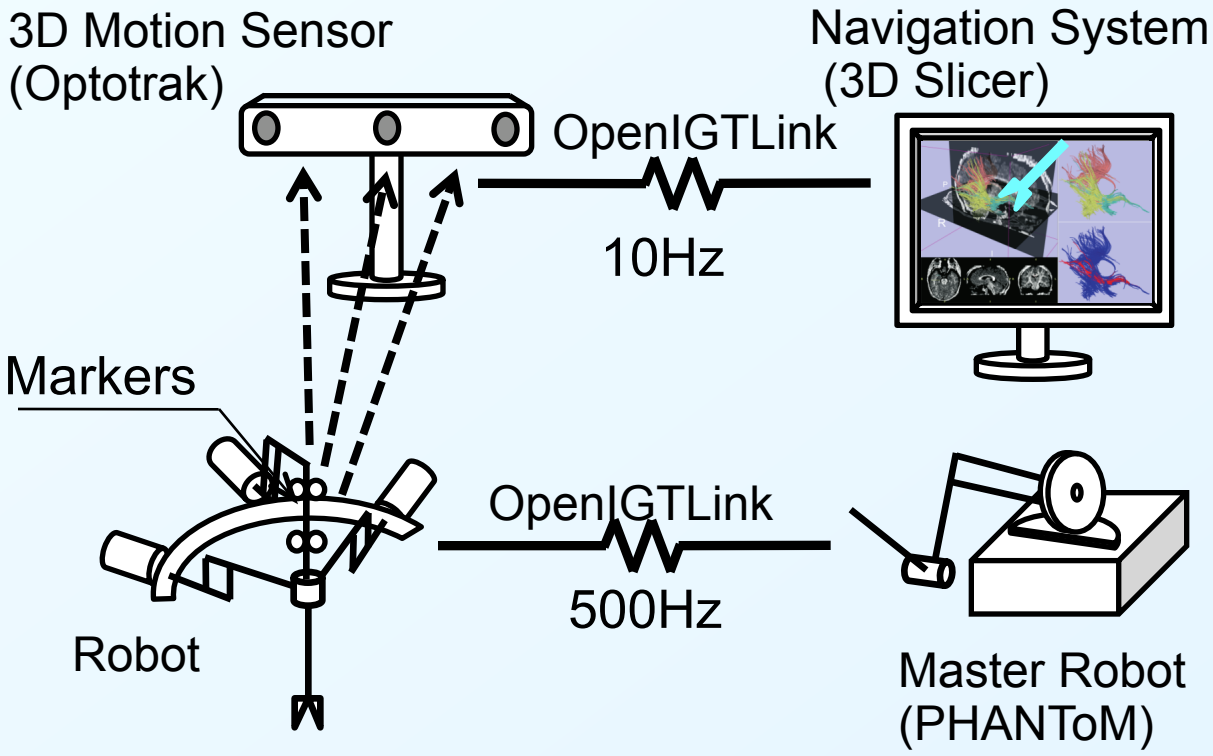
1. Prototyping Clinical System

- Surgical manipulator integration

Drs. H. Fujimoto and J. Arata, Nagoya Institute of Technology

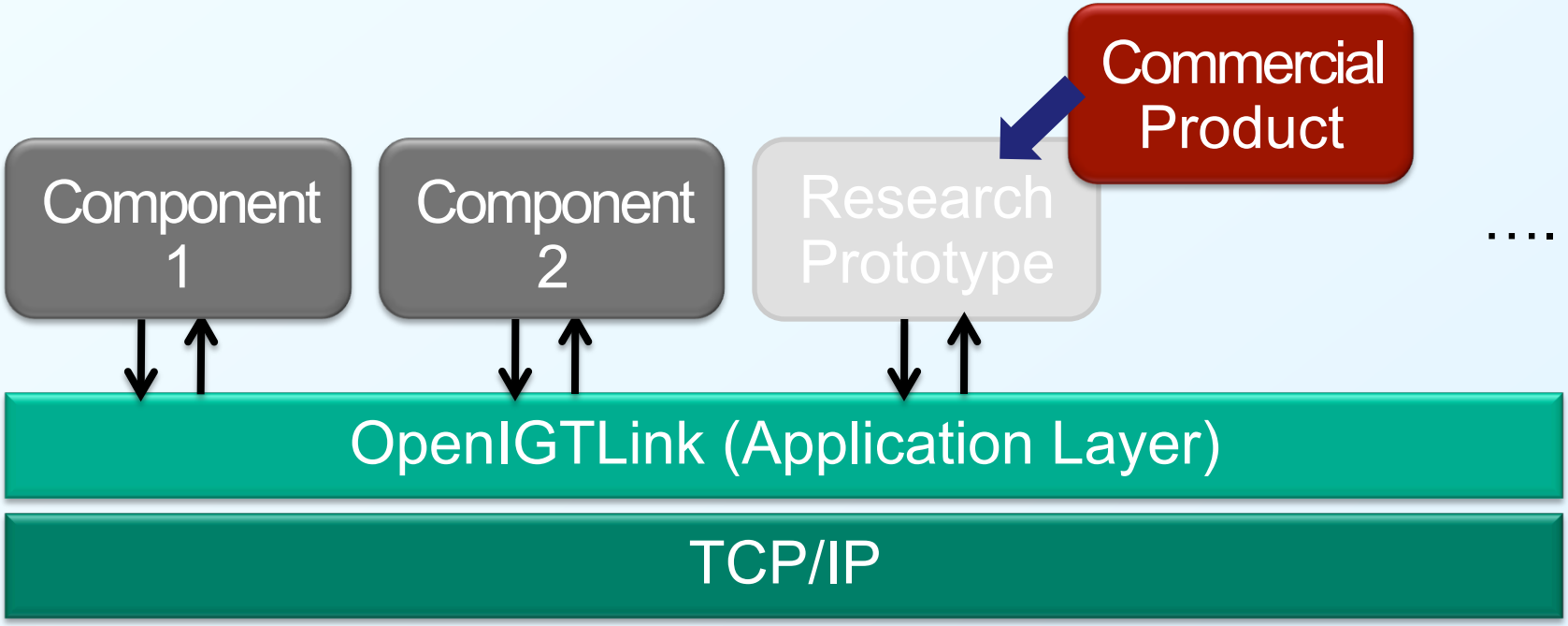
1. Prototyping Clinical System

- Surgical manipulator integration



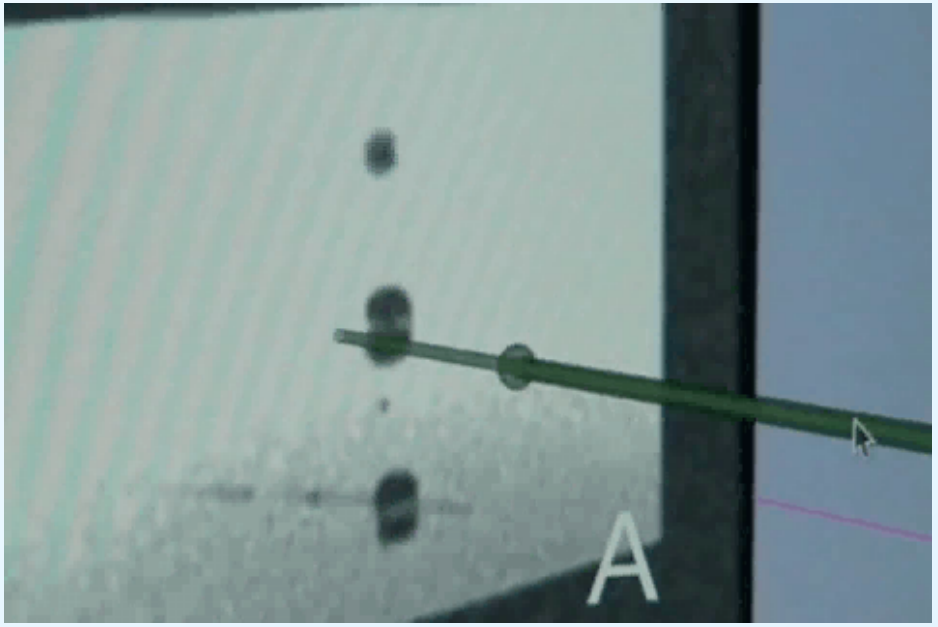
2. Research-Commercial Transition

- Replace research prototype with commercial product prototype



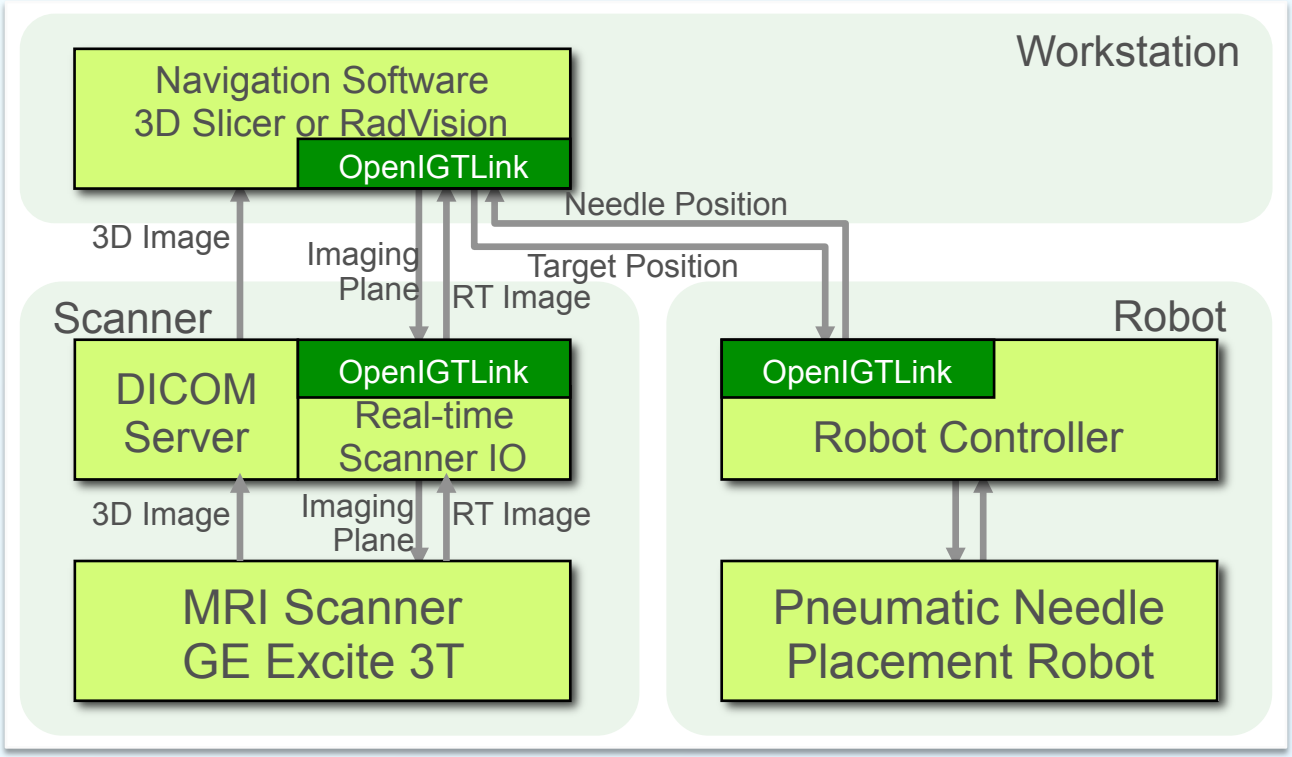
2. Research-Commercial Transition

- MR-guided prostate robotic intervention
  - MRI-compatible needle placement robot [Fischer 2007]



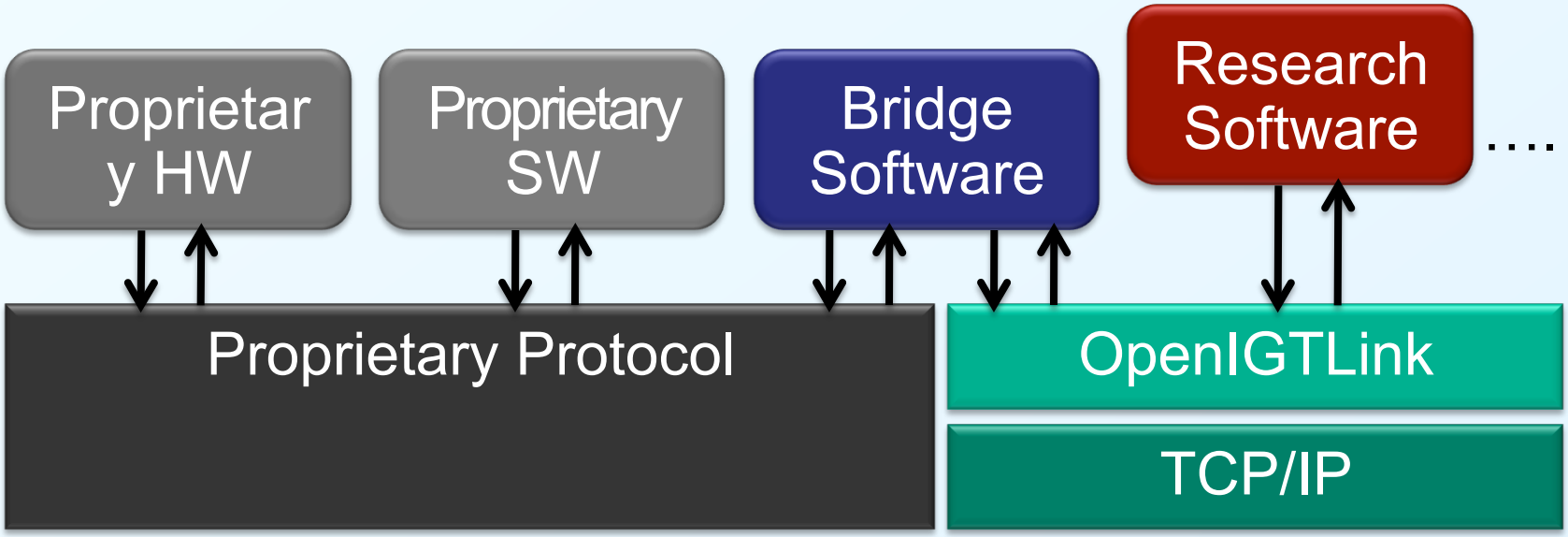
2. Research-Commercial Transition

- MR-guided prostate robotic intervention
  - 3D Slicer : research prototype
  - RadVision (Acoustic Med Systems) : commercial



3. Clinical Research Bridging

- Export clinical data from approved system (proprietary) to research software

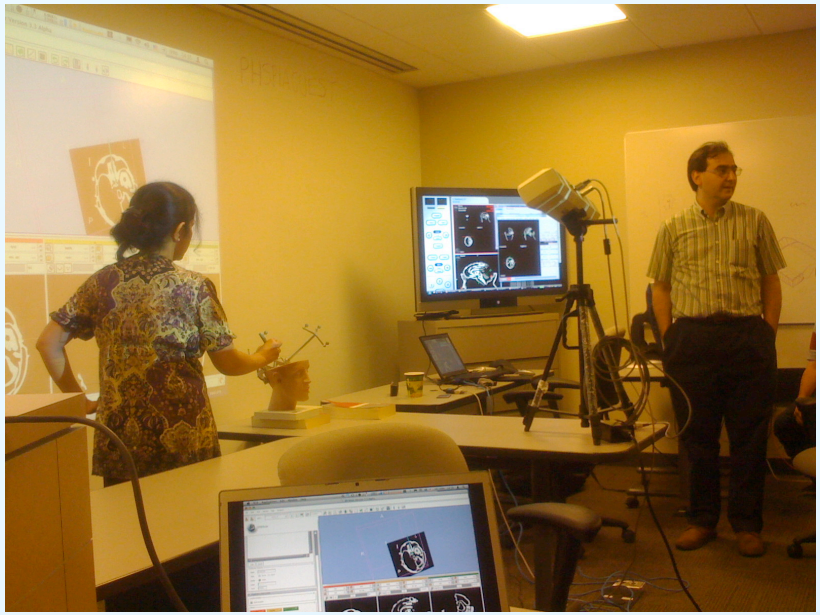


3. Bridging to commercial system

- BrainLab – Slicer 3
  - *BrainLab*, commercial navigation system
  - *3D Slicer*, research platoform
  - *BioImage Suite* (by Xenophon Papademetris, Yale University),

  bridging VVLink and

  OpenIGTLink protocols



Endowments

- GE Excite MRI
- JHU robots and encoders
- IGSTK -- NDI and Micron trackers
- Robin Medical EndoScout
- NIT robots (Intelligent SI Project)
- BrainLab via BioImage Suite (Papademetris)
- 3D Slicer
- Matlab interface

Summary

- OpenIGTLink
  - Open, simple, extensible and reliable
  - Slicer 3, MRI, tracking device, robot, etc.
  - Used in navigation and surgical robot projects

- Communication protocol for IGT
  - Prototyping clinical system
  - Research-commercial technological transition
  - Clinical research bridging

Future Work

- Complete toolbox for development
  - Testing tools
  - Monitoring / analysis tools
- Logging - “Blackbox”
  - Record all events in OR
- Hard real-time capability
  - Motion compensation in radiotherapy / FUS

For more information…..

google “open igt link”