Enhanced Simulation for the daVinci System

Group 6

Check Point Talk

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Outline

- Motivation
- Significance
- Deliverables
- Simulation Sandbox
- Dependencies
- Timeline

Background

daVinci Skills Simulator on Si Console[1]

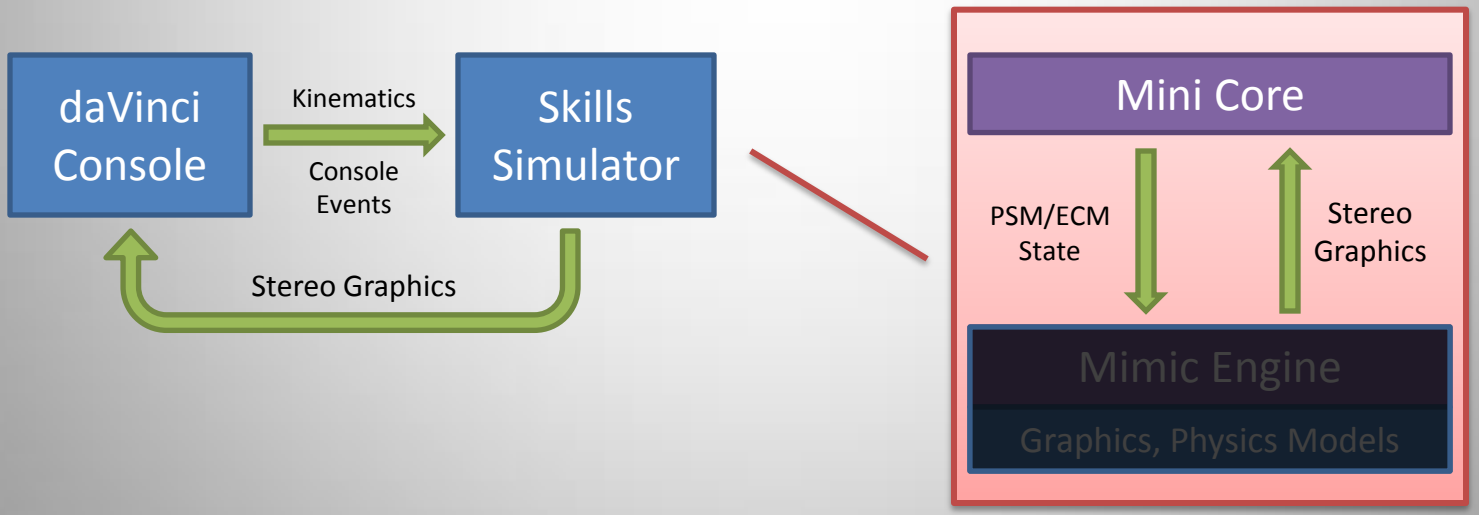
daVinci S Console[2]

Anastomosis Task using Simulation

Anastomosis Task using Phantoms

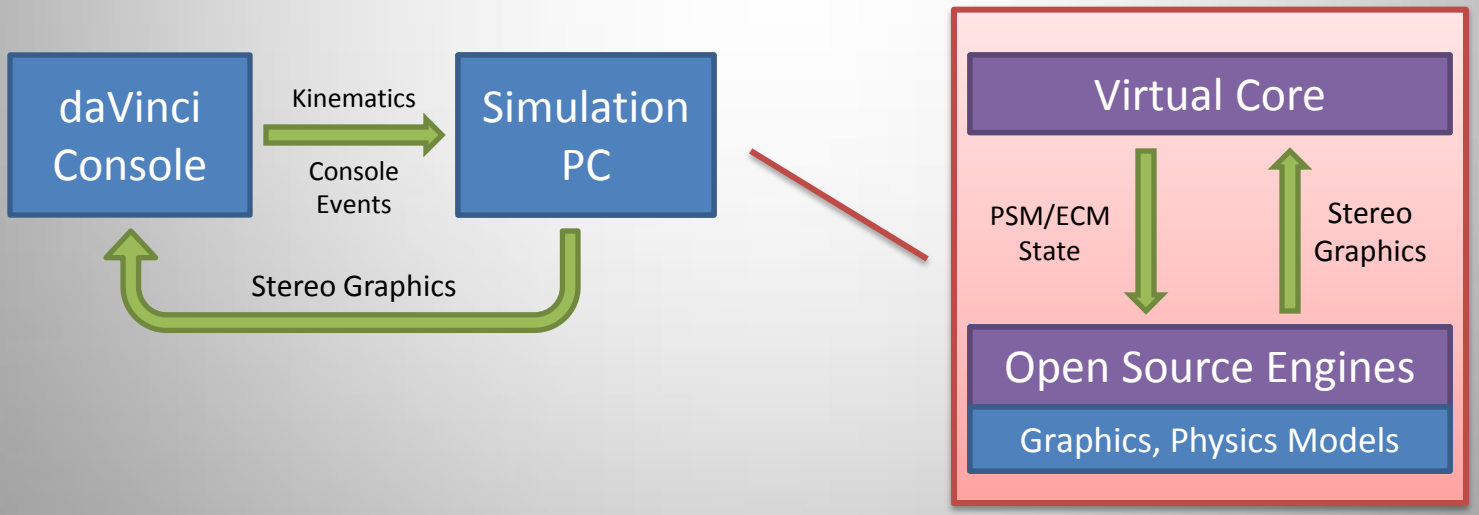
Motivation

- Simulation exercises outsourced to *Mimic Simulation Inc.* (which acts as a black box)
- Developer has no access to the graphics rendering and the environment



Goal: Simulation Sandbox

- Develop a simulation framework for the daVinci System using Open Source dependencies (except ISI API [3])
  - CISST-SAW [4,5] (developed at ERC-CISST, JHU)
  - H3DAPI [6]



Significance

- Develop new environments using existing graphics and physics models
- Develop new object models for new applications
- Allow patient specific anatomical data simulation for procedural planning
- Provide a rapid prototyping environment for UI's, image guidance, new procedures, new instruments
- Be the testing ground for learning approaches to model task performance, perform tool-tracking

Deliverables

- MINIMUM [1 WEEK BEHIND]
  - Extend CISST component for BB-API [IN PROGRESS]
  - Implement 'virtual slaves' component for simulation [IN PROGRESS]
  - Demo *sandbox* using a basic example
- EXPECTED
  - Extend sandbox to incorporate camera control, clutching
  - Demo using an application like *Match Board* task
- MAXIMUM
  - Extend *sandbox* by developing new models
  - Demo an application using these models

Simulation Sandbox Framework

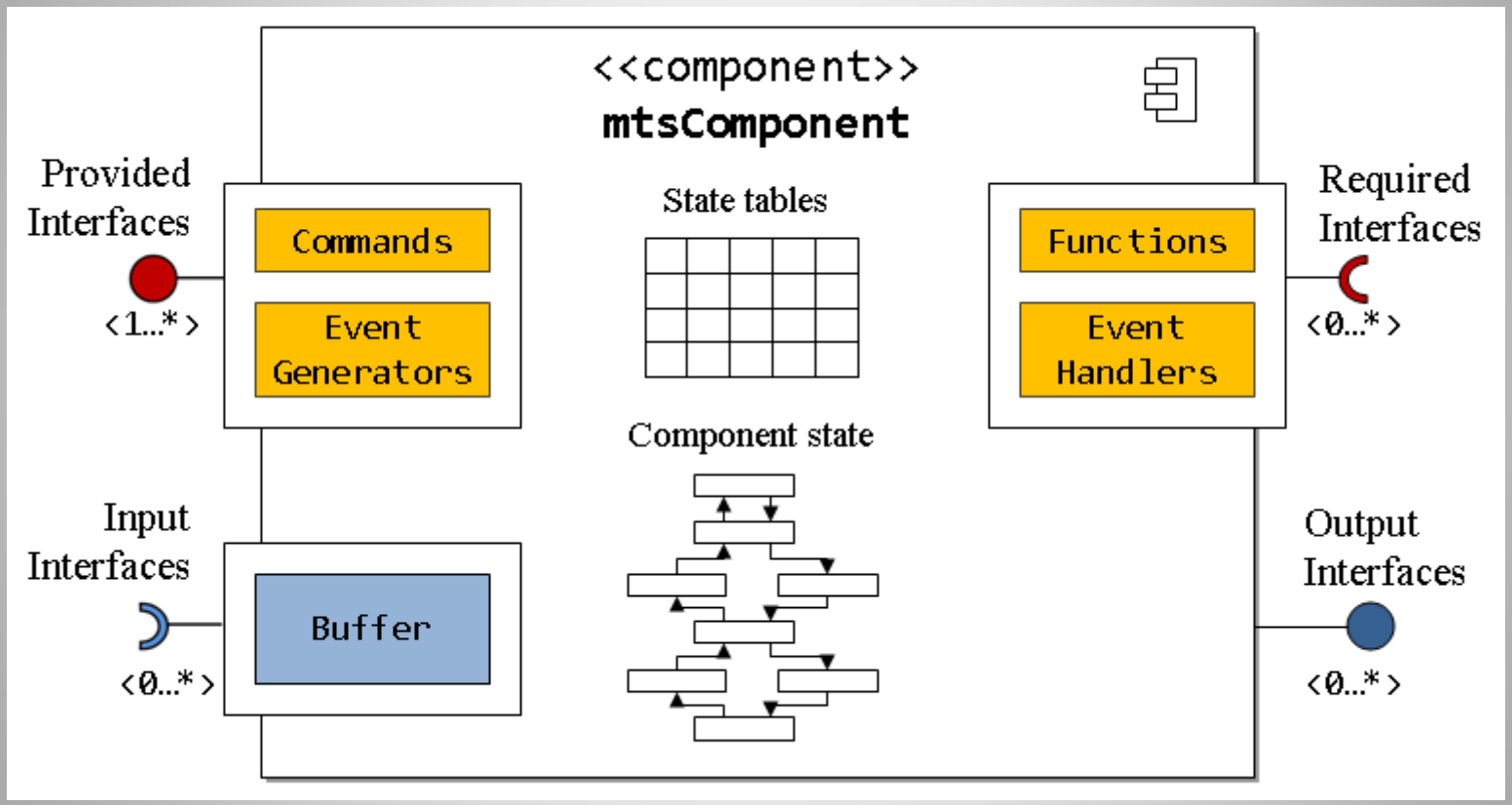
- Software dependencies:
  - ISI daVinci Research Interface (API)
  - CISST libraries and SAW framework
  - H3D library (includes HAPI, H3DPhysics)
- Design:
  - Block diagram
  - Flow diagram

ISI API [3]

	isi-api	isi-bb-api	isi-sim-api
Read Access	Yes	Yes	Yes
Write Access	No	Yes	Yes
Robot Versions	Standard/S/Si	S	Si
Setup Access	No	No ?	Yes

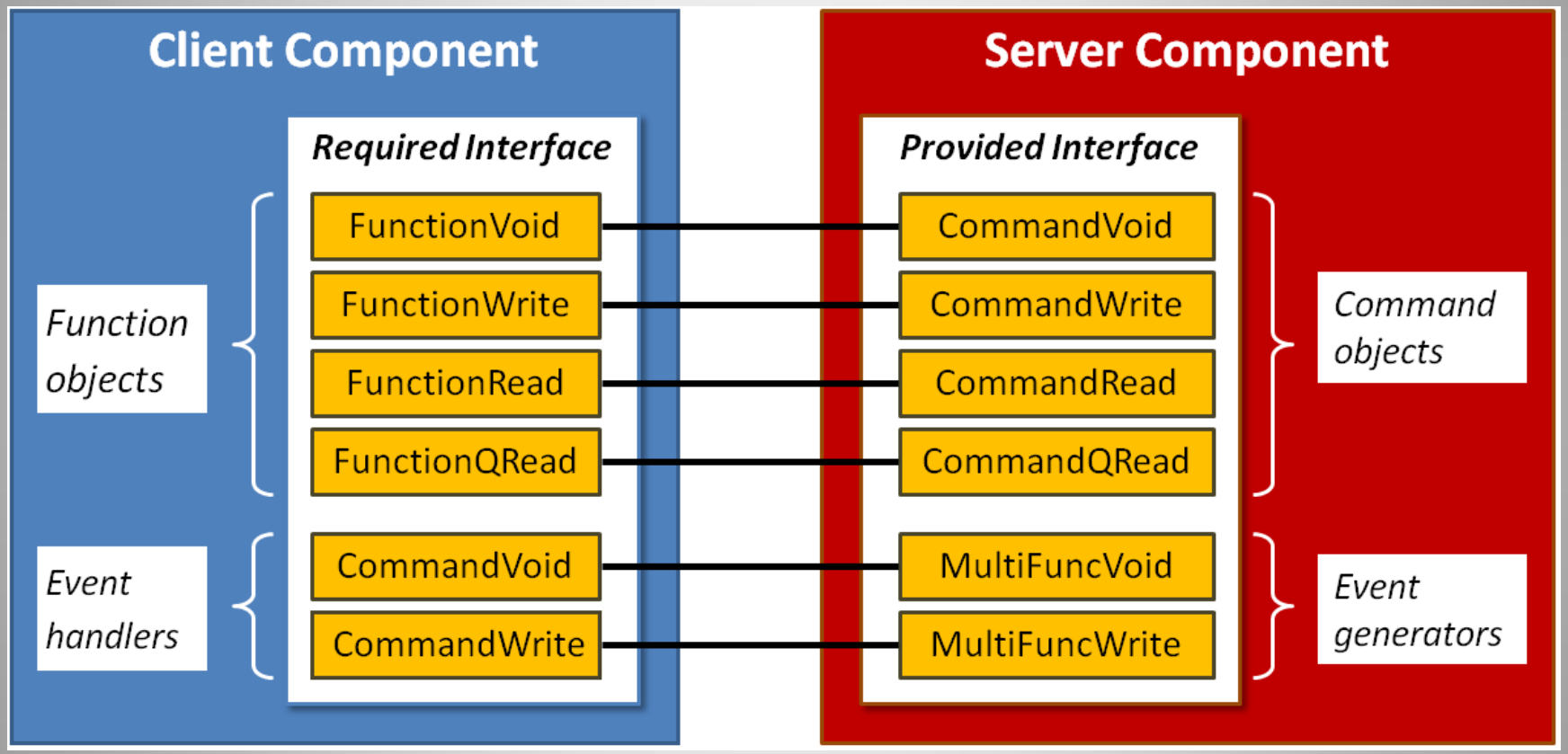
- *Write* access from bb-api to disengage slaves
- Loss of *core* on slaves due to dis-engagement
- Component for methods related to simulation

CISST Component Framework [7]



CISST MultiTask Library – Component [7]

CISST Component: Interfaces [7]



CISST MultiTask Component – Interfaces [7]

CISST-SAW Components

- *sawVirtualSlaves*
  - Emulate the slave side "*core*"
  - Methods relevant for simulation (inspired from isi-sim-api)
  - *Provided* and *Required* interfaces to connect to any *master*

- *cisstDaVinci (cdvReadWrite)*
  - Wrapper for the isi-bb-api
  - Add methods to disengage slaves from masters
  - Add methods as per need

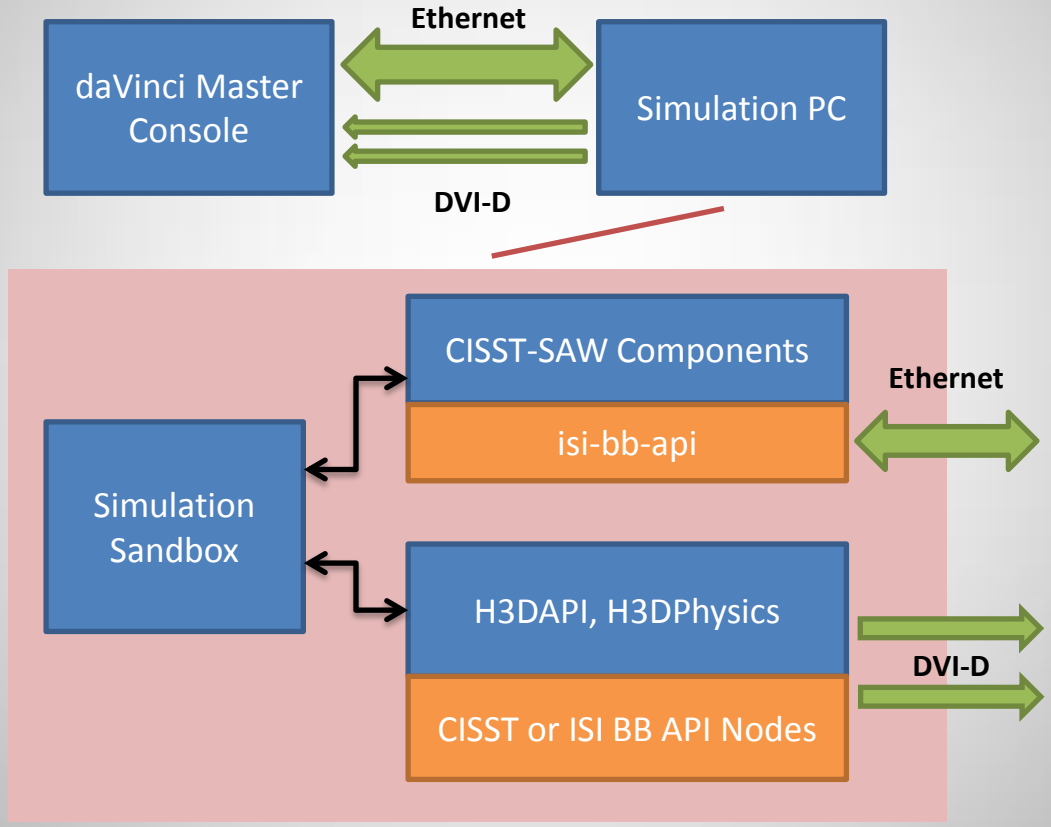
H3D Library [8]

- Three levels of programming – X3D, Python, C++
- X3D
  - XML-based file format for representing 3D graphics
  - Define geometry, arrange scene-graph elements
  - Fields (data containers), Nodes (containers for fields)
- Python
  - Define behaviour of the application e.g. keyEvent handler
- C++
  - Define *nodes* and *fields* for specific purposes

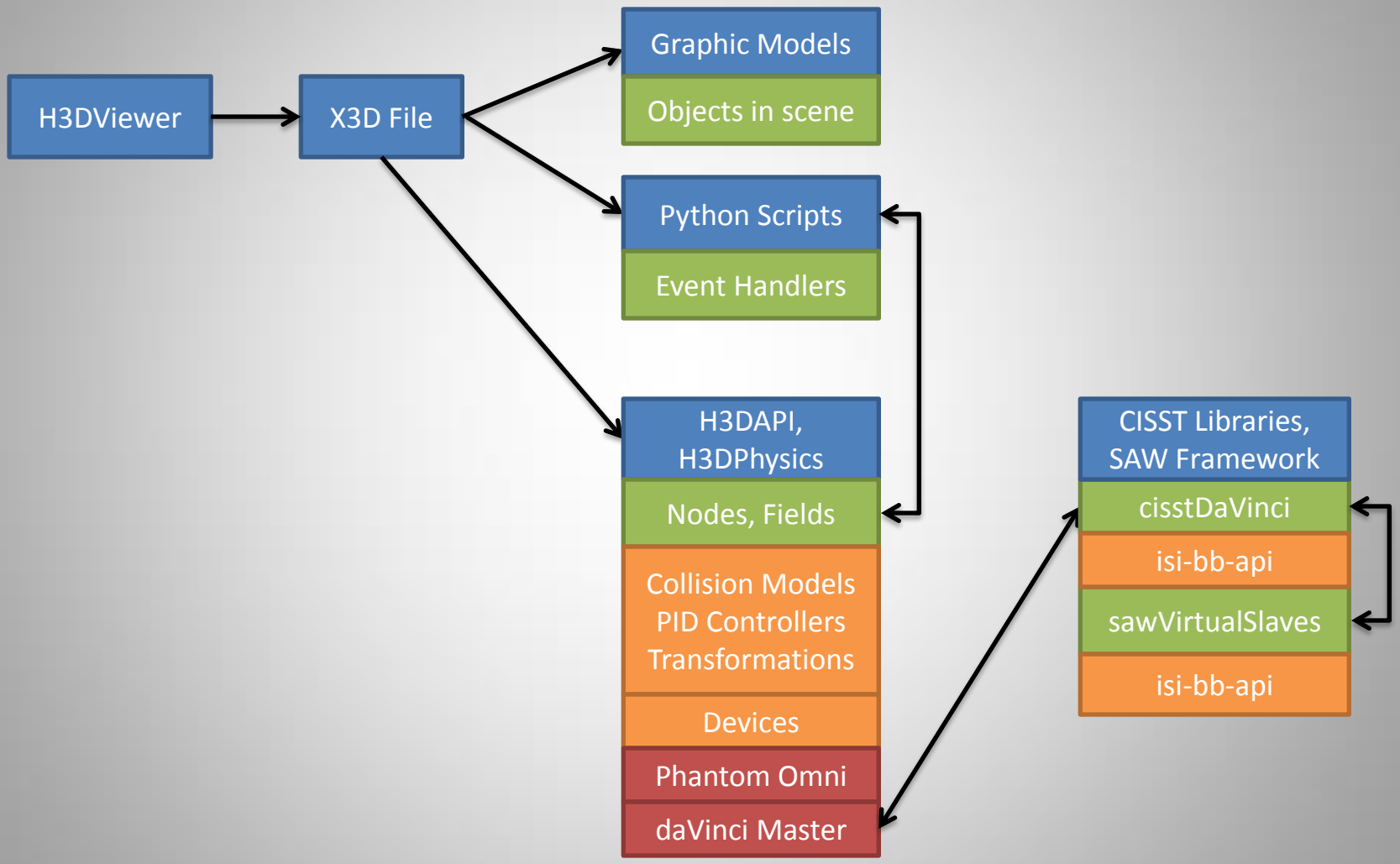
H3D Custom Nodes

- Virtual slaves simulation
  - Already created by ISI (Ashwin) – *JointPID*, *SevenDOF*, etc.
  - Existing ones modified also – *SingleAxisJoint*, *SliderJoint*
  - New one for *sawVirtualSlaves*
- Master device
  - New device node for *cisstDaVinci* (isi-bb-api wrapper)

Proposed Framework



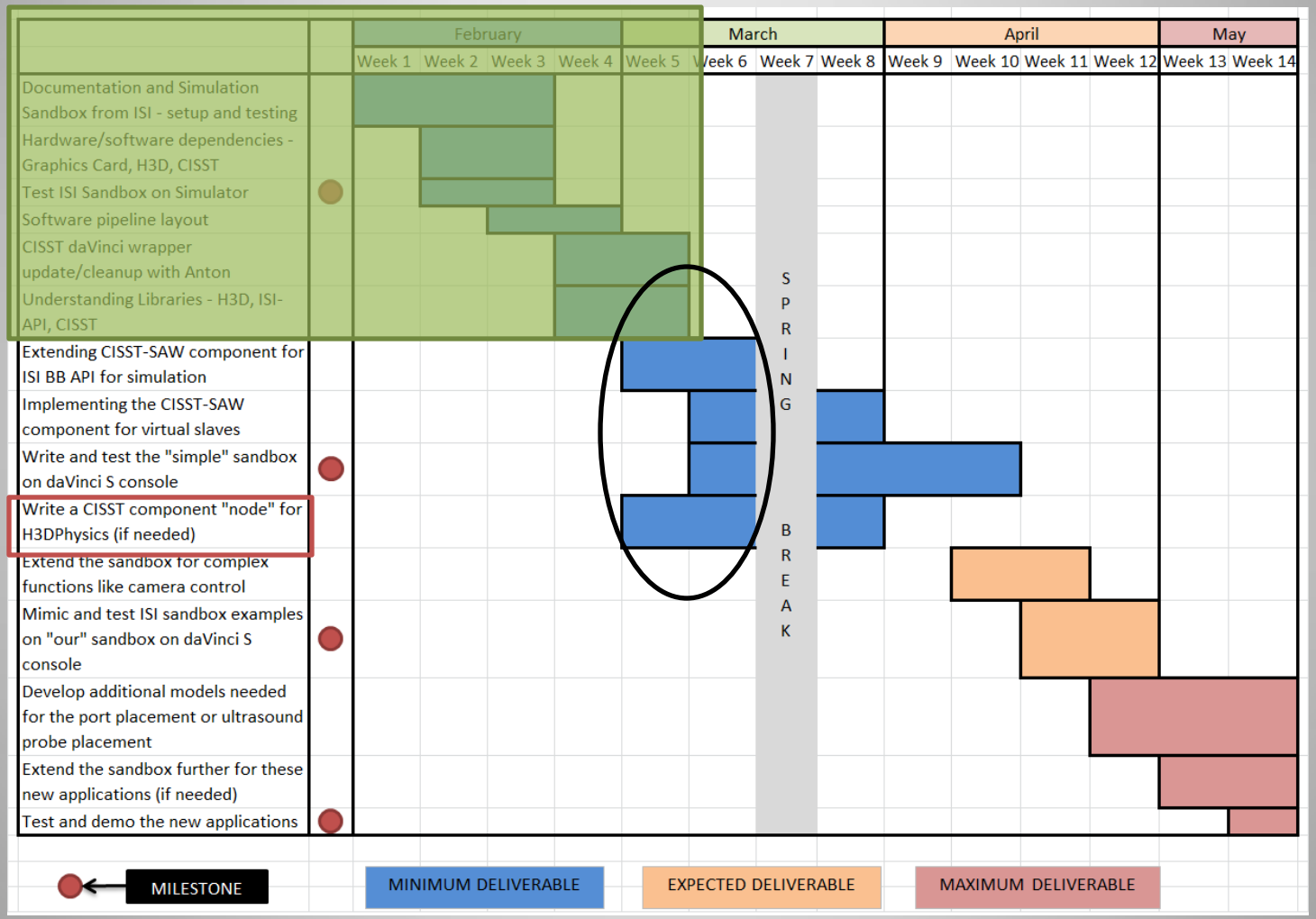
Flow Diagram



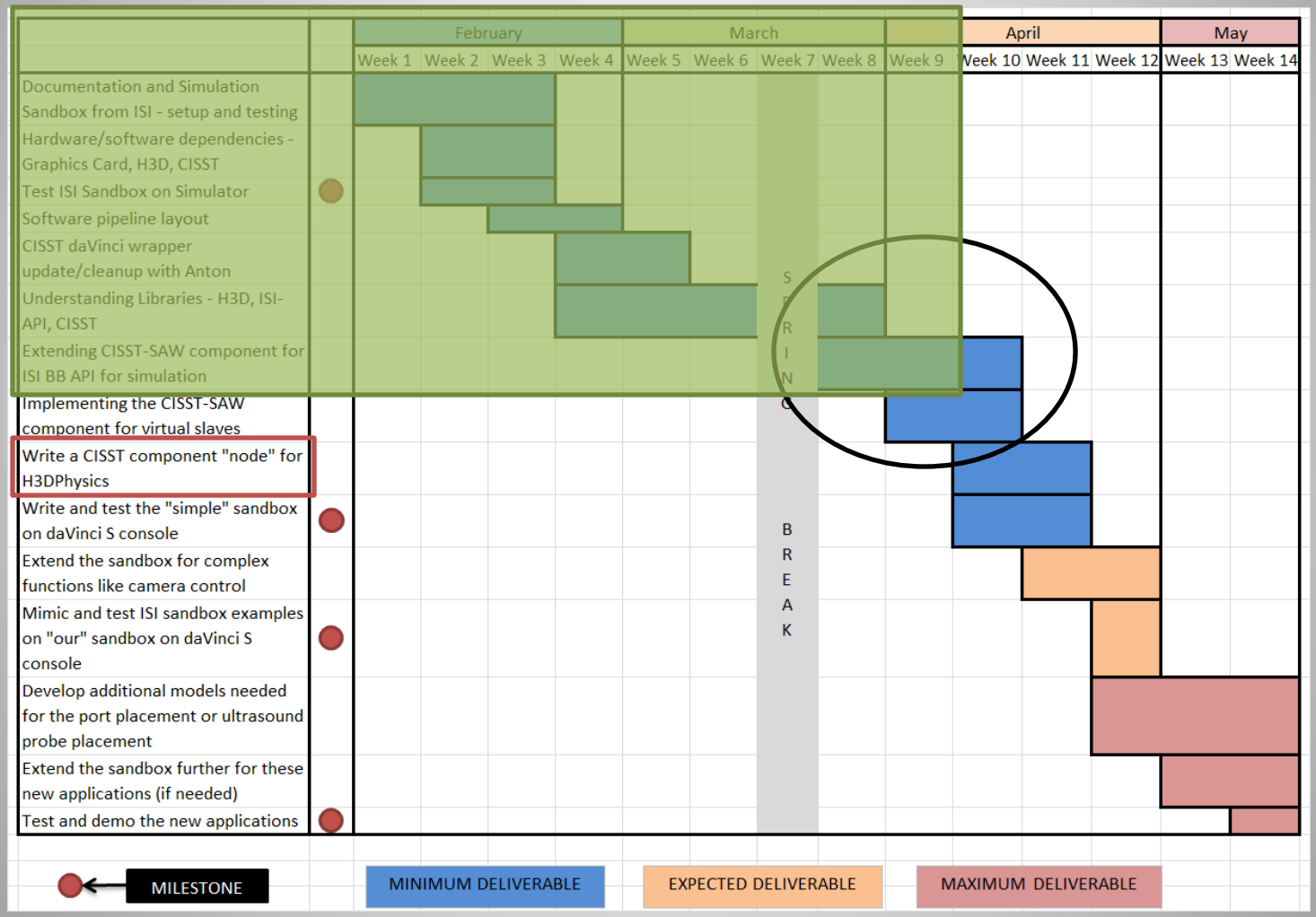
Dependencies

Dependency	Resource	Alternative	Impact
daVinci Skills Simulator assess	Other projects usage	None	Not much
Devel. Drive for Simulator	Anton	None	Not much
Existing Sandbox from ISI	Ashwin, Simon	None	Slow down!
Funds for using the daVinci S	Prof. Taylor	None	Need this!
Computer for simulation	ISI (info), Prof. Taylor (approval)	None	Need this!
ISI-BB-API assess	Anton	None	Need this!
H3D library svn assess	Network Security	Use network outside Hopkins	Not much, except bug fixes
Test hardware pipeline	New GPU	Other GPU	Project output depends on it
CISST BB-API component	Anton	Do myself	Crucial for communication with robot
ISI_SIM_API documentation	Simon	Talk to Prof. Taylor	Not much
3D Model creation in X3D	Ashwin	Do myself	Maximum deliverables

Proposed Timeline



Modified Timeline



References, Reading

1. Intuitive Surgical Inc., *daVinci Skills Simulator User Manual*
2. Intuitive Surgical Inc., *daVinci S System User Manual*
3. S. DiMaio and C. Hasser, *The daVinci Research Interface*, MICCAI Workshop on Systems and Architectures for Computer Assisted Interventions, Sep. 2008
4. A. Deguet and R. Kumar and R. Taylor and P. Kazanzides, *The cisst libraries for computer assisted intervention systems*, MICCAI Workshop on Systems and Architectures for Computer Assisted Interventions, Sep. 2008
5. B. Vagvolgyi and S. DiMaio and A. Deguet and P. Kazanzides and R. Kumar and C. Hasser and R. Taylor, *The Surgical Assistant Workstation*, MICCAI Workshop on Systems and Architectures for Computer Assisted Interventions, Sep. 2008
6. Sense Graphics A B, Open Source Haptics – H3D.org
7. ERC-CISST, https://trac.lcsr.jhu.edu/cisst/wiki/cisstMultiTaskTutorial
8. H3D Wiki, http://www.h3dapi.org/modules/mediawiki/index.php/Design_concepts

Thank you!

Questions?