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Model-Based Systems Engineering for Electronic Voting System Security

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Voting System Security in the News

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Georgia moves to replace hackable electronic voting

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FBI investigating alleged breach in Georgia at KSU's elections

Senators: Extent of Russian election intrusion still unknown

Voters fill out their ballots at the Cincinnati Public Library precinct on primary election day, Tuesday, May 8, 2018, in Cincinnati. Ohio's roller-coaster gubernatorial primary season will be decided Tuesday as Republicans and Democrats vote for their nominees to replace term-limited Republican Gov. John Kasich. (AP Photo/John Minchillo)

Posted: 7:35 p.m. Tuesday, May 08, 2018

WASHINGTON — The United States still doesn't know — and may never know — the extent of Russian interference in state election systems in 2016, according to bipartisan findings released Tuesday by the Senate intelligence committee. Lawmakers say they do know the U.S. is still vulnerable to such an attack.

The Senate committee made the findings public ahead of the panel's full election security report, which is expected to be released in the coming weeks. The document provides new details about the level of Russian activity during the last presidential election.

The committee found that in at least six states "Russian-affiliated cyber actors" conducted "malicious access attempts on voting-related websites" that went beyond routine scanning previously reported. In a majority of those cases, the Russians used a common hacking technique to attack the states' public-facing election websites. The committee didn't identify the six states.

The Federal Bureau of Investigation is investigating an alleged data breach in Georgia at the Center for Election Systems at Kennesaw State University, The Atlanta Journal-Constitution has learned.

2 Man rushed to hospital after shooting in Buckhead

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Why MBSE for Voting System Security?

- MBSE provides a clear and self-consistent specification of EVS requirements, hardware, software, process and logistics
- MBSE allows for the systematic definition of failure modes for security analysis
- MBSE provides a framework for connecting multiple models in different software tools and building a unified roadmap of the system

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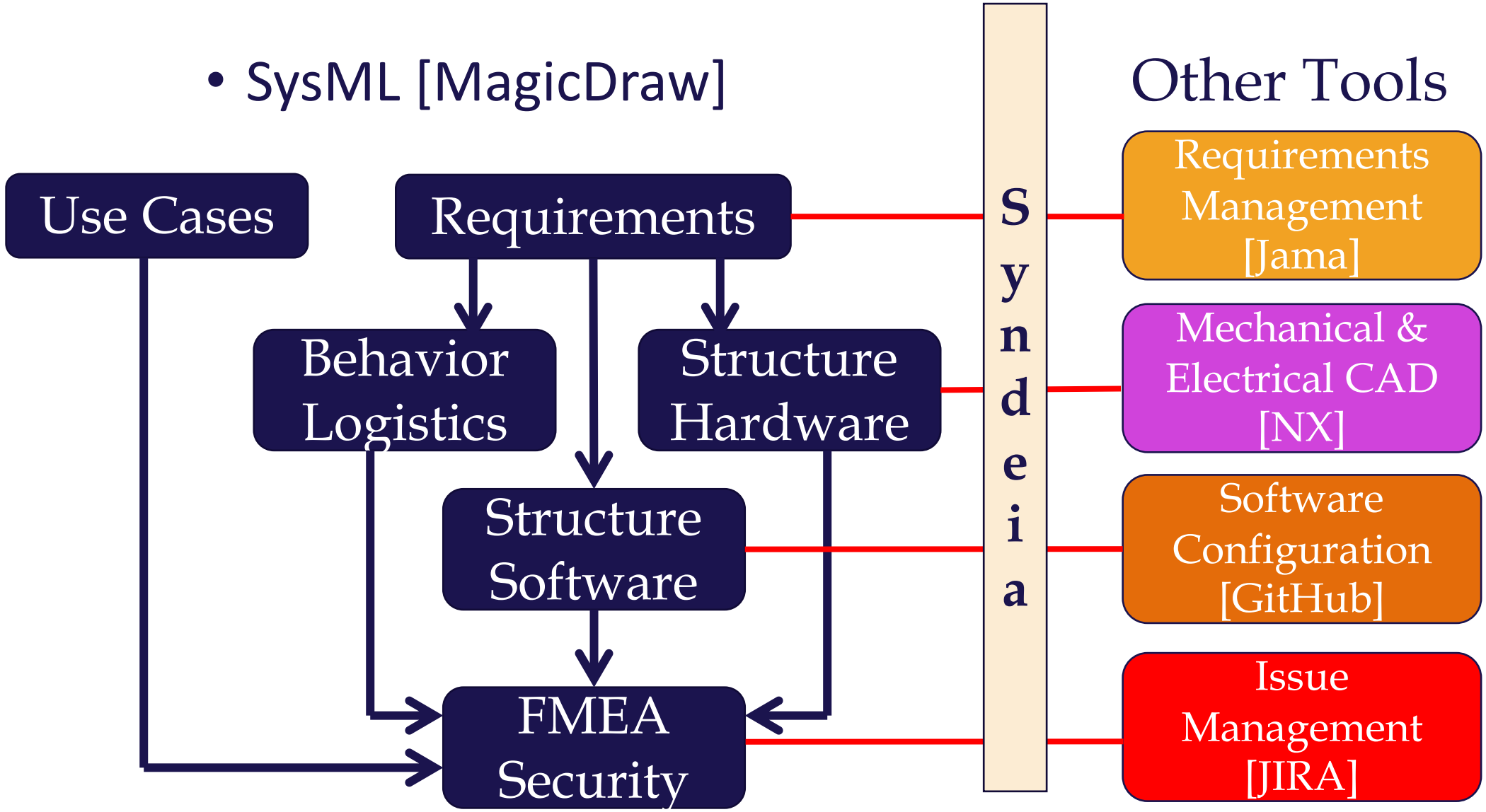
Model Architecture

- SysML [MagicDraw]



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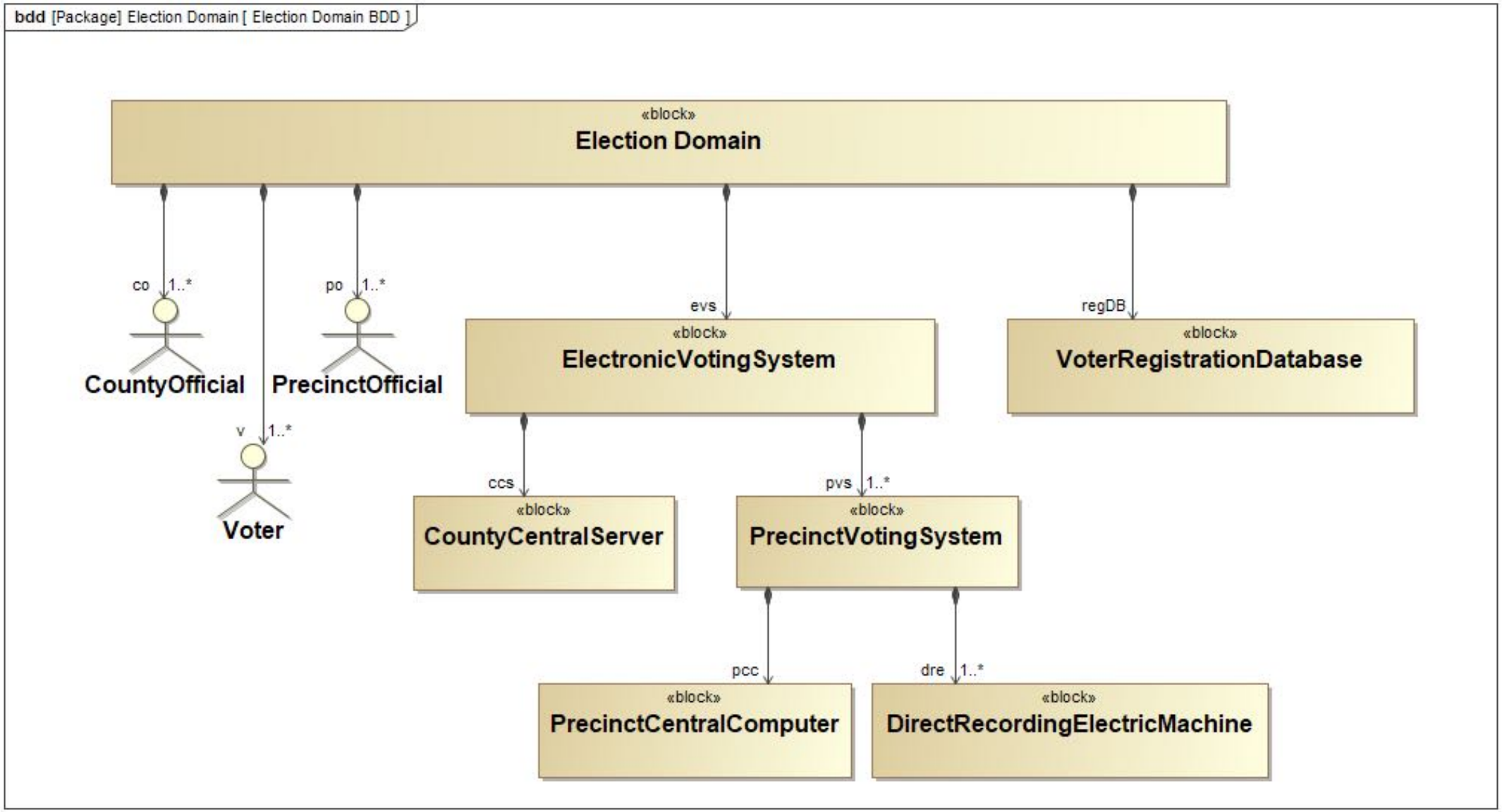
Electronic Voting System Structure



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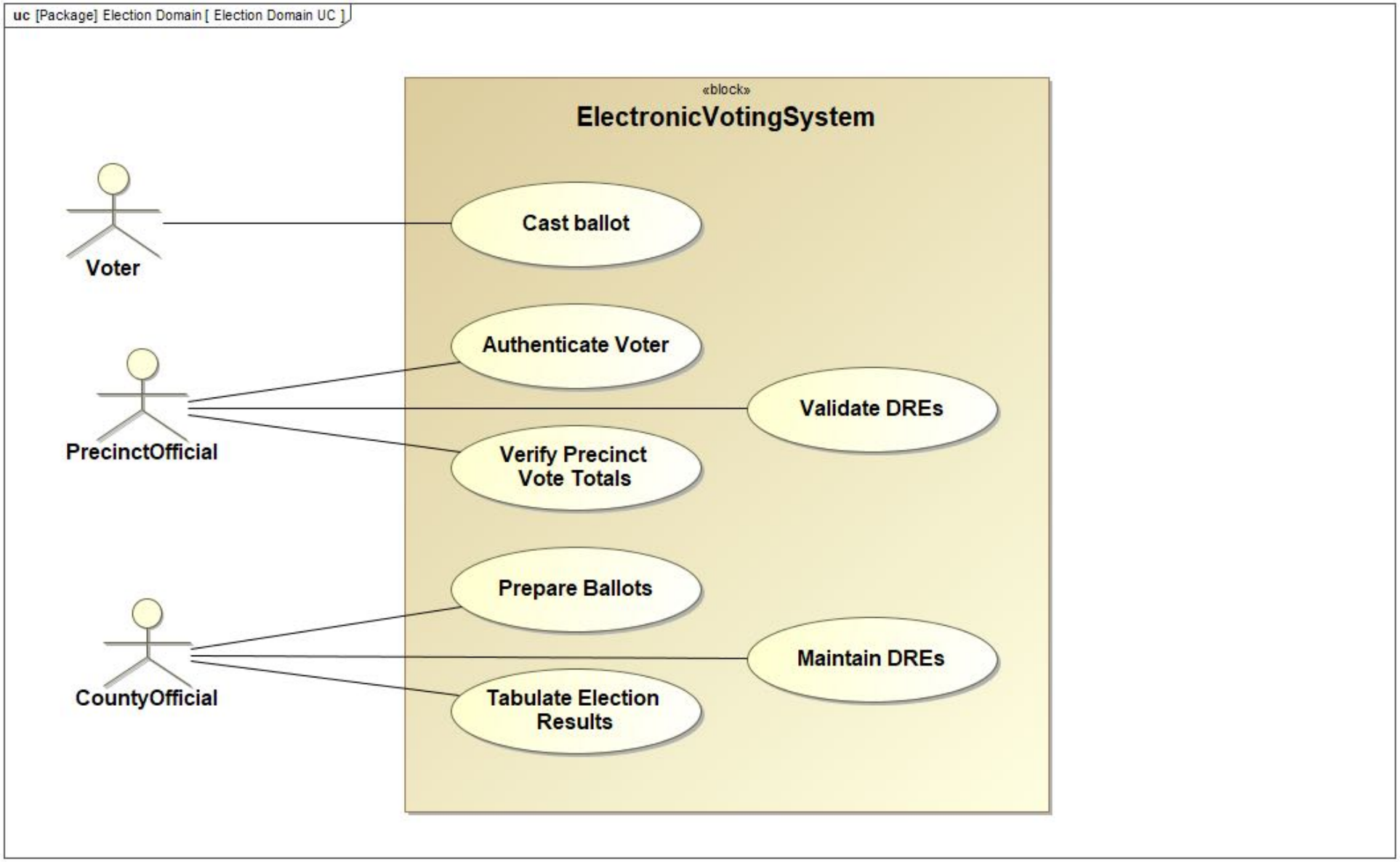
Electronic Voting System Use Cases



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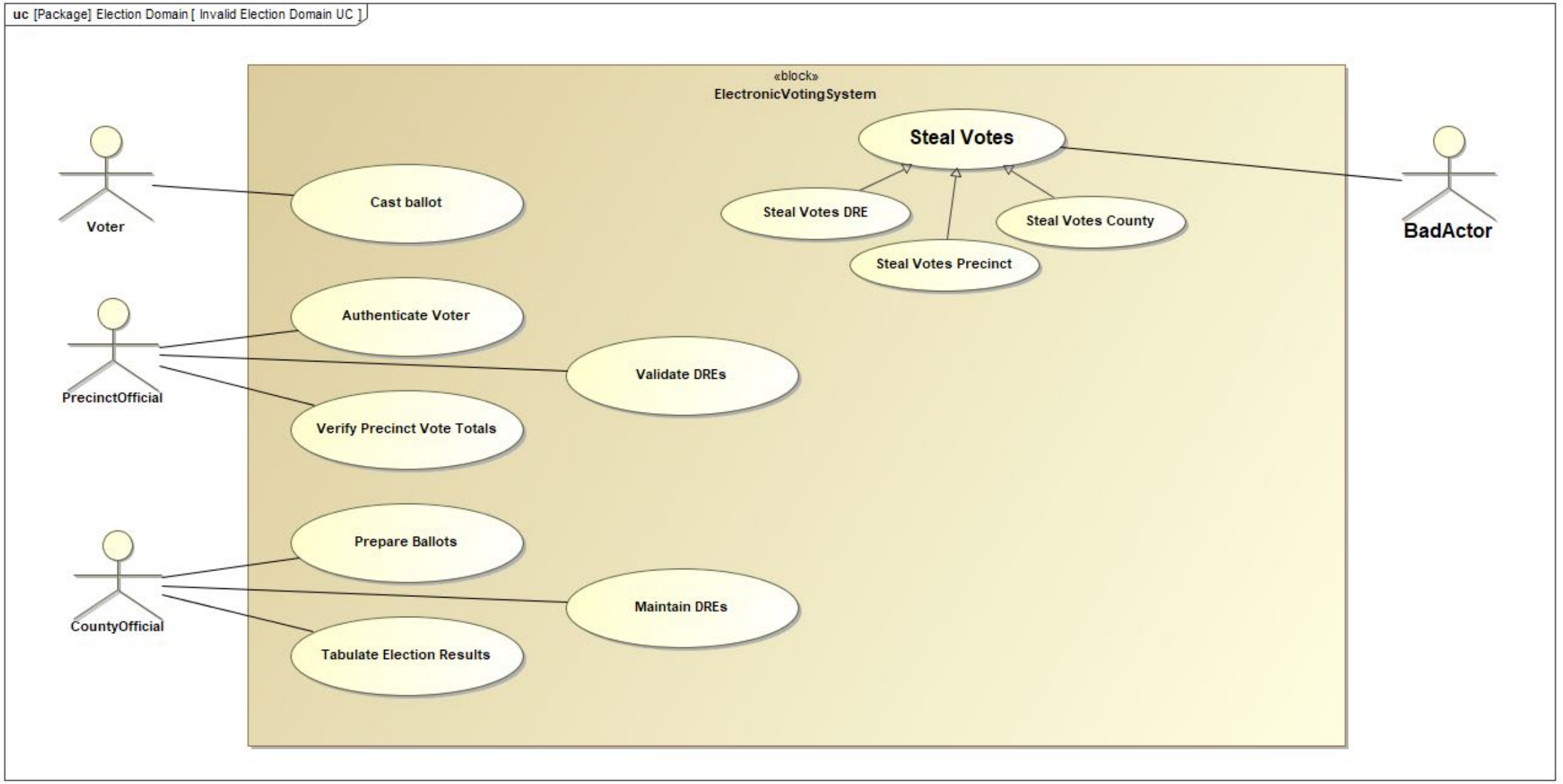
Electronic Voting System Use Cases



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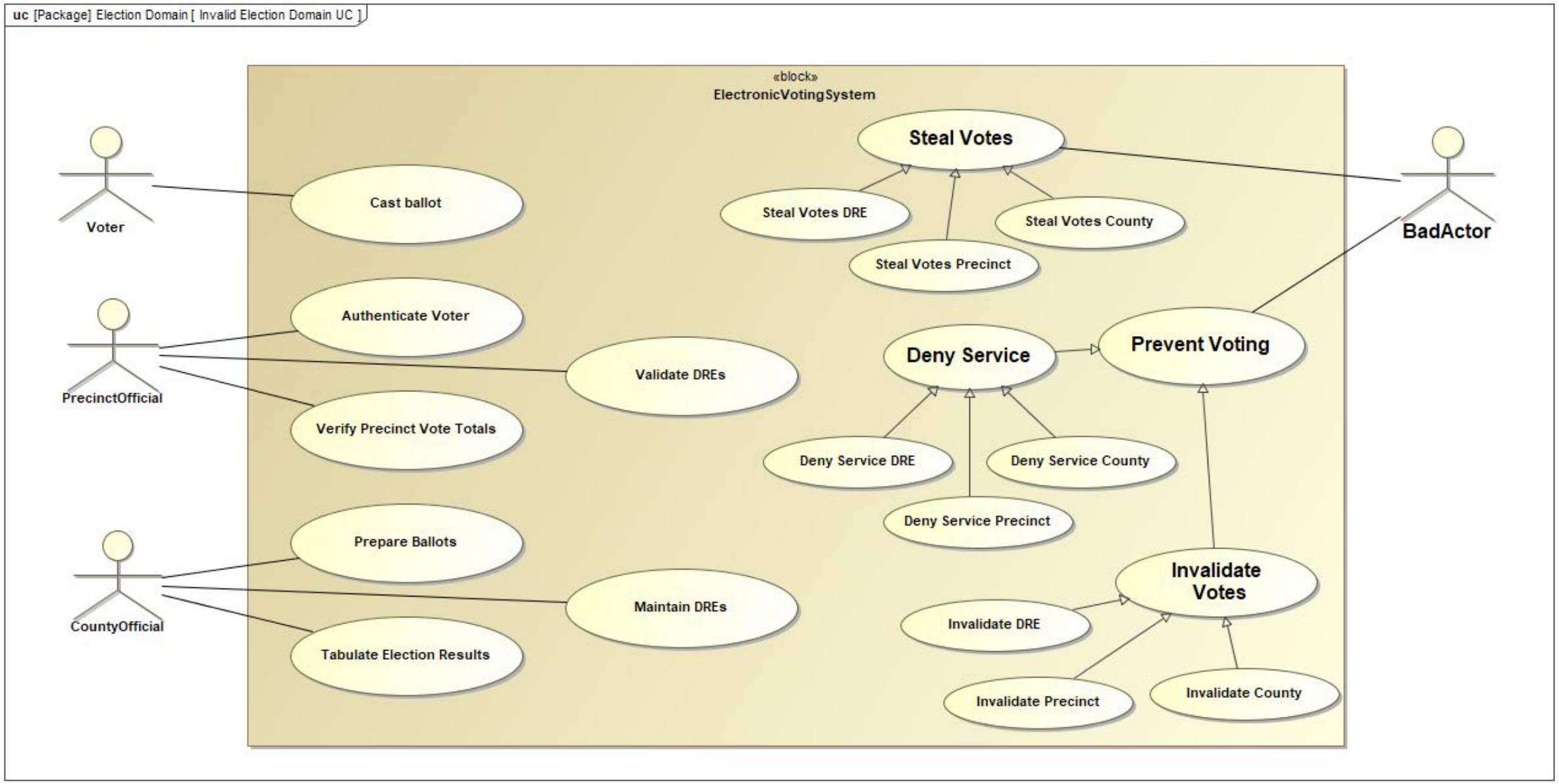
Electronic Voting System Use Cases



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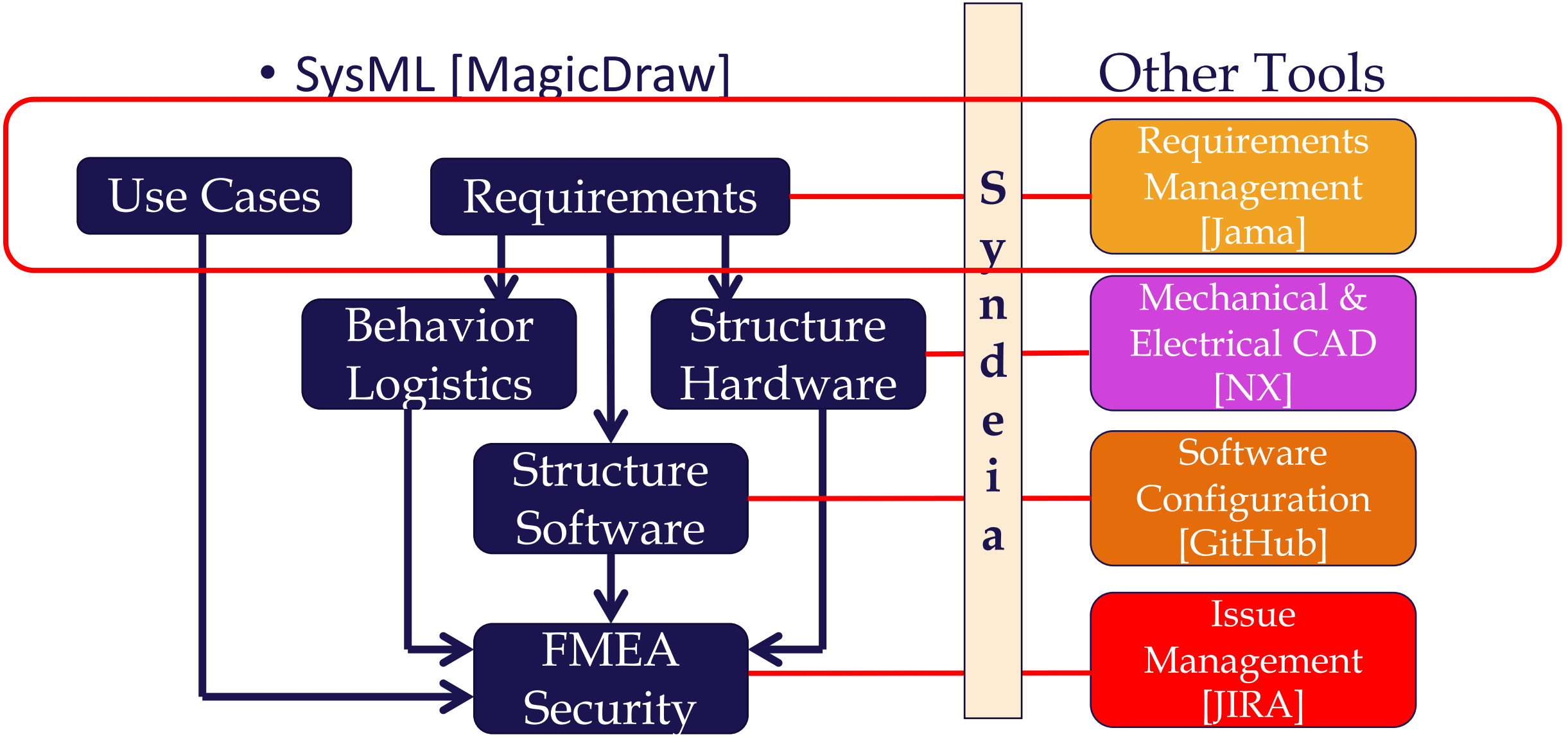
Model Architecture - Requirements



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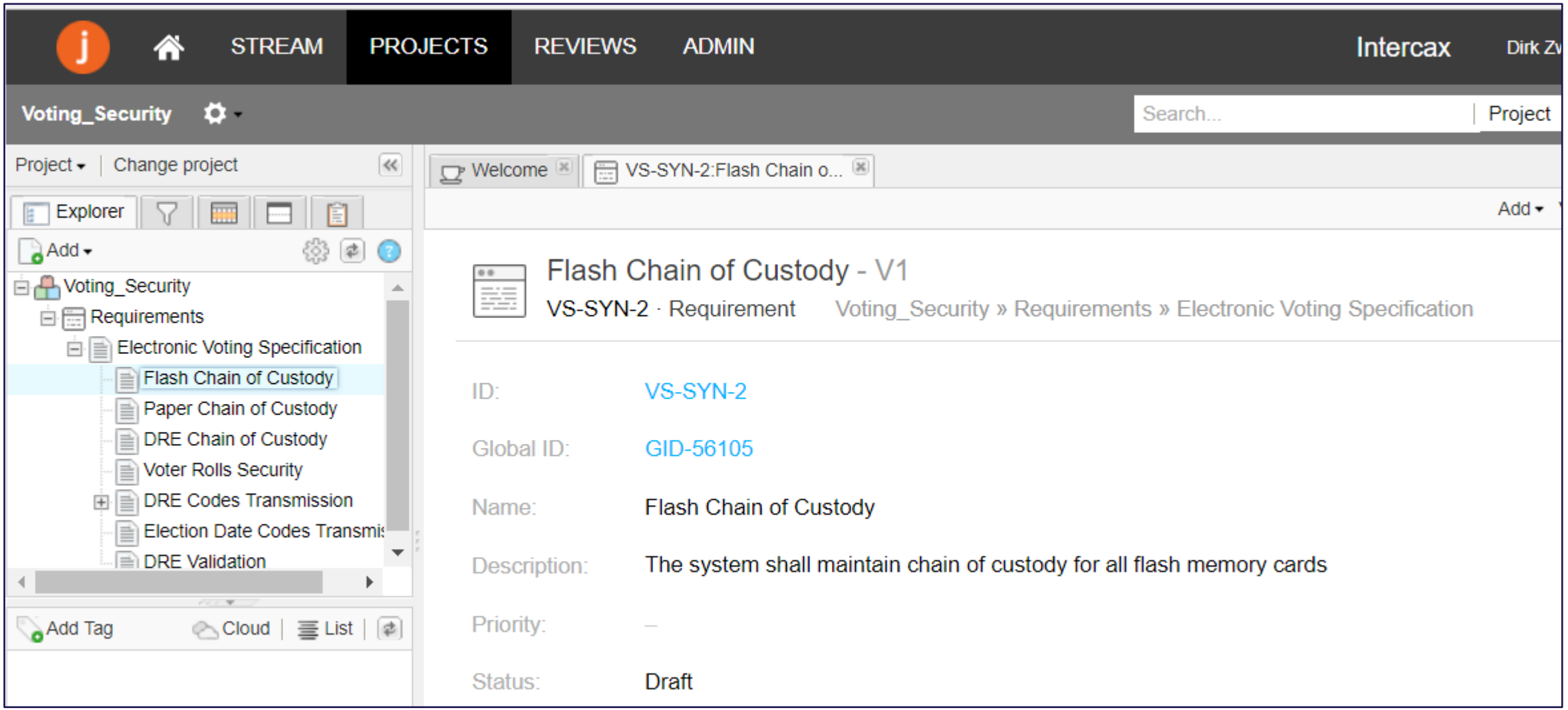
Electronic Voting System Requirements

Populated from Requirements Management Repository (Jama) by Syndeia (Intercax)



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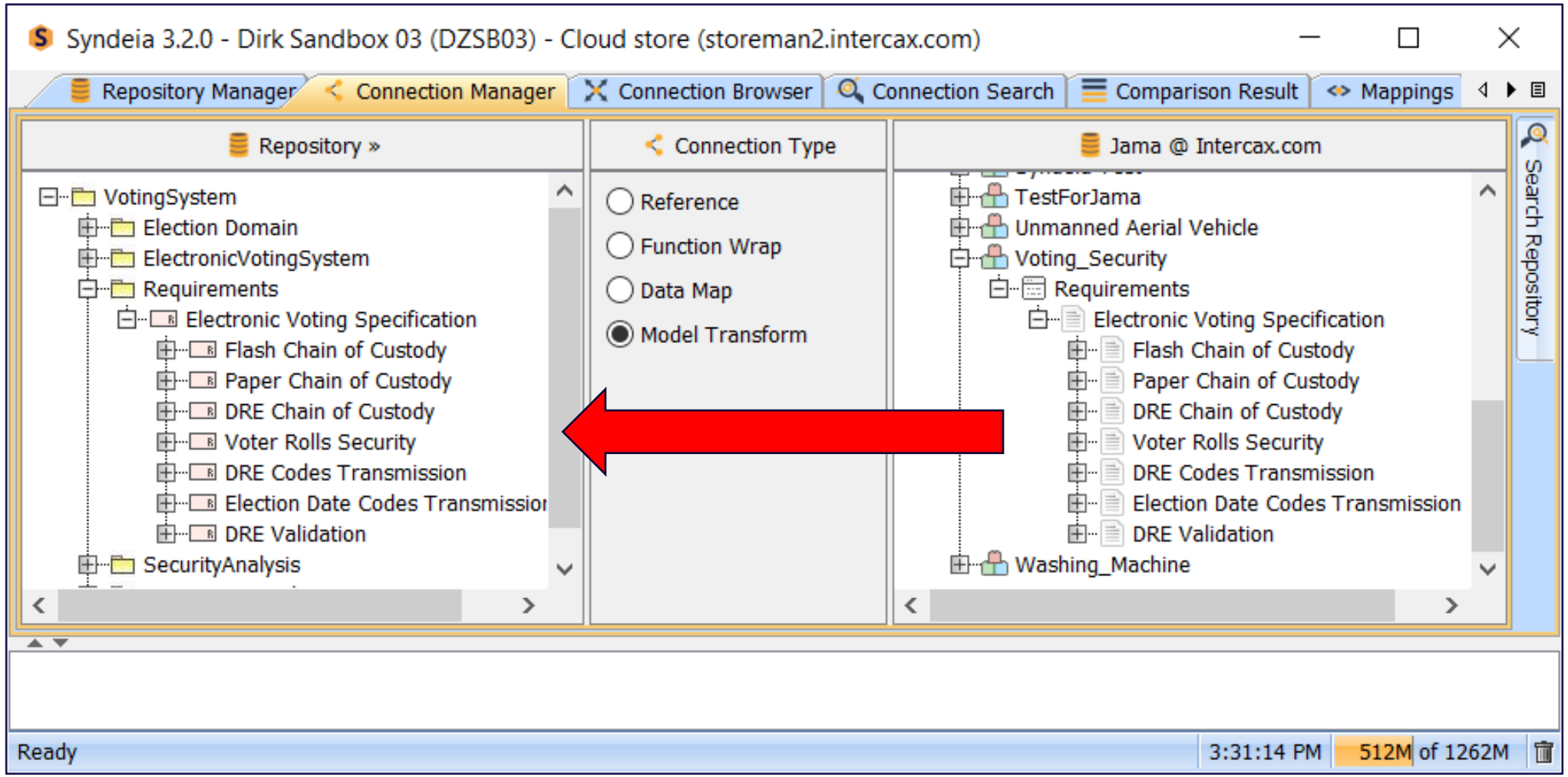

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Electronic Voting System Requirements

Populated from Requirements Management Repository (Jama) by Syndeia (Intercax)

MagicDraw 18.5 - VotingSystem_v6.mdzip [D:\Egnyte\Shared\Publications\Papers and Presentations\2018-07_INCOSE IS 2018 Wash DC\Voting Systems Presentation\1_Draft_Presentation\]

File Edit View Layout Diagrams Options Tools Analyze Collaborate Window Help

Create Diagram

Diagram Containment Structure

Containment

- Model
  - Relations
  - ISO-80000 [ISO-80000.mdzip]
  - MD Customization for Requirements [MD Customiza
  - MD Customization for SysML [MD_customization_for
  - MD Customization for ViewsViewpoints [MD_custom
  - UML Standard Profile [UML_Standard_Profile.mdzip]
  - VotingSystem
    - Election Domain
    - ElectronicVotingSystem
    - Requirements
      - Traceability of Safety And Reliability Analysi
      - Election REQ
      - Requirements
      - GID-56104 Electronic Voting Specification
        - GID-56105 Flash Chain of Custody
        - GID-56106 Paper Chain of Custody
        - GID-56107 DRE Chain of Custody
        - GID-56108 Voter Rolls Security
        - GID-56109 DRE Codes Transmission
        - GID-56111 Election Date Codes Transm
        - GID-56112 DRE Validation
    - SecurityAnalysis
    - VotingSystemLibrary
    - VotingSystem
    - VotingSystem PKG
  - FMEA_profile [FMEA Profile.mdzip]
  - Syndeia_Profile [Syndeia_Profile.mdzip]

Election Domain UC | Invalid Election Domain ... | Setup_Election | Test and Validate DRE | FMEA | DRE Composition BDD | Requirements | DRE_Modes | Elect

Add New | Add Nested | Add Existing... | Delete | Remove From Table | Unnest | Nest | Export

Criteria

Scope (optional): Drag elements from the Model Browser ... Filter:

#	Name	Text
1	GID-56104 Electronic Voting Specification	
2	GID-56105 Flash Chain of Custody	The system shall maintain chain of custody for all flash memory cards
3	GID-56106 Paper Chain of Custody	The system shall maintain chain of custody for all paper documentation1
4	GID-56107 DRE Chain of Custody	The system shall maintain chain of custody for all DRE voting machines.
5	GID-56108 Voter Rolls Security	The system shall use secure authentication methods for voter roll transmission.
6	GID-56109 DRE Codes Transmission	The system shall include specific DRE activation, start and end codes with precinct ballot data on flash memory card.
7	GID-56110 DRE Codes Encryption	The system shall encrypt DRE activation, start and end codes with precinct ballot data on flash memory card.
8	GID-56111 Election Date Codes Transmission	The system shall include specific DRE election date codes with precinct ballot data on flash memory card.
9	GID-56112 DRE Validation	The system will validate all DREs at each precinct location before polls open on election day.

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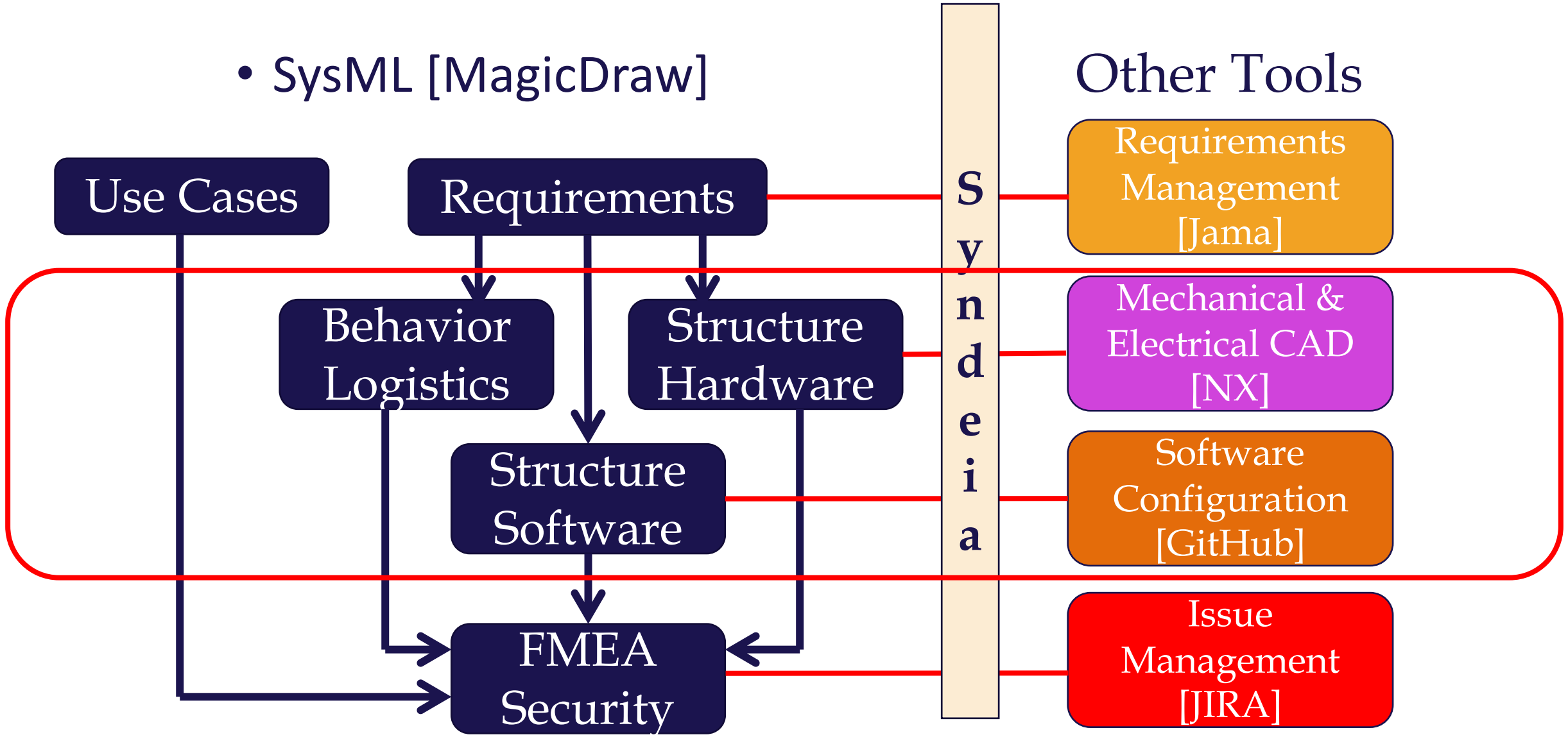
Model Architecture – Hardware, Software and Logistics



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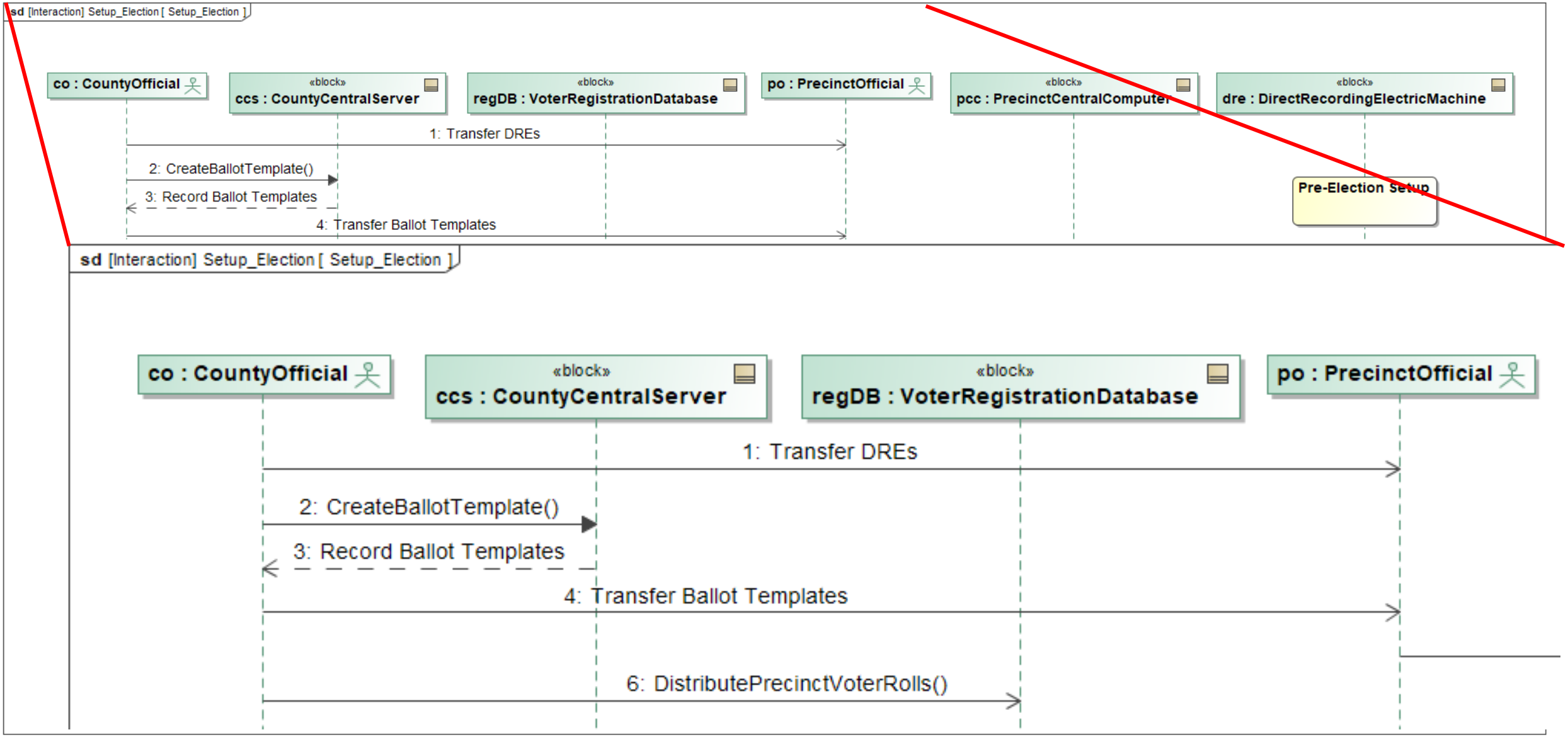
Electronic Voting System Operations



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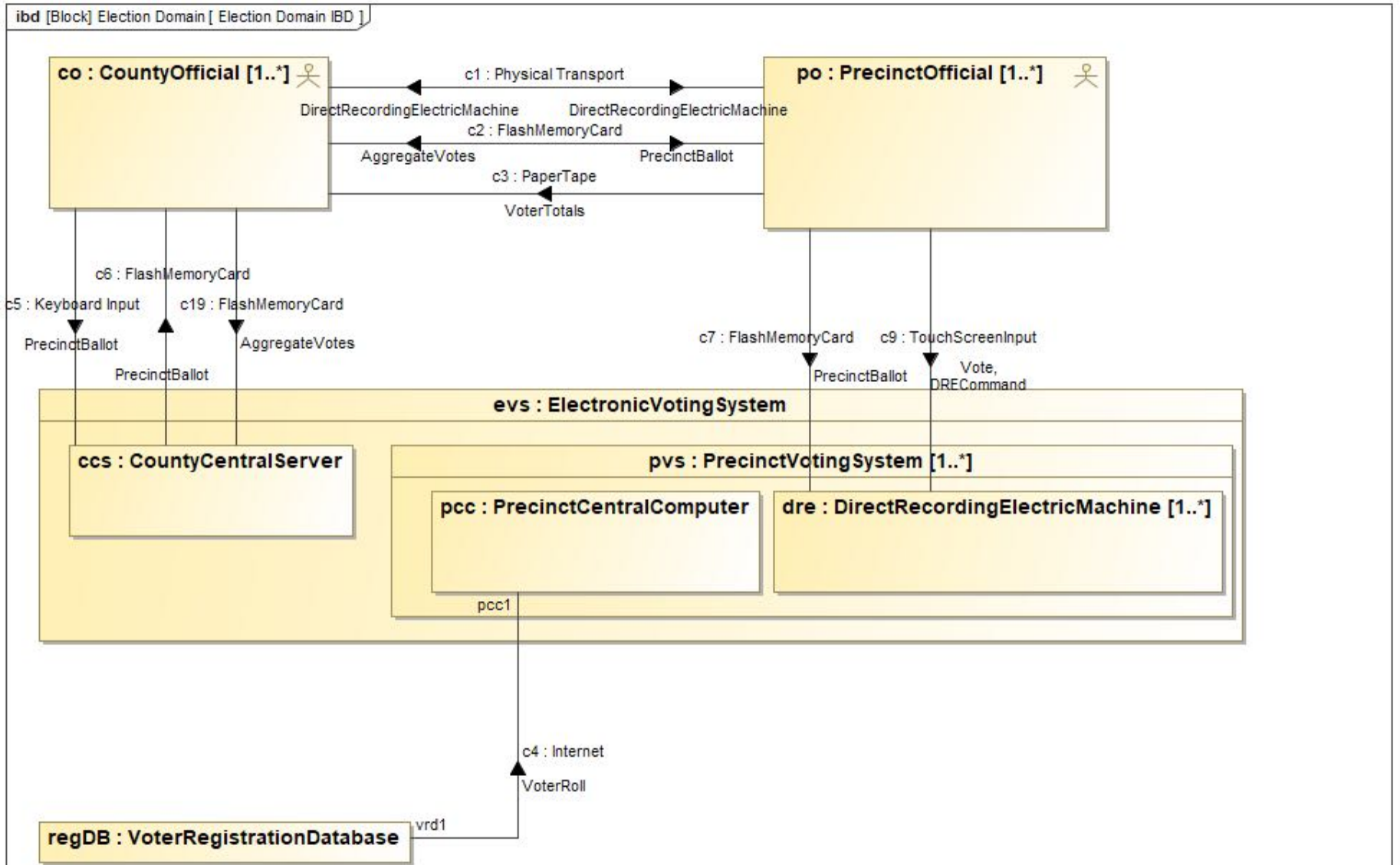
Electronic Voting System Operations



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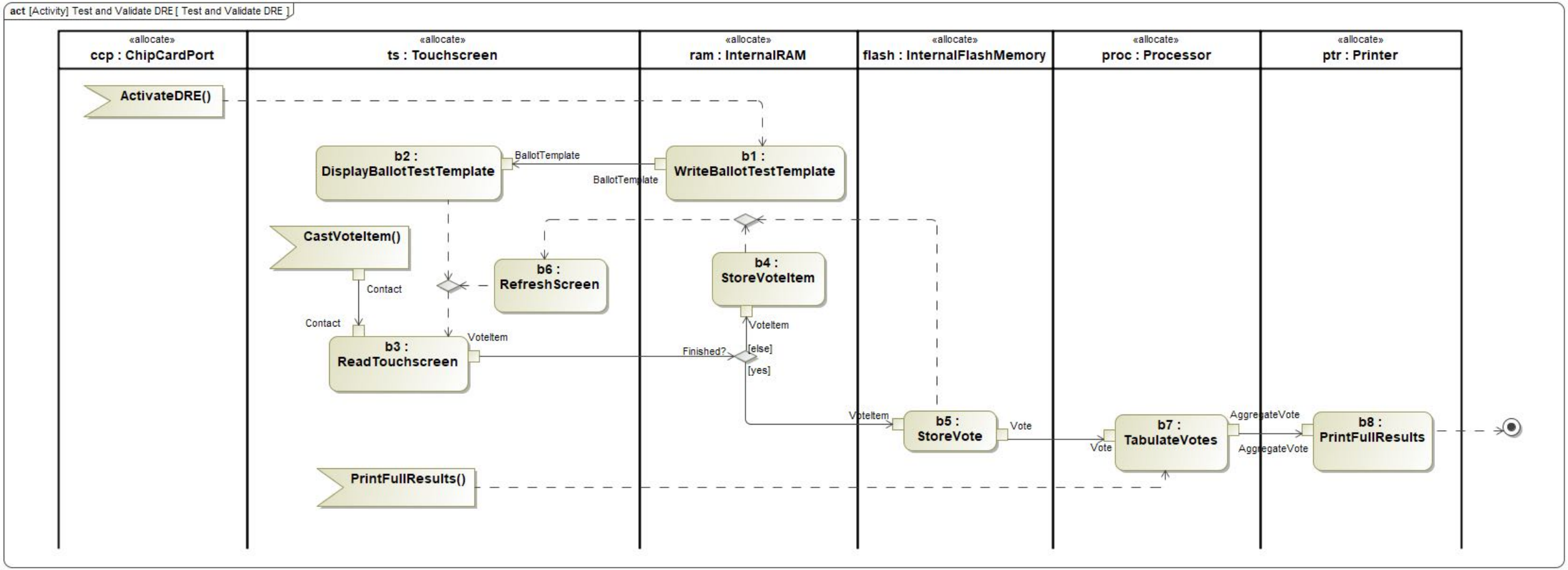
Electronic Voting System Software

- DRE Software functions are linked to GitHub-managed software files by Syndeia



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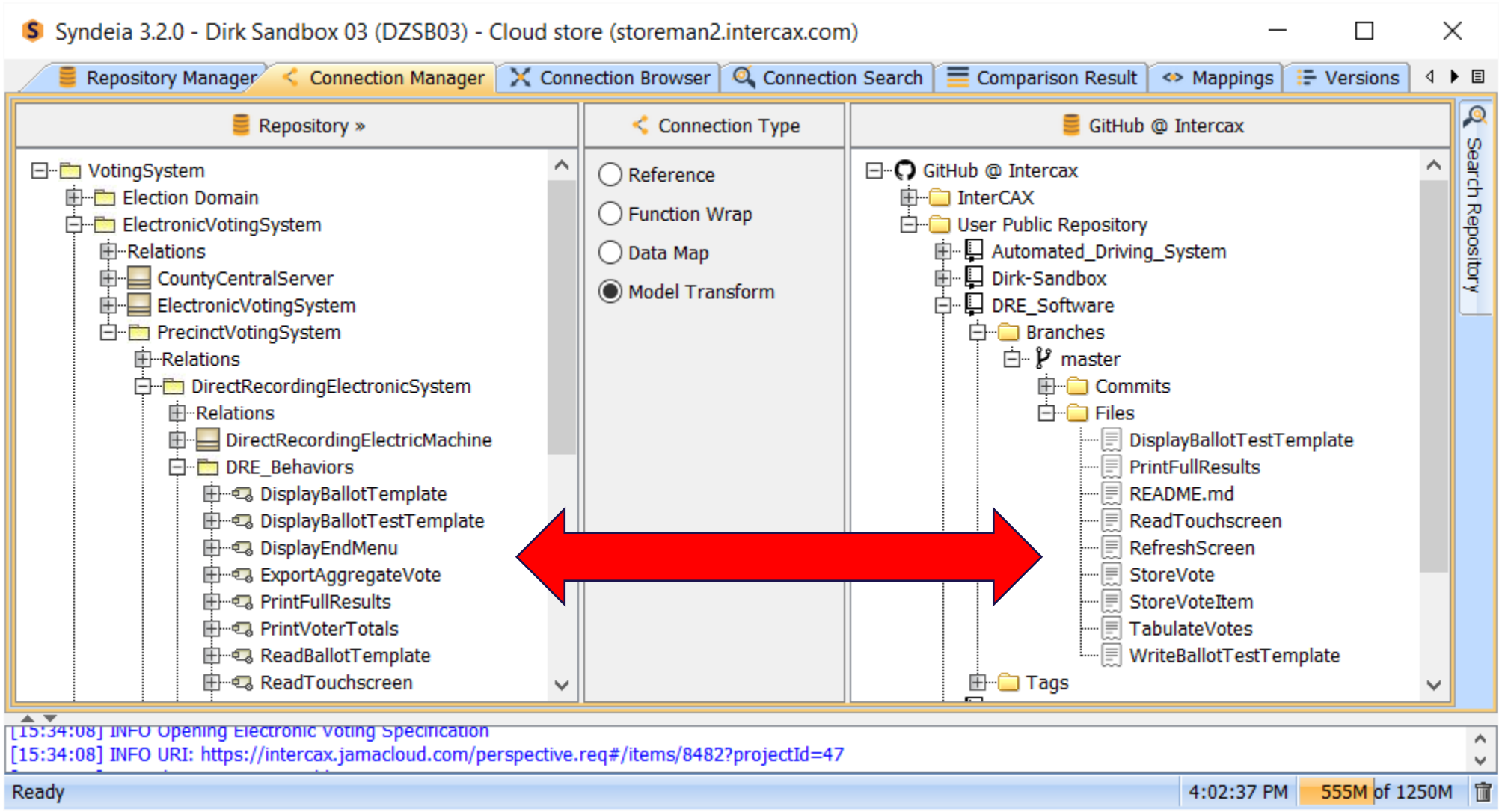

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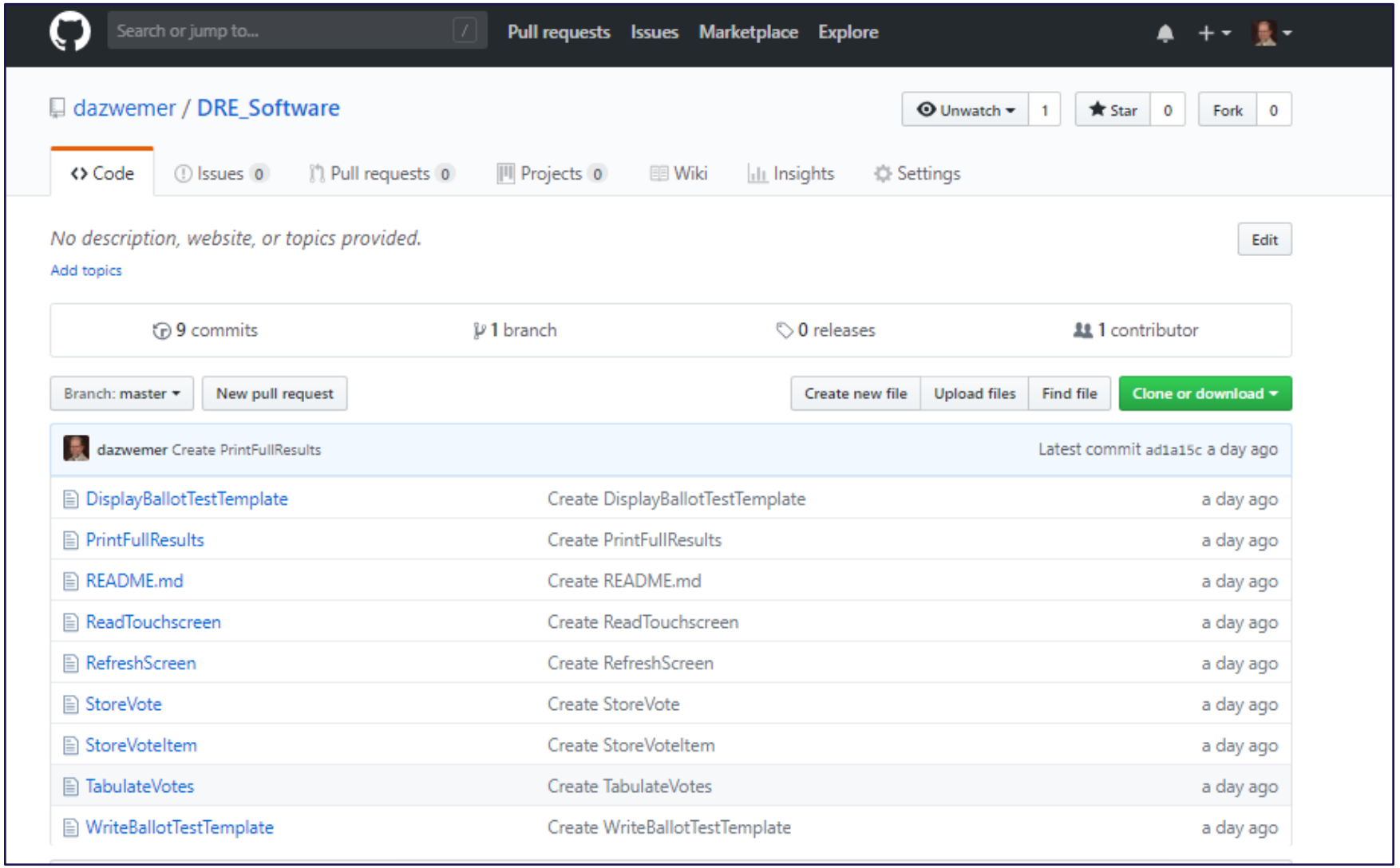

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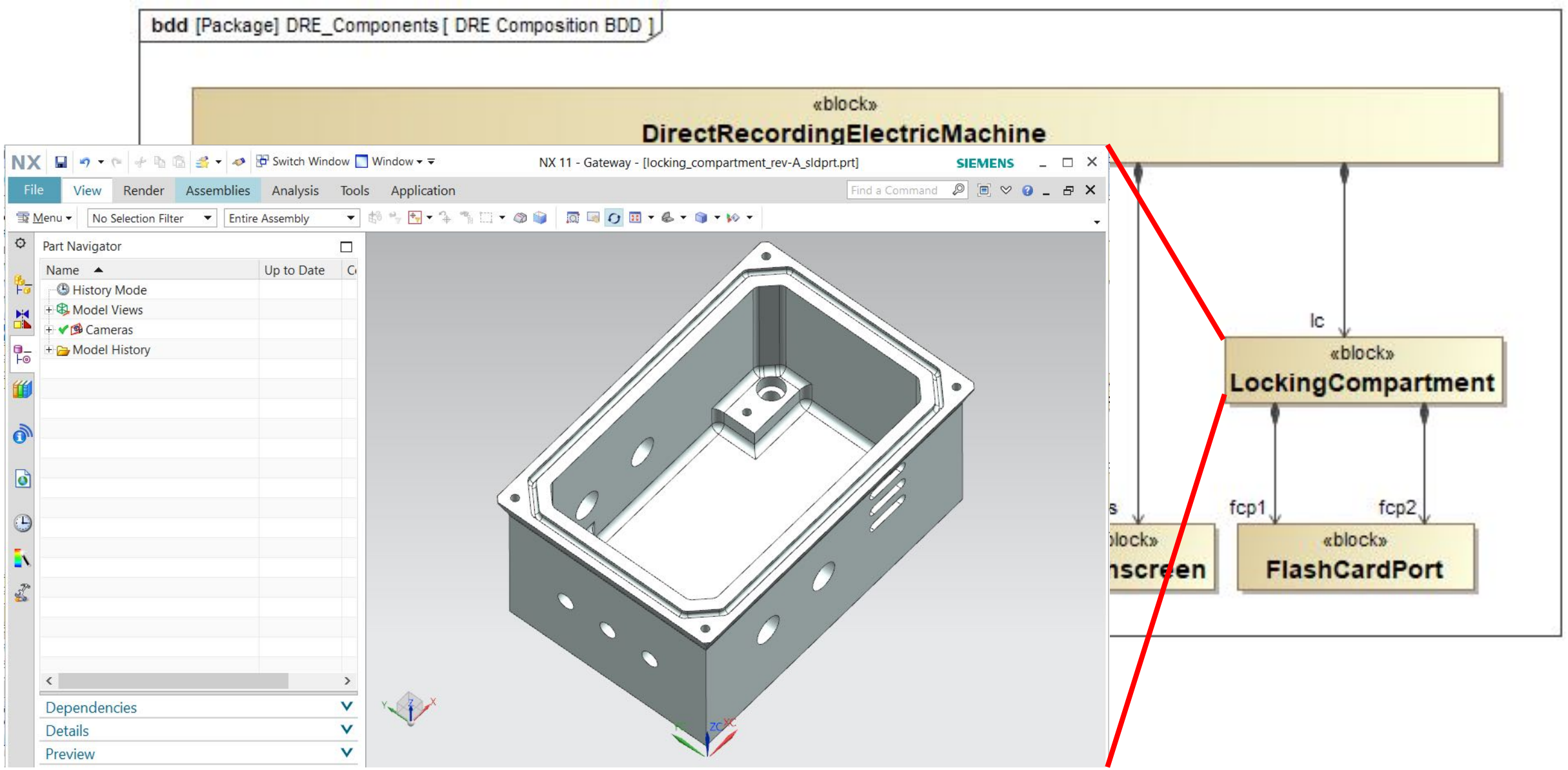
Electronic Voting System Hardware



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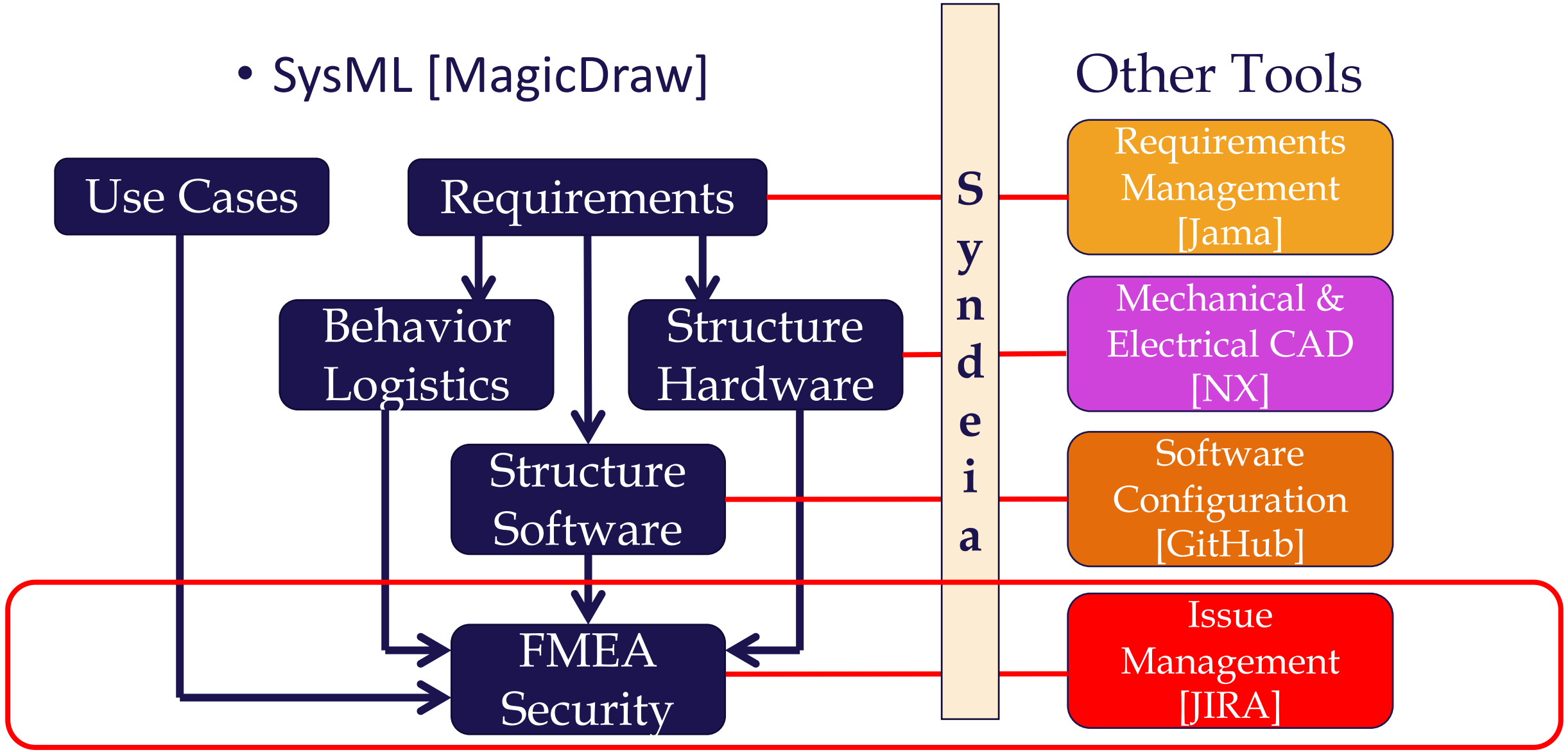
Model Architecture – FMEA and Project Management



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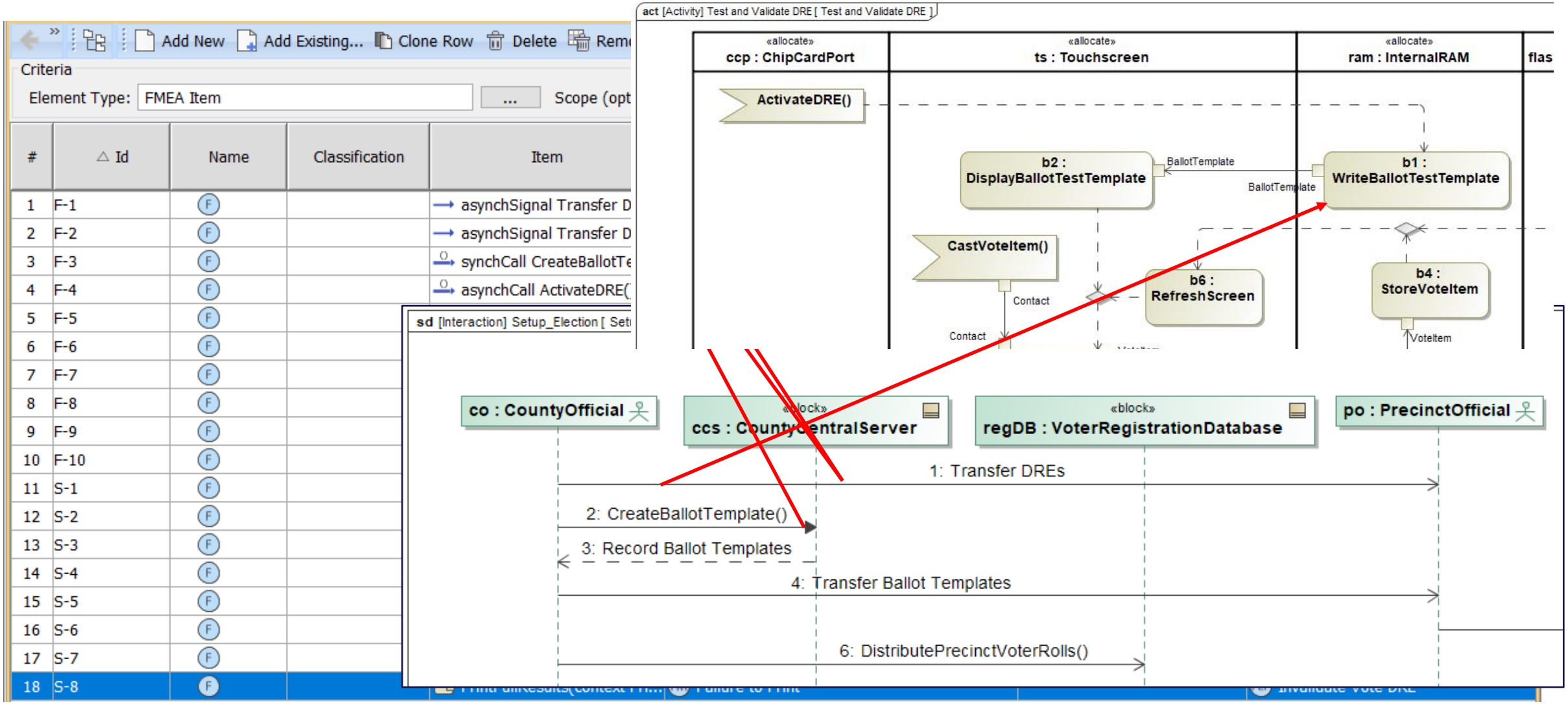
Failure Mode and Effect Analysis

- Failure modes are identified by stepping through the behaviors and structure



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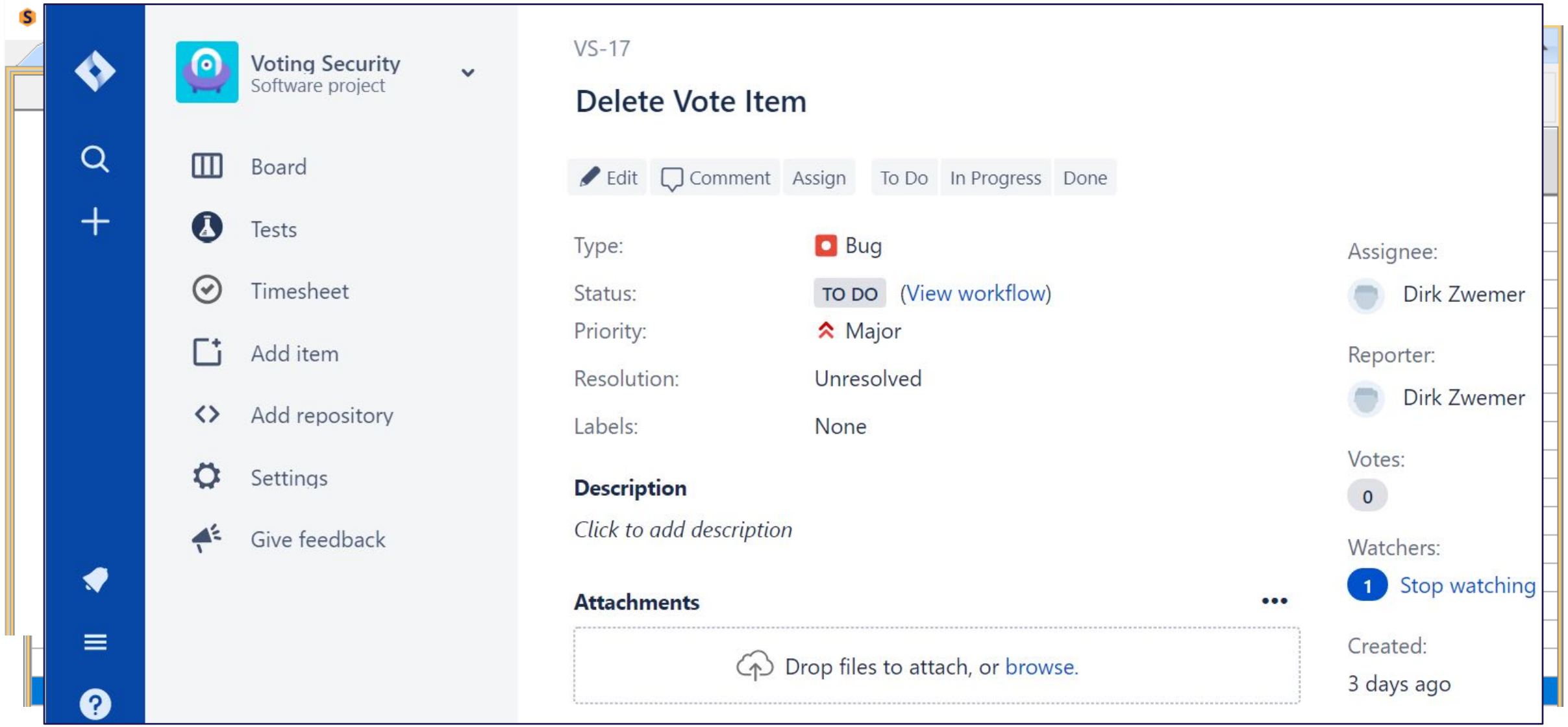
Failure Mode and Effect Analysis

- Failure modes are connected to JIRA issues for tracking mitigation action



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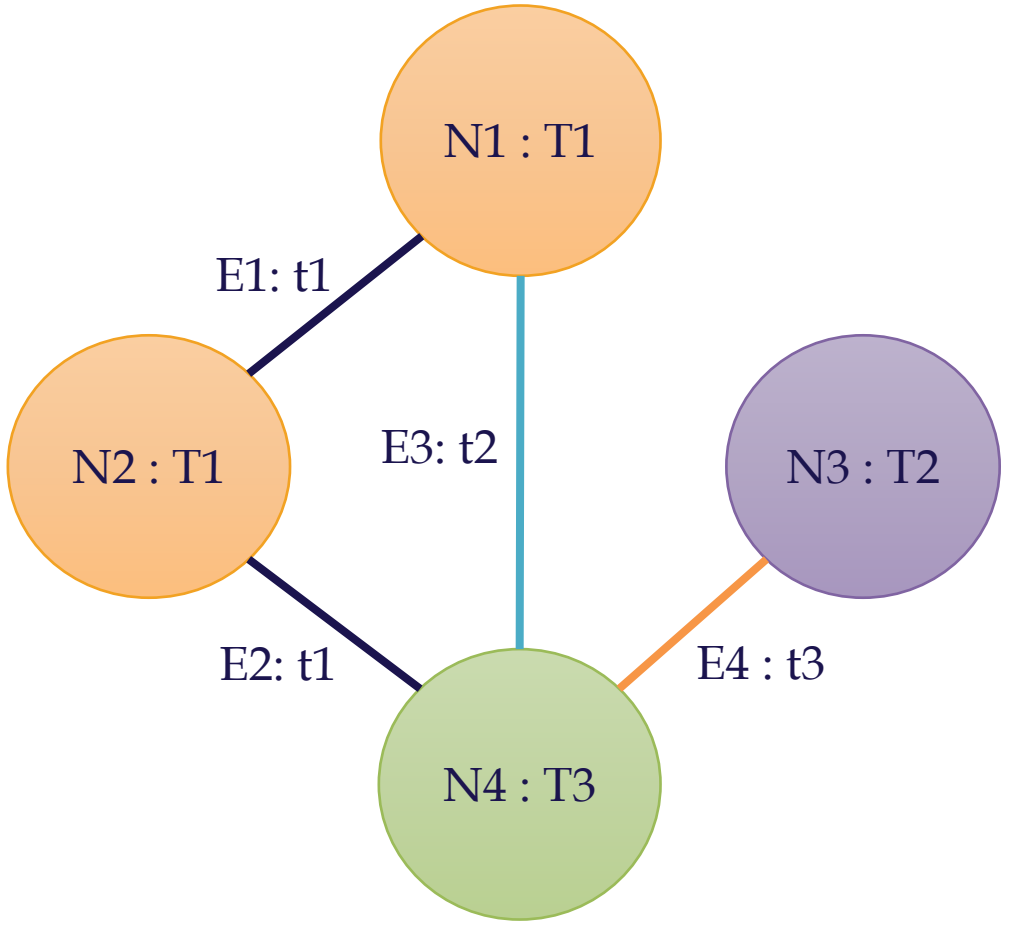
Graphs

Graph Theory drives social networks like Facebook and LinkedIn

Systems engineering needs to take advantage of the same capabilities



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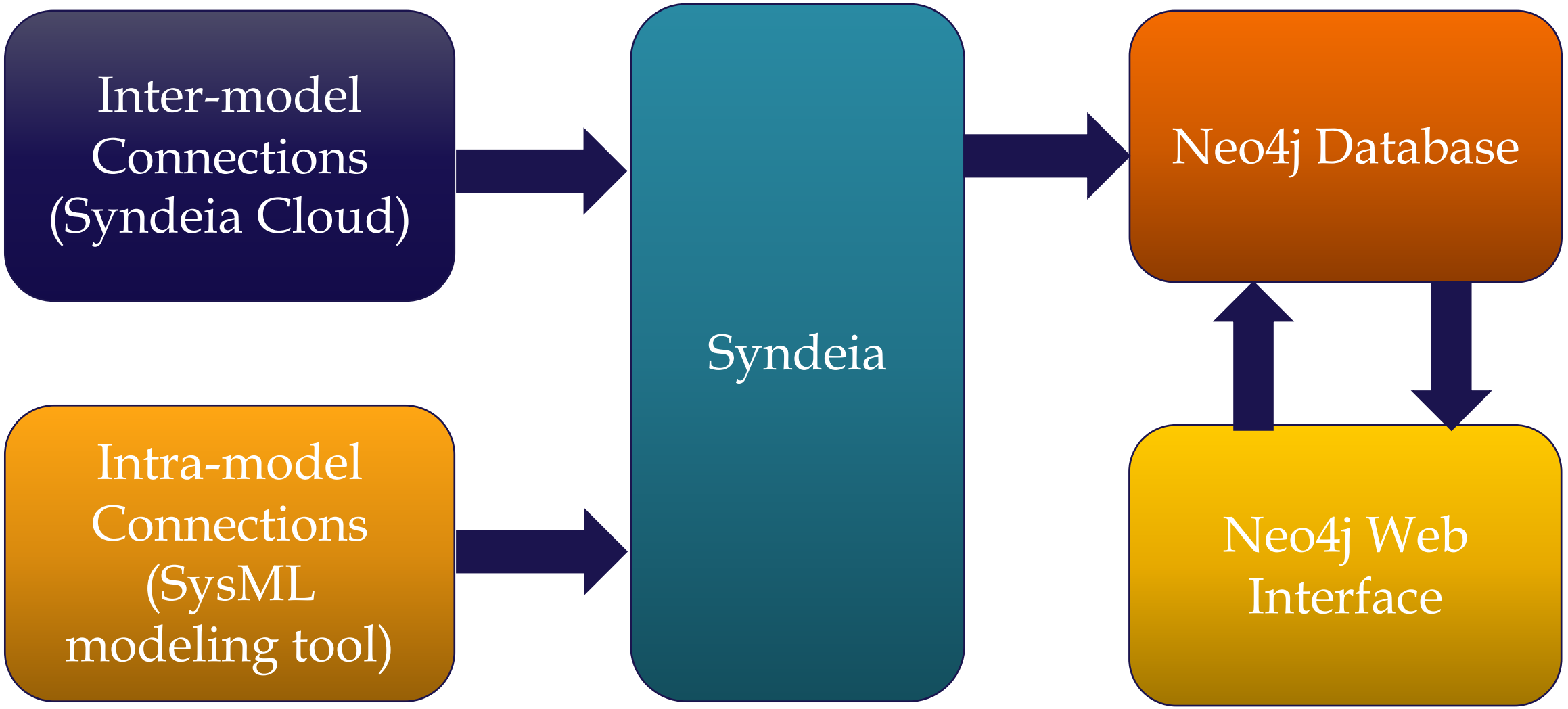
Syndeia Graphs



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Graph Queries on the Total System Model

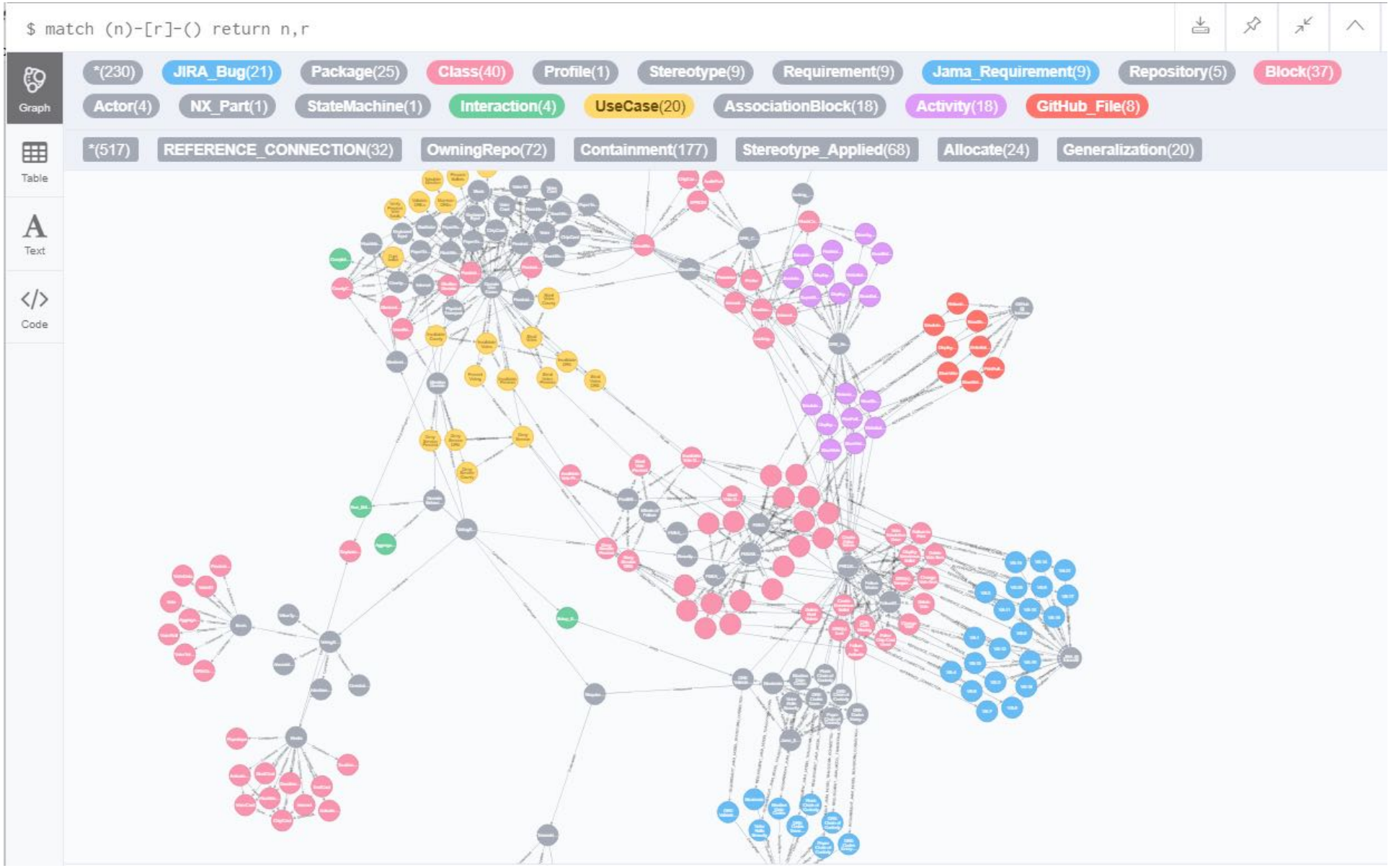
Show Everything

230 nodes

517 edges

Elements:

- SysML
- Jama
- JIRA
- GitHub
- NX



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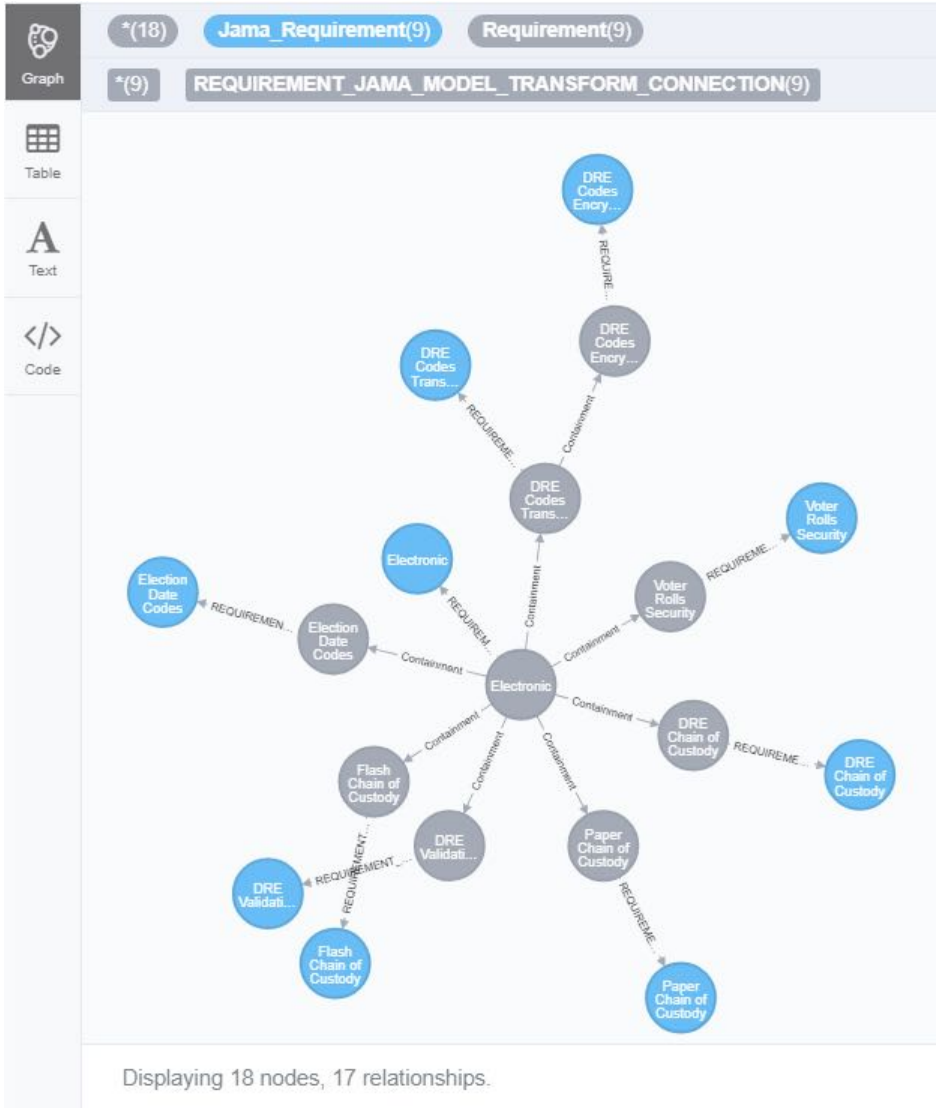
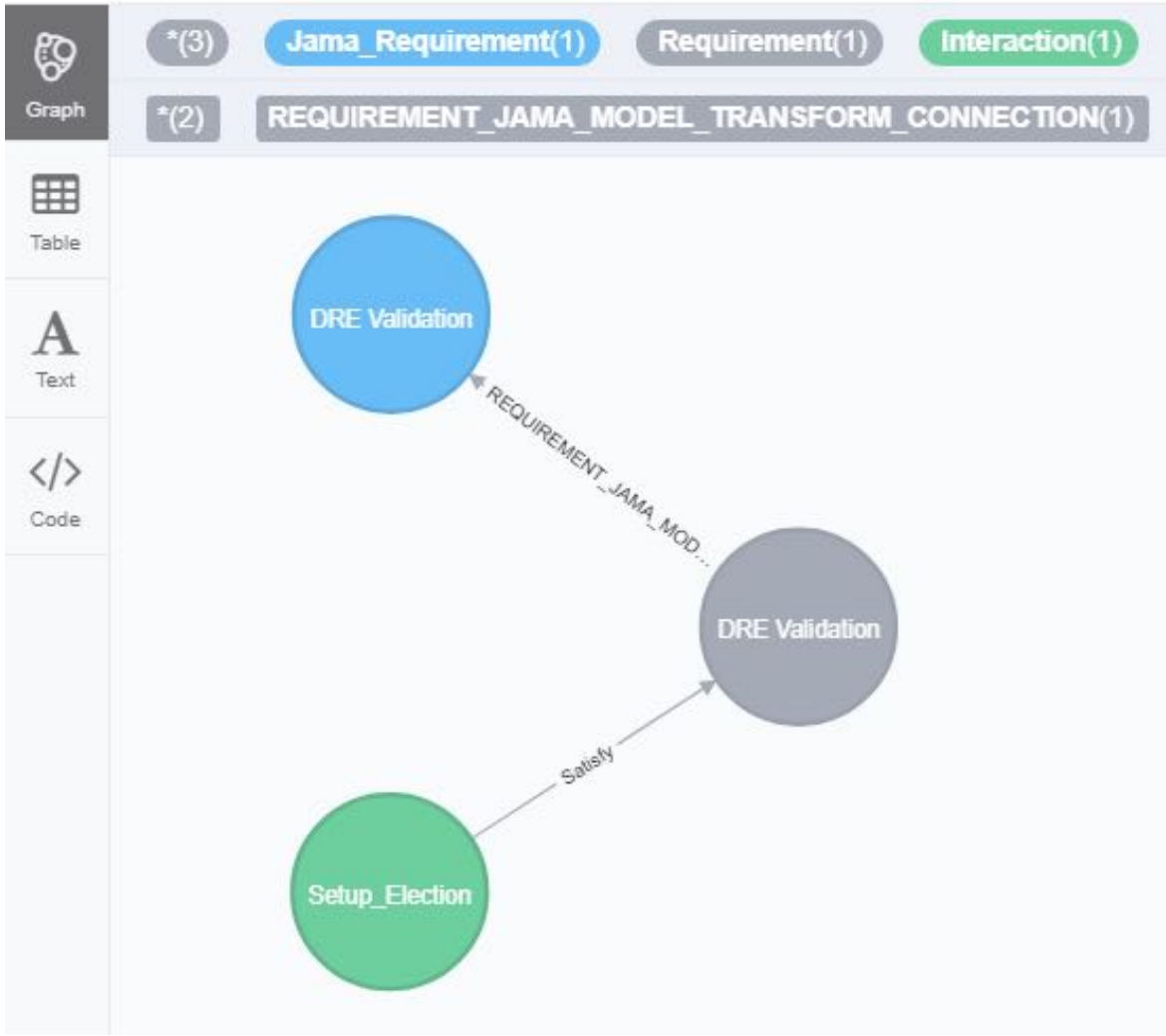
Graph Queries on the Total System Model

Show all Jama requirements



Show all “Satisfied” Jama requirements



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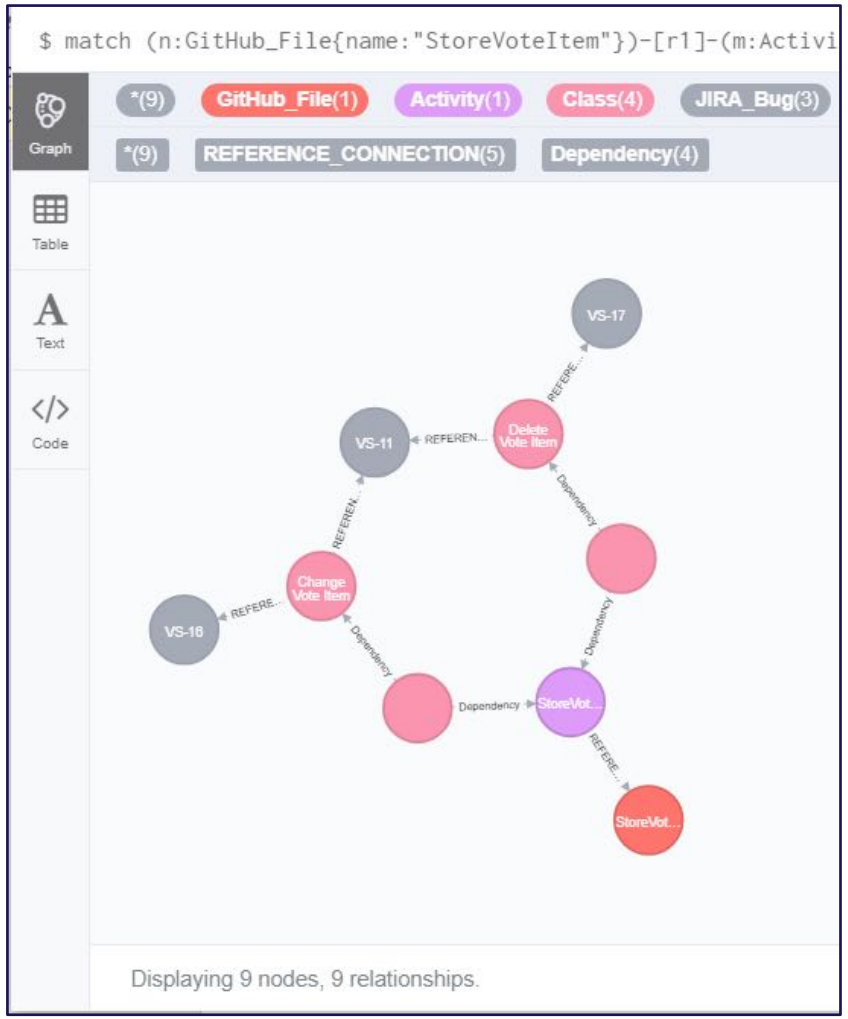
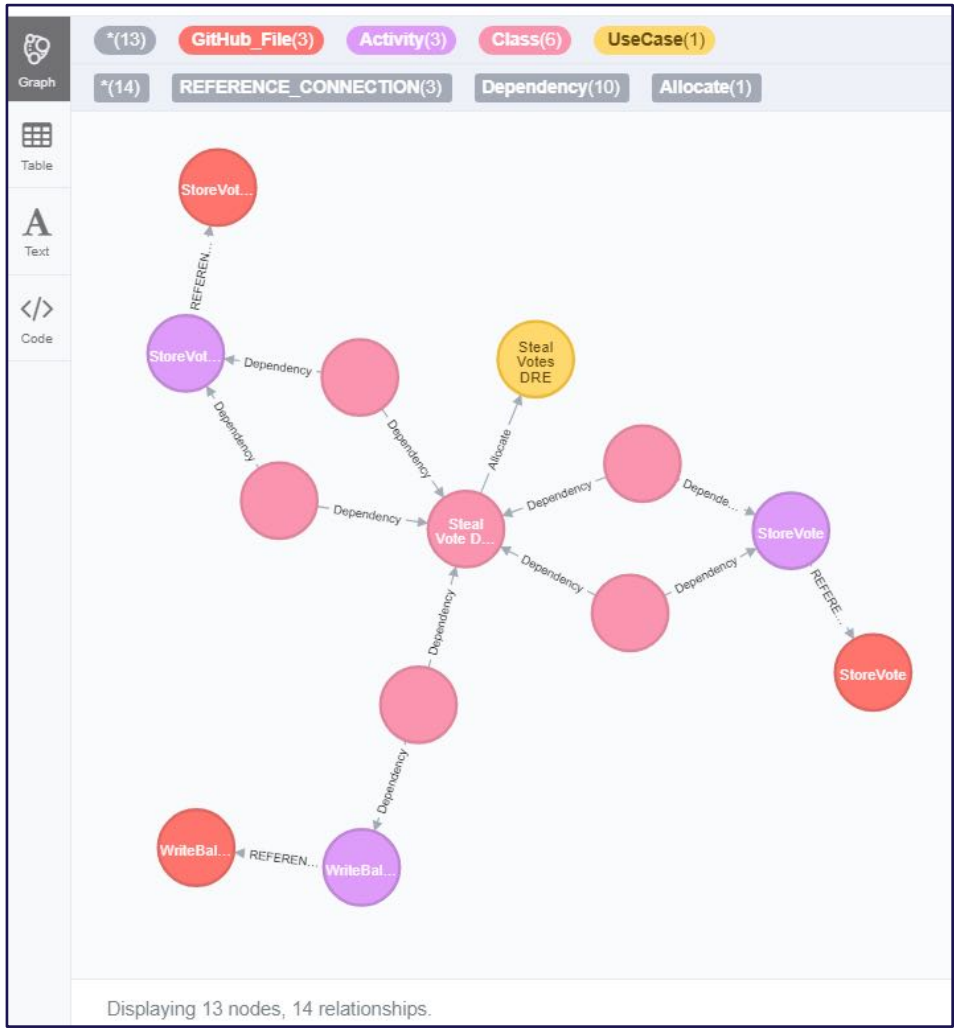
Graph Queries on the Total System Model

Show all JIRA issues connected to GitHub file “StoreVoteItem”



Show all GitHub files connected to use case “Steal Votes DRE”



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- Check out our website for product info and video demonstrations at www.intercax.com/syndeia
- Schedule a web demo with Intercax – contact us at info@intercax.com
- Request an evaluation license – set up an account and submit your request at www.intercax.com/help

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Appendix

Intercax Snapshot

- Born: Georgia Tech spin-off 2008
- Location: Perimeter Center, Atlanta; Pune IT Park, Pune, India
- Focus: Software for MBSE
  - **Syndeia -** PLM/CAD/CAE/ALM Integration with SysML
  - SysML parametric solvers (**ParaMagic, Melody, ParaSolver, Solvea**)
- Training and Custom Development
  - 4000+ students since 2008
- Customers
  - Aerospace, Automotive, Defense, others

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Benefits – Communication and Change Management

- Syndeia can enhance communication between departments, navigate across system data for design reviews, and support failure and safety analysis.
  - Have any requirements impacting my design changed since time A?
  - Where is the test data for design variant B?
  - What was the total product configuration on date C?

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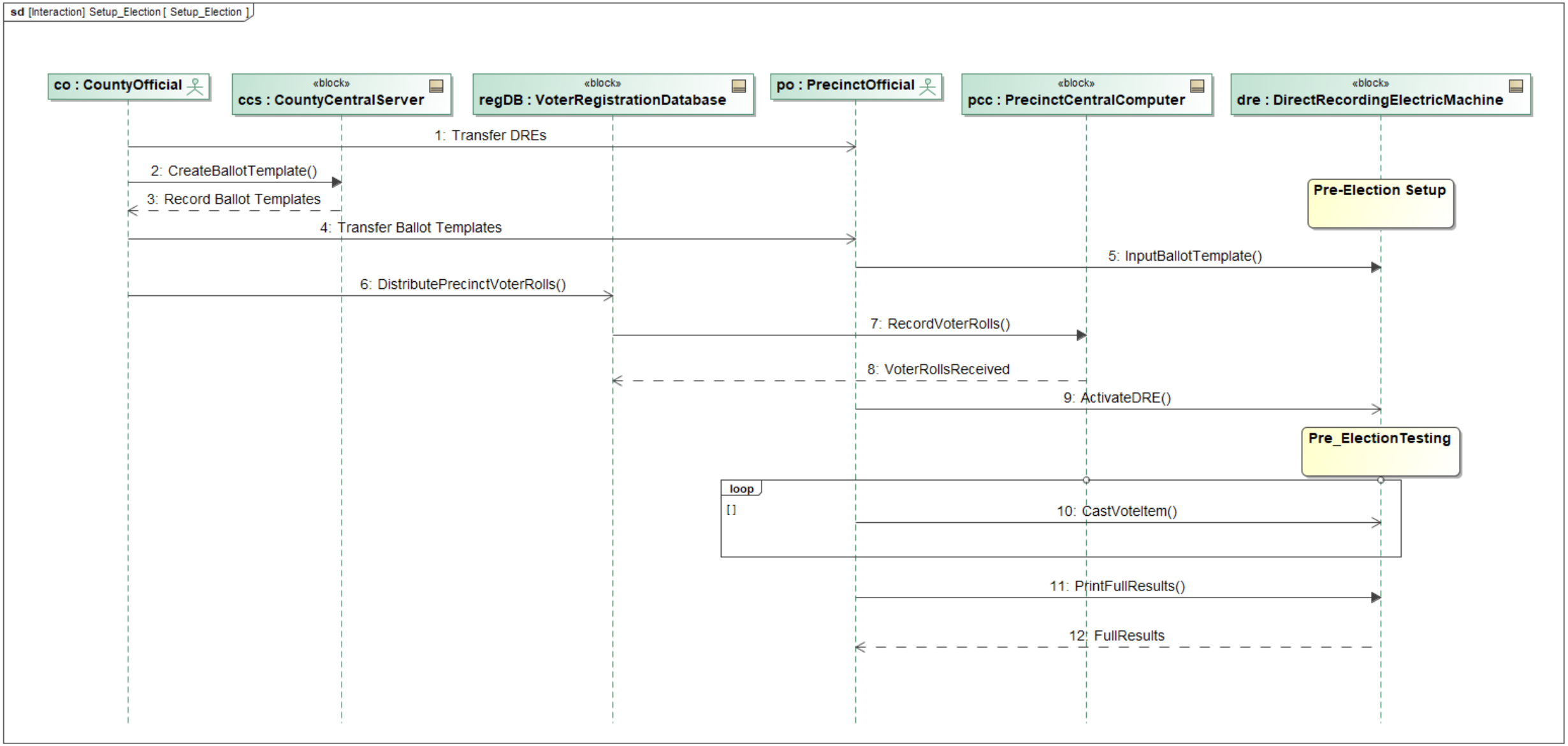
Electronic Voting System Operations



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