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Sandia National Laboratories

US NDC Modernization

US NDC Modernization Project Overview

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US NDC Modernization Goals

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1. *Re-architect US NDC software using modern practices*
   - Rational Unified Process (RUP)
   - Model-Based software architecture
2. Enhance existing mission capabilities
   - Improve analyst tools & workflow – e.g. undo/redo
3. Support incremental improvement
   - Service Oriented Architecture (SOA)
   - Updated data model & common object interface
4. Develop/integrate state-of-the-art algorithms
   - e.g. NNSA R&D
5. Design for platform independence
   - Open platforms to reduce vendor lock (hardware, operating system, database
6. Integrate improved geophysical models
   - e.g. NNSA R&D
7. Test to ensure success
   - Integrated system and mission test capability
8. Address new System Requirements Document (SRD) elements
   - Geographic processing configuration model
   - Capture and use processing history

Current Work

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- Scope: specify and design a new US NDC architecture using Rational Unified Process (RUP)

- RUP Phases
  - **Inception – scope the system**
  - **Elaboration – architecture/analysis**
  - Development – software development
  - Transition – deploy the system

The current SNL project

Future work being specified

- 6-Month Iterations

	FY12	FY13		FY14		FY15		FY16-TBD
Phase	Inception			Elaboration				Development-Transition
Iteration	Plan	I-1	I-2	E-1	E-2	E-3	E-4	TBD

We Are Here

What is RUP?

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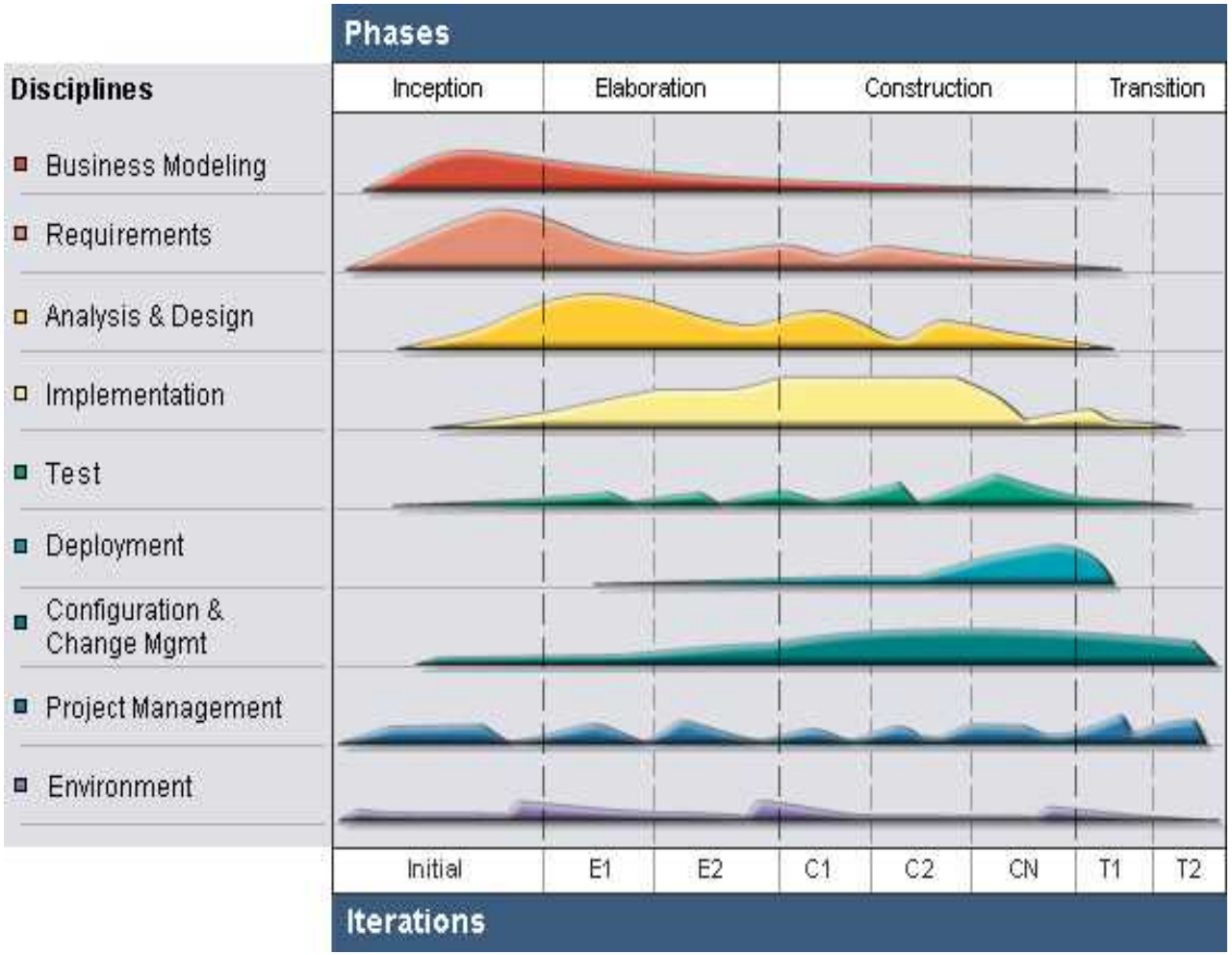
- The Rational Unified Process (RUP) is a Software Engineering Process framework
  - Disciplined approach to task assignment
  - Based on “best practices” in modern software development
  - *Tailored* to individual projects

- RUP is
  - Iterative
  - Use Case Driven
  - Architecture Centric and Risk Driven
  - Object Oriented Methodology
  - Modeled with Unified Modeling Language (UML)
  - Supported by an integrated tool set

RUP Phases and Disciplines



Best Practices

- Develop iteratively to reduce risk
- Manage requirements
- Employ a component-based architecture
- Model software visually
- Continuously verify quality
- Control changes

Key Principles

- Adapt the Process
- Balance Competing Stakeholder Priorities
- Collaborate Across Teams
- Demonstrate Value Iteratively
- Elevate Level of Abstraction
- Focus Continuously On Quality

Architecture Views

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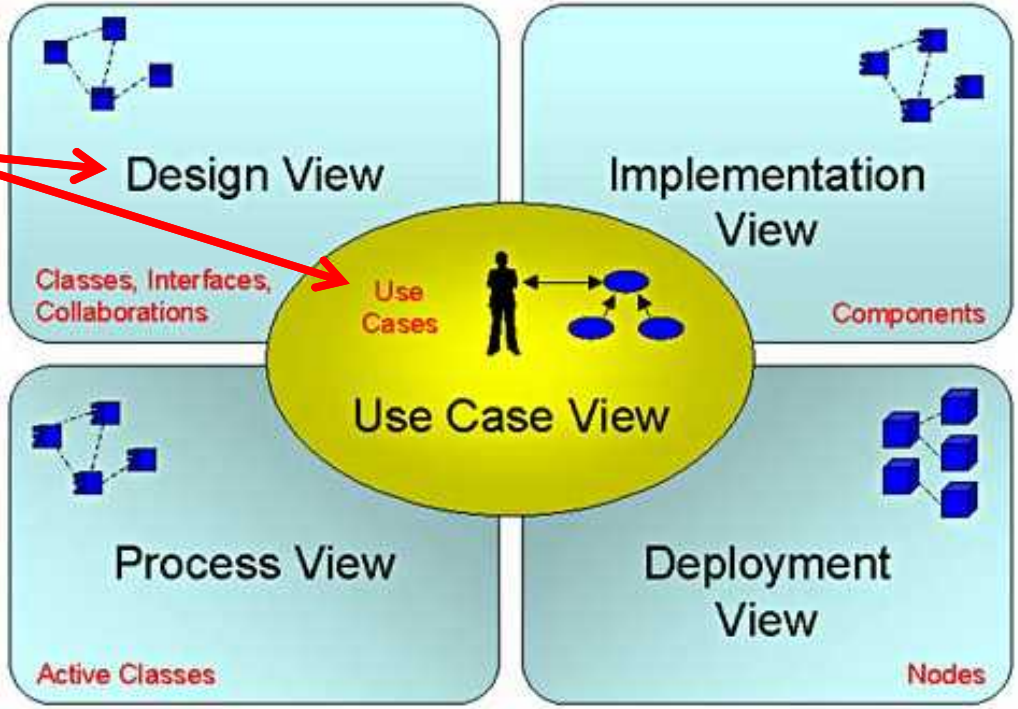
Analysis
Software Design

Programmers
Software organization

We Are Here

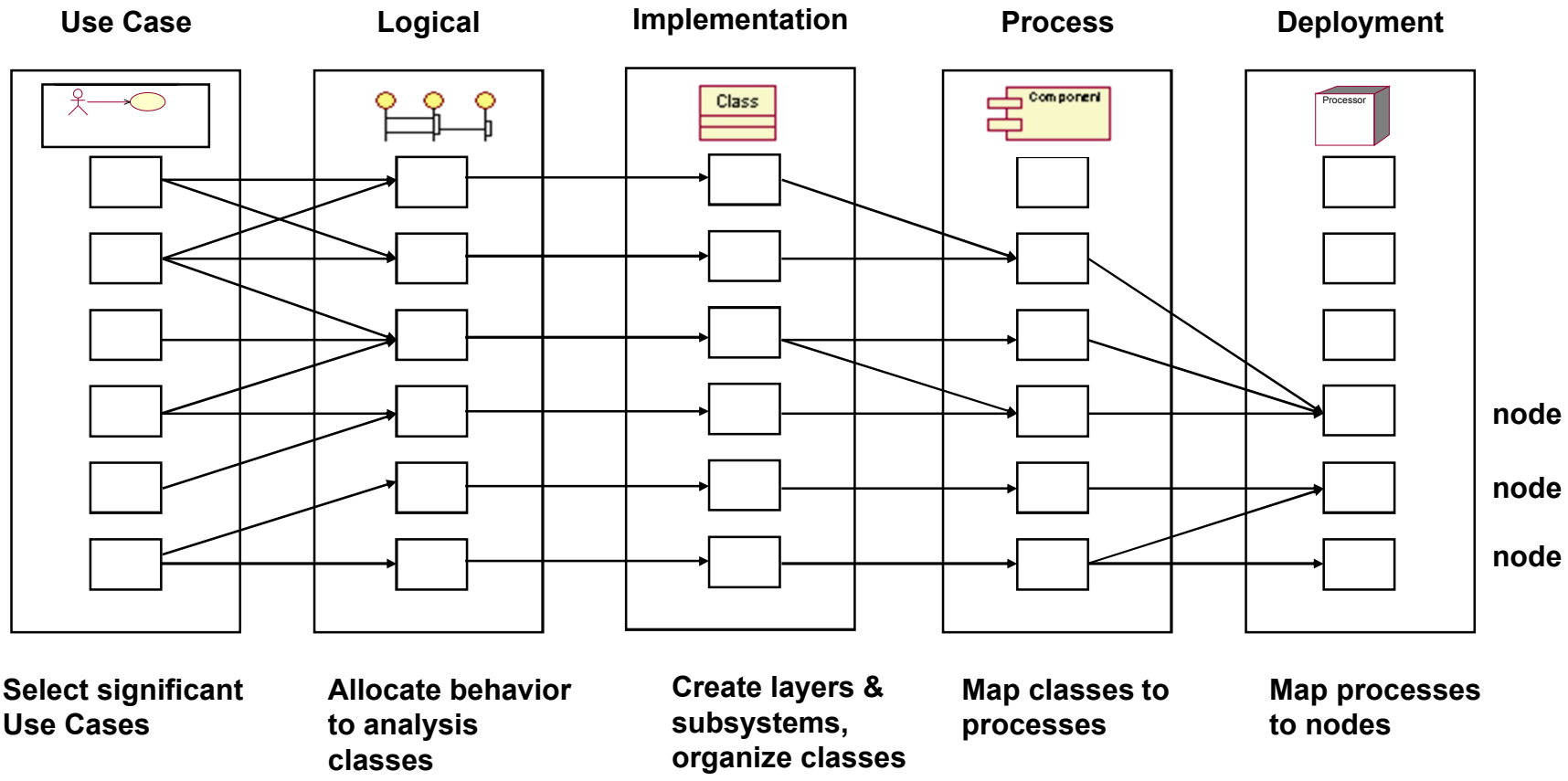
End-user
Functionality



Performance
Scalability
Throughput
System Integrators

System Topology
Delivery, Installation
Telecommunication
System Engineering

Progression of Architectural Views



Inception Activities

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- System Requirements
  - Review US NDC System Requirements Document (SRD)
- System Specifications
  - Develop US NDC System Specification Document (SSD)
- Use Cases
  - Develop use case hierarchy
  - Develop architecturally significant use cases
- Technology Trade Studies for risk reduction
- Propose Candidate Architecture
- Initial Cost Estimate

Elaboration Activities

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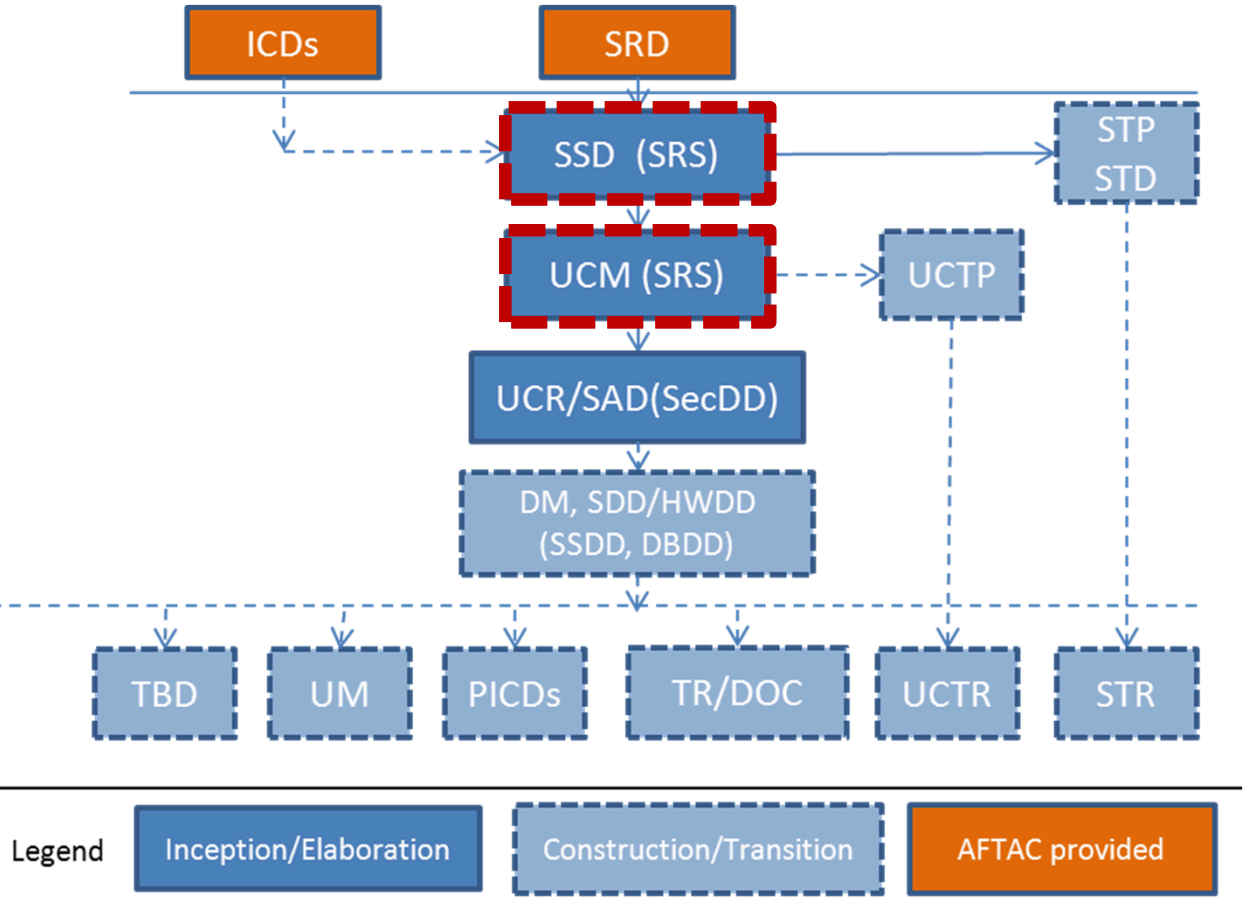
- Complete System Specifications
- Develop Use Cases
- Develop User Interface Storyboards
- Develop Use Case Realizations
  - For architecturally significant use cases
- Define Architecture
- Prototype technology for risk reduction
- Demonstrate Executable Architecture Prototype
- Update Cost Estimate

System Design Products



DBDD* = Database Design Document
DM = Design Model
HWDD = Hardware Design Document
ICDs* = Interface Control Documents
PICDs = Product ICDs
SAD = System Architecture Document
SecDD = Security Design Document
SRD* = System Requirements Document
SRS* = System Requirements Specification
SSD = System Specification Document
SSDD* = System Subsystem Design Description
STD = System Test Description
STR = System Test Results
STP = System Test Plan
TR/DOC = Training/Documentation
UCM = Use Case Model
UCR = Use Case Realizations
UCTP = Use Case Test Plan
UCTR = Use Case Test Results
UM = User's Manual

Architecture Products (E1 delivery)

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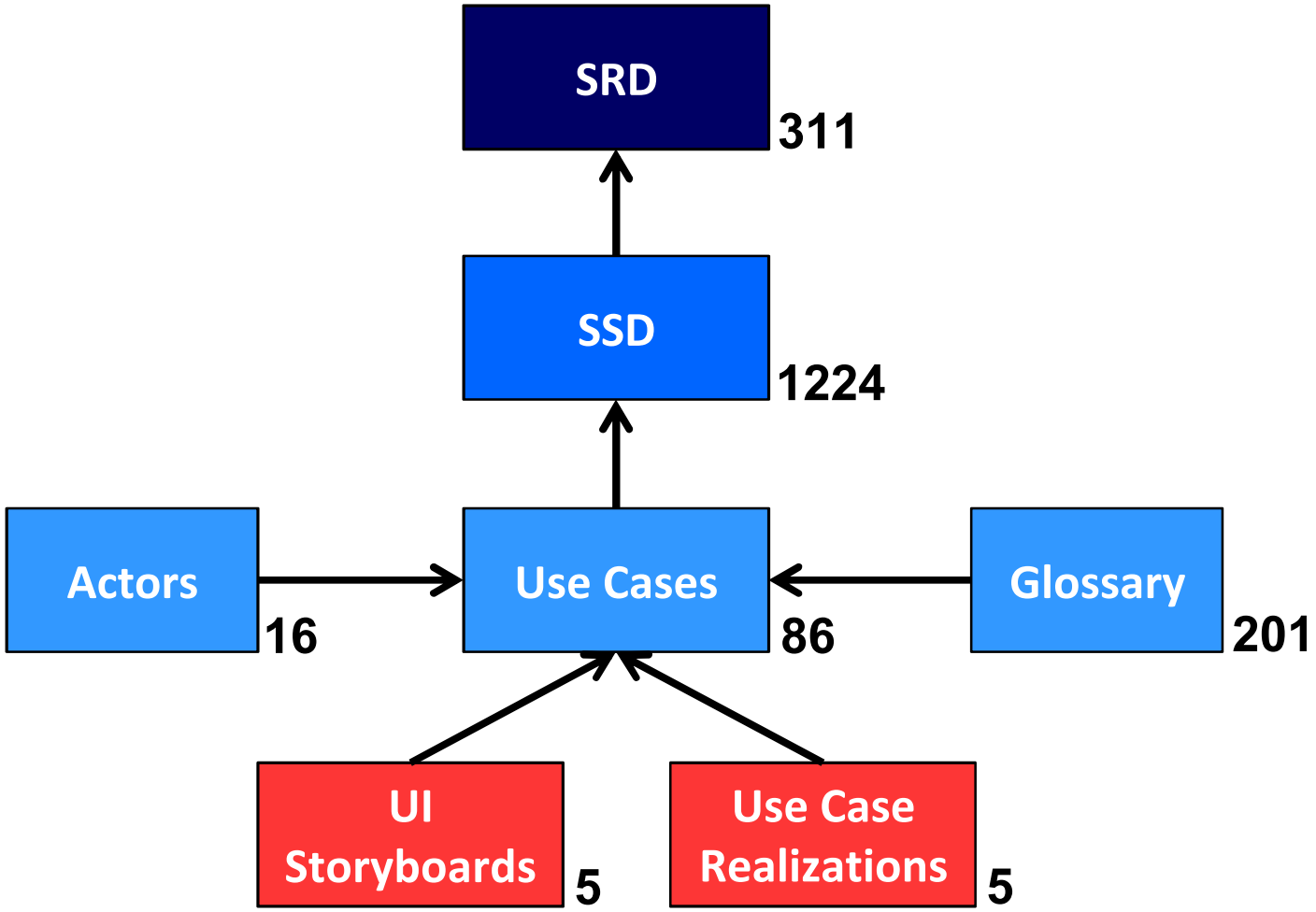
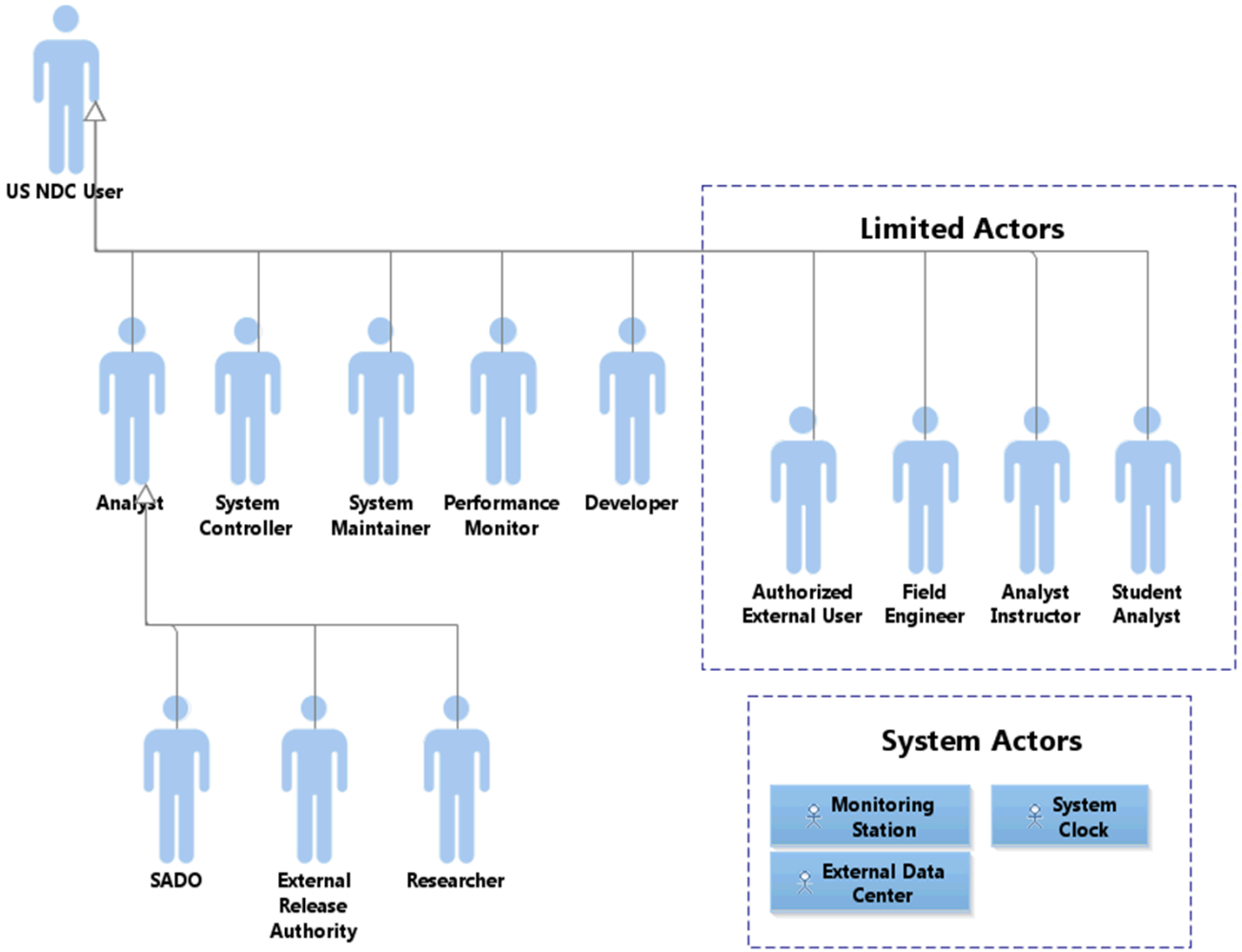
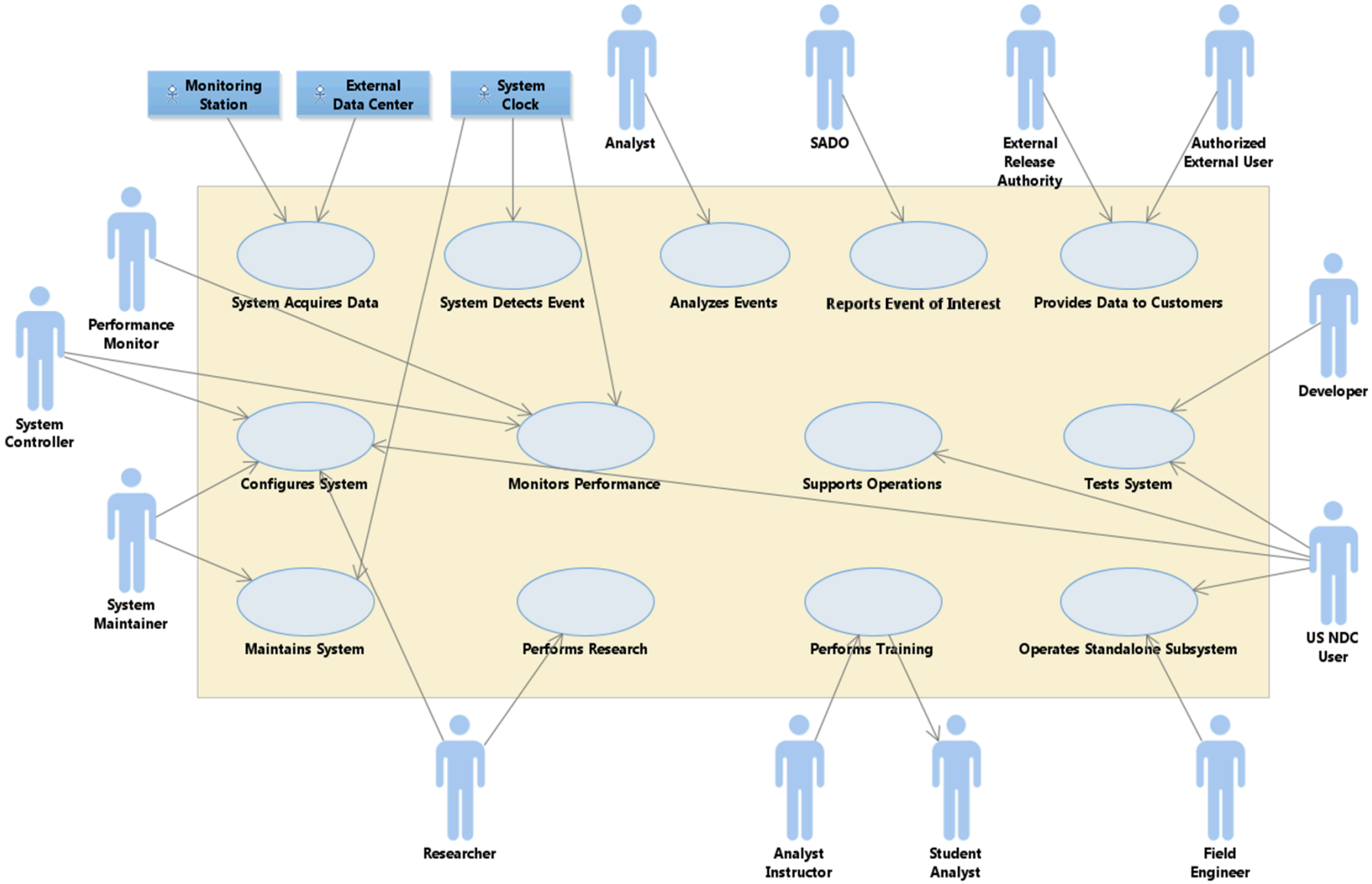


Actors


US NDC User
Analyst
System Controller
System Maintainer
Performance Monitor
Developer
SADO
External Release Authority
Researcher
Limited Actors
Authorized External User
Field Engineer
Analyst Instructor
Student Analyst
System Actors
Monitoring Station
System Clock
External Data Center

Top Level Use Case Diagram



Construction/Transition Concept

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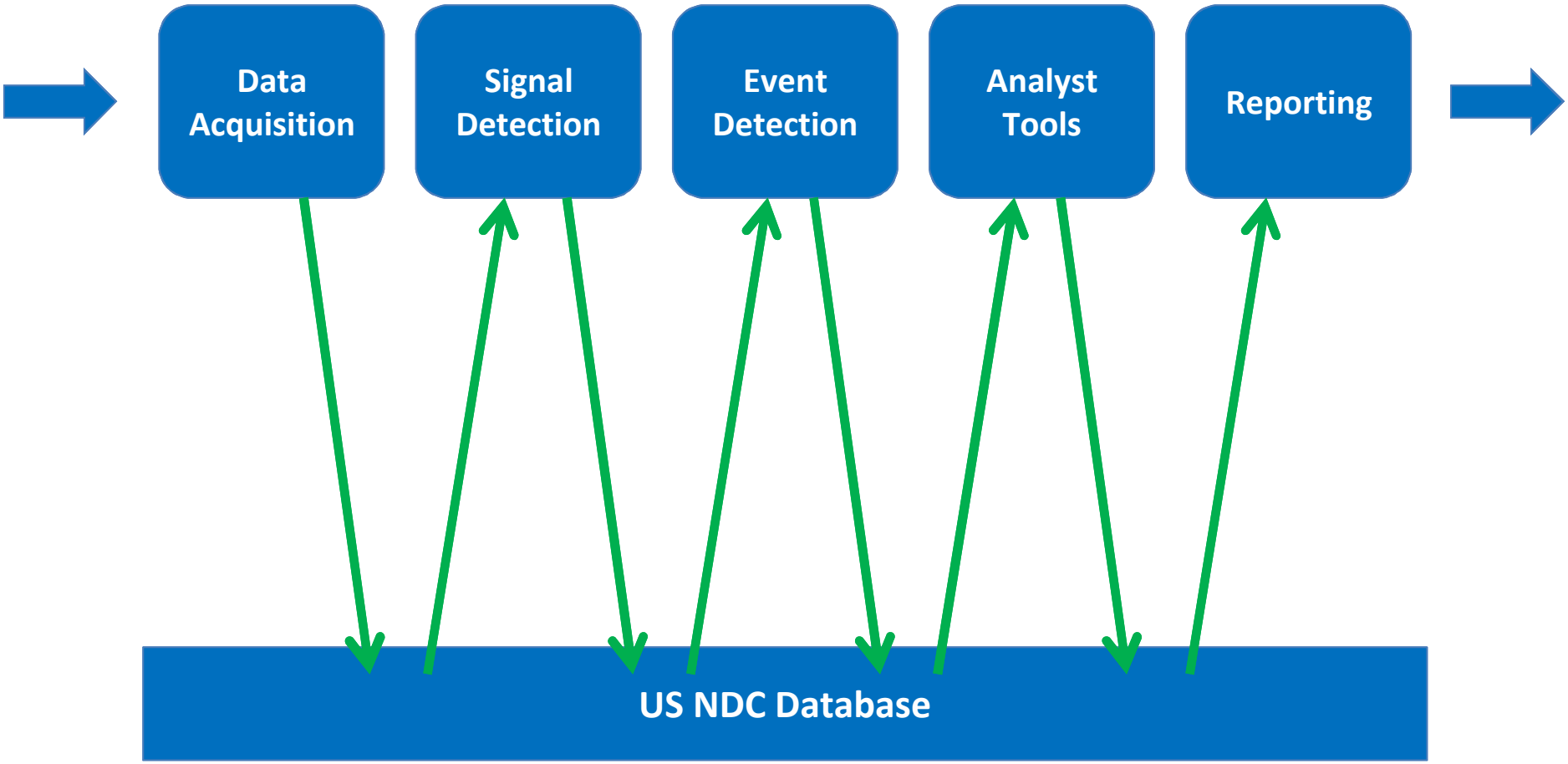
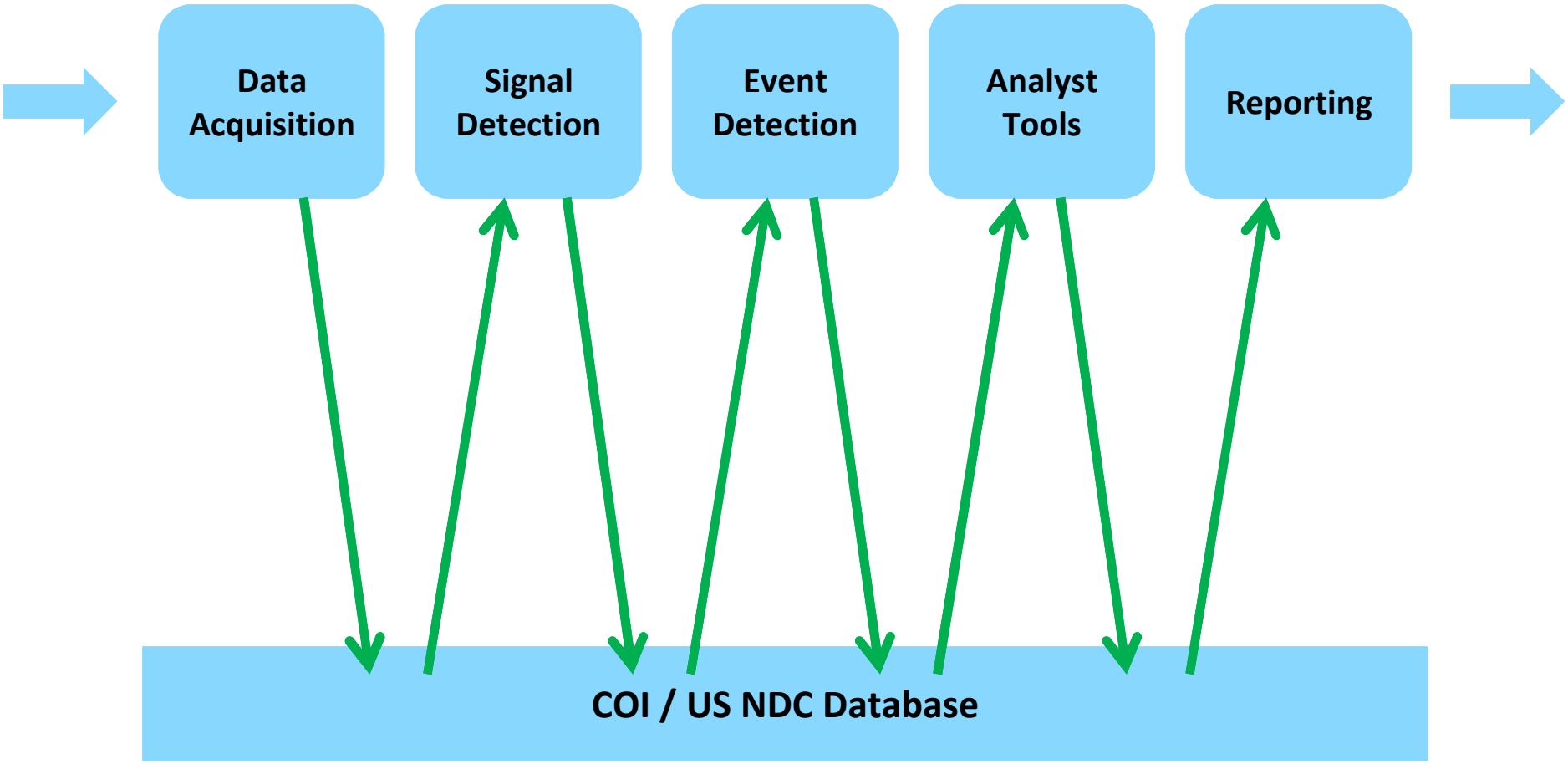
- New system components will be developed and transitioned over time
  1. Develop and deploy processing framework and control component
  2. Encapsulate data access with Common Object Interface (COI) layer
  3. Wrap some existing components to test architecture
  4. Replacement components are refactored/redeveloped and deployed to the framework over time
- Mission execution is transitioned to new components as features are validated
- Allows incremental use of new components and retirement of old

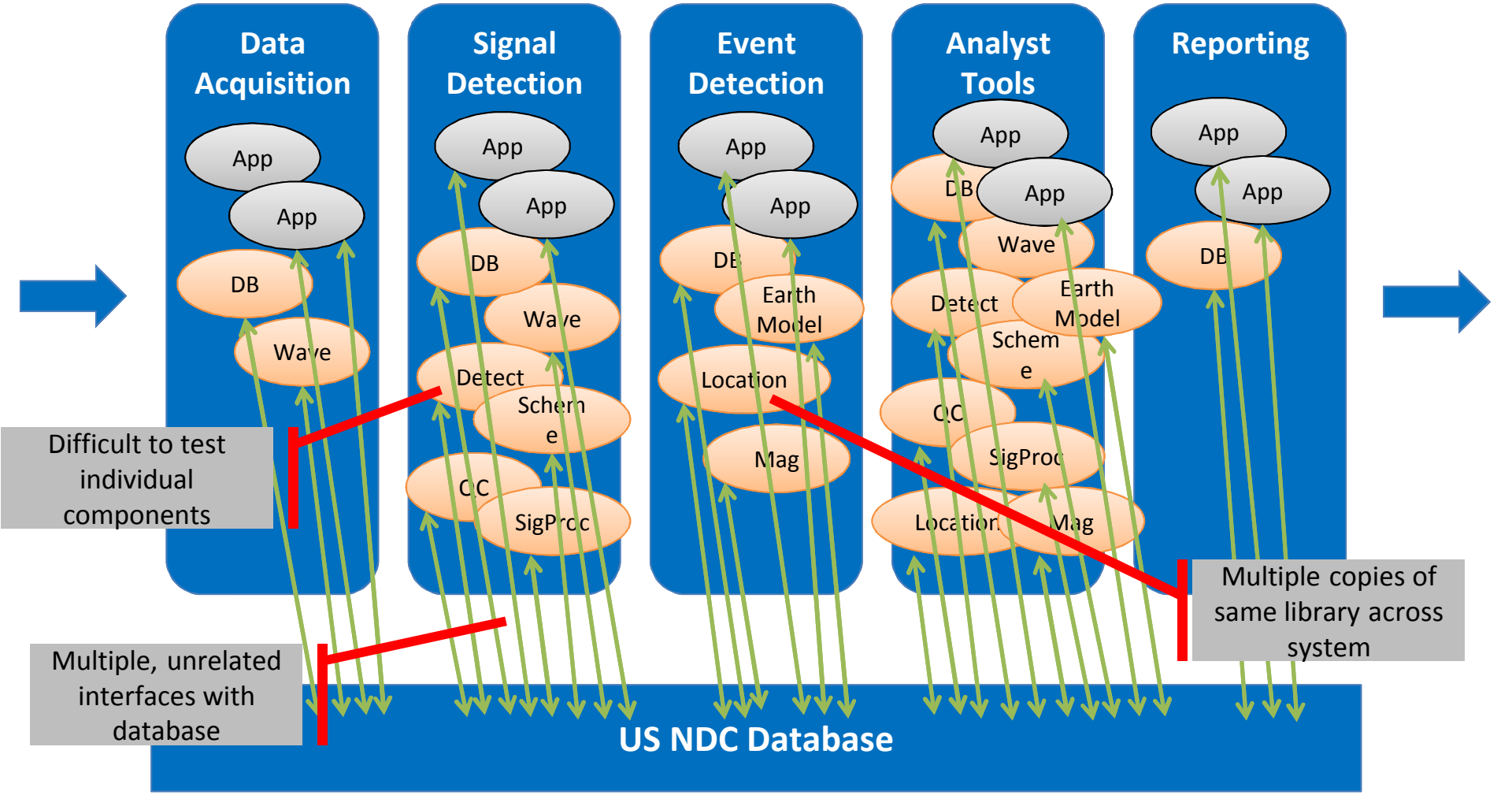
Current US NDC



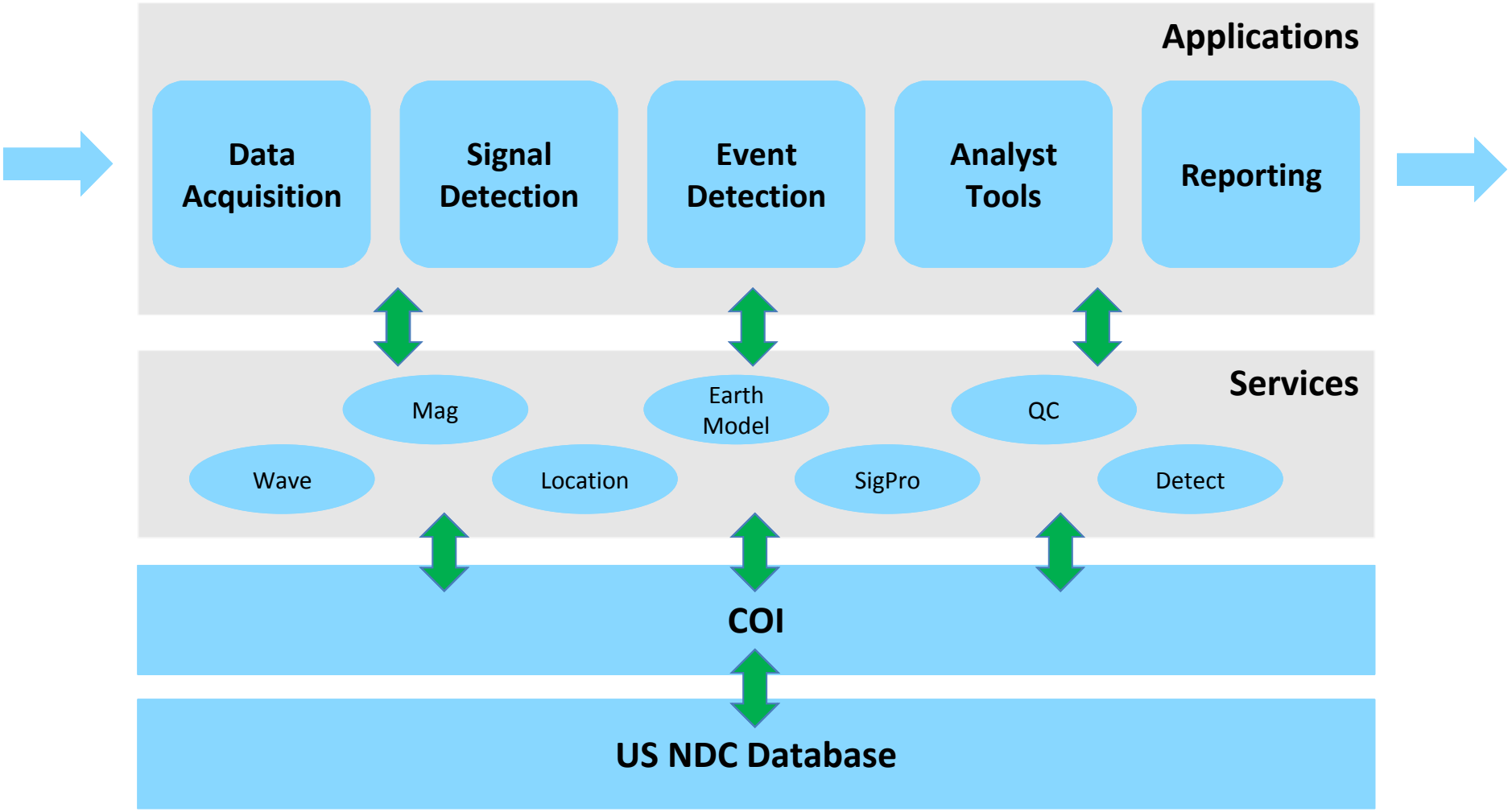
Modernized US NDC



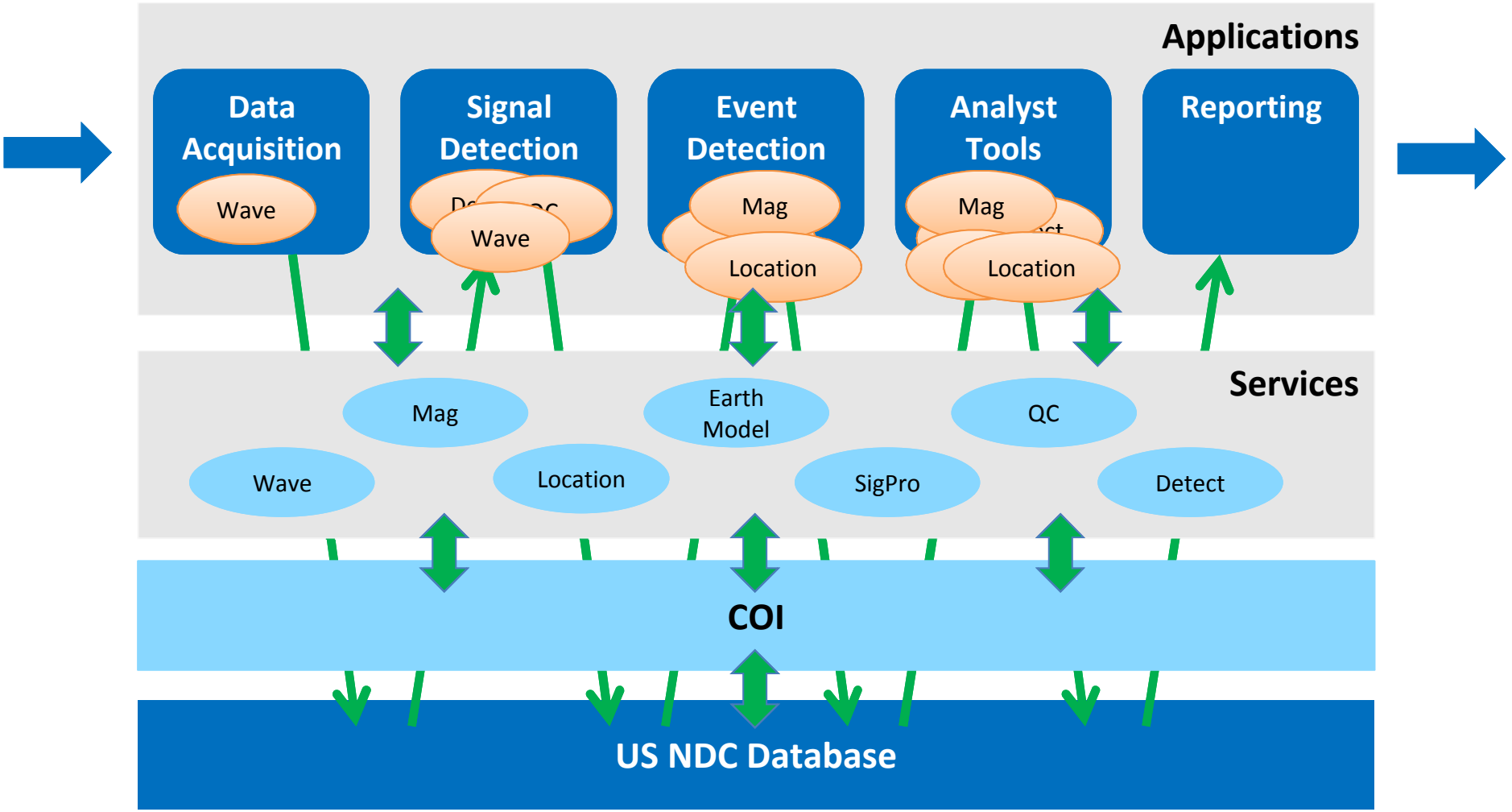
Current US NDC



Modernized US NDC



US NDC Transition



IDC Reengineering Phase 2&3

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- **IDC is pursuing a similar modernization project**
  - We are leveraging US NDC Modernization products to assist this effort
- **IDC Pre-Inception (Sept 2013 – Jan 2014)**
  - AFTAC released US NDC SRD and UCMS
  - Reviewed with IDC and planned development of IDC SRD and Scope
- **IDC Inception Iteration I1 (Feb 2014 – July 2014)**
  - Assisted IDC to create IDC SRD with AFTAC collaboration
    - Conducted SRD Workshop (6/2-4)
  - AFTAC released US NDC SSD
- **IDC Inception Iteration I2 (Aug 2014 – Jan 2015)**
- Creating SSDs and UCs for IDC requirements

IDC Reengineering Phase 2&3

Sandia National Laboratories

- IDC is pursuing a similar modernization program
  - We hope to develop a common architecture for the IDC and US NDC leveraging US NDC Modernization products
  - Common requirements definition is important to common architecture
- IDC Pre-Inception (Sept 2013 – Jan 2014)
  - AFTAC released US NDC SRD and UCMS
  - Reviewed with IDC and planned development of IDC SRD and Scope
- IDC Inception Iteration I1 (Feb 2014 – July 2014)
  - Assisted IDC to create IDC SRD with AFTAC collaboration
    - Conducted SRD Workshop (6/2-4)
  - AFTAC released US NDC SSD
- IDC Inception Iteration I2 (Aug 2014 – Jan 2015)
  - Creating SSDs and UCs for IDC requirements

Summary

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- Inception Phase Complete
  - SRD
  - SSD
  - Use Cases
- Elaboration Phase Underway
  - Use Case Model
  - UI Storyboards
  - Use Case Realizations
  - Executable Architecture Prototype
- IDC Reengineering is leveraging US NDC Modernization