Exceptional service in the national interest

SAND2013-7355P

Sandia National Laboratories

US NDC Modernization

Project Status Review

Shack Burns

9 Sep 2013

SAND 2013-xxxxx

U.S. DEPARTMENT OF ENERGY | NNSA

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

US NDC Modernization Goals

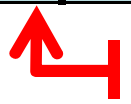
Sandia National Laboratories

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
   - Services-based Architecture
   - 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

Statement of Work

- Scope: specify and design a new US NDC architecture using Rational Unified Process (RUP)
- RUP Phases
  - **Inception – scope the system**
  - Elaboration – architecture/analysis
  - Construction – software development
  - Transition – deploy the system
- 6-Month Iterations

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



Inception Activities

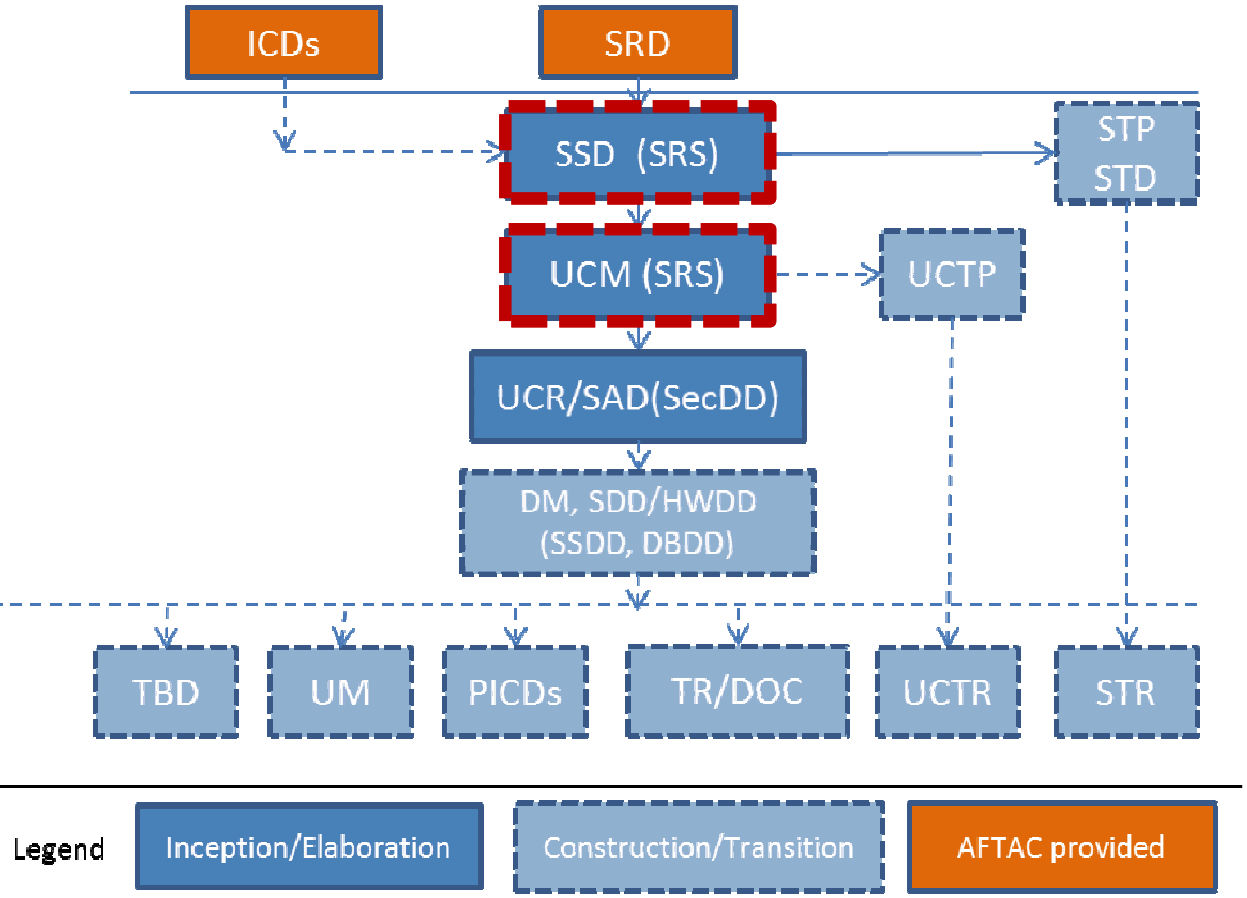
- System Requirements
  - Review US NDC System Requirements Document (SRD)
- System Specifications
  - Implements SRD & ICDs
- Use Cases
  - Interview system users
  - Build list of use cases
  - Identify architecturally significant use cases
- Technology Trade Studies for risk reduction
- Propose Candidate Architecture
- Initial Cost Estimate

Elaboration Activities

Sandia National Laboratories

- Update System Specifications
- Complete Use Cases
- Develop Use Case Realizations
- Define Architecture
- Prototype technology for risk reduction
- Develop Executable Architecture Prototype
- Update Cost Estimate

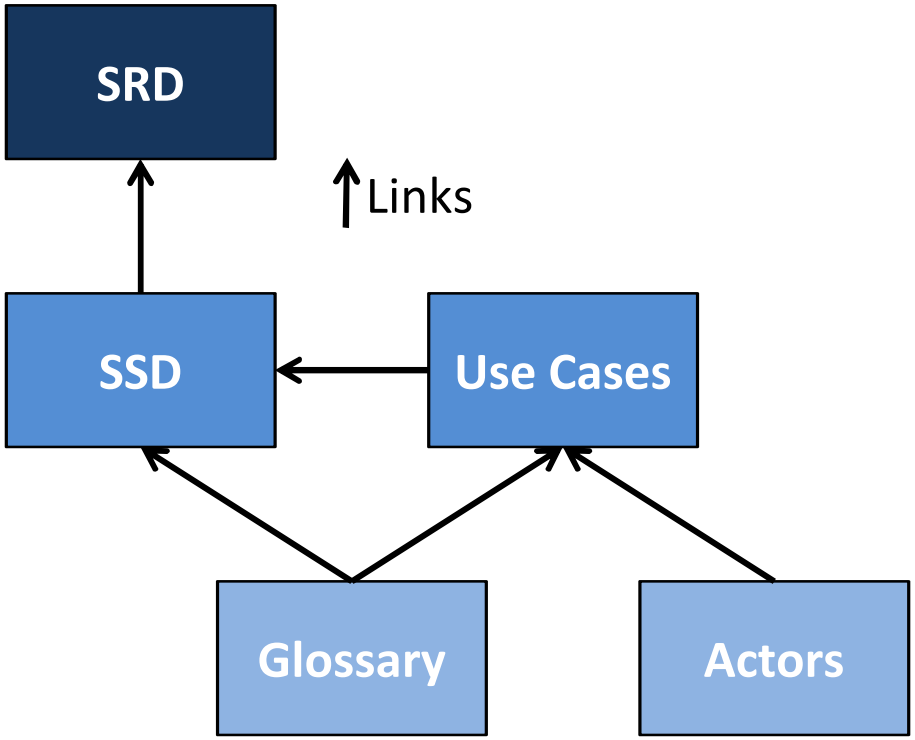
System Design Products



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 Deliverables

- System Requirement Document (SRD)
- System Specification Document (SSD)
- Use Case Model
  - Use Case Hierarchy with Brief Descriptions
  - Actors
- All Items in DOORS



System Specification Document

- SNL Team analyzed all US NDC SRD items
  - Each SRD item assigned to an owner for specification
  - 305 items
- SNL Team developed System Specification Document (SSD) items to achieve SRD
  - SSD items linked to relevant SRD items
  - 1170 items in initial version
- Will update throughout project
- RUP acknowledges requirements development continues iteratively

System Specification Example

Sandia National Laboratories

SRD Item

SRD	SNL Owner
The System shall compute predicted travel-times and associated uncertainties from user specified three-dimensional basemodels.	jwoodbr

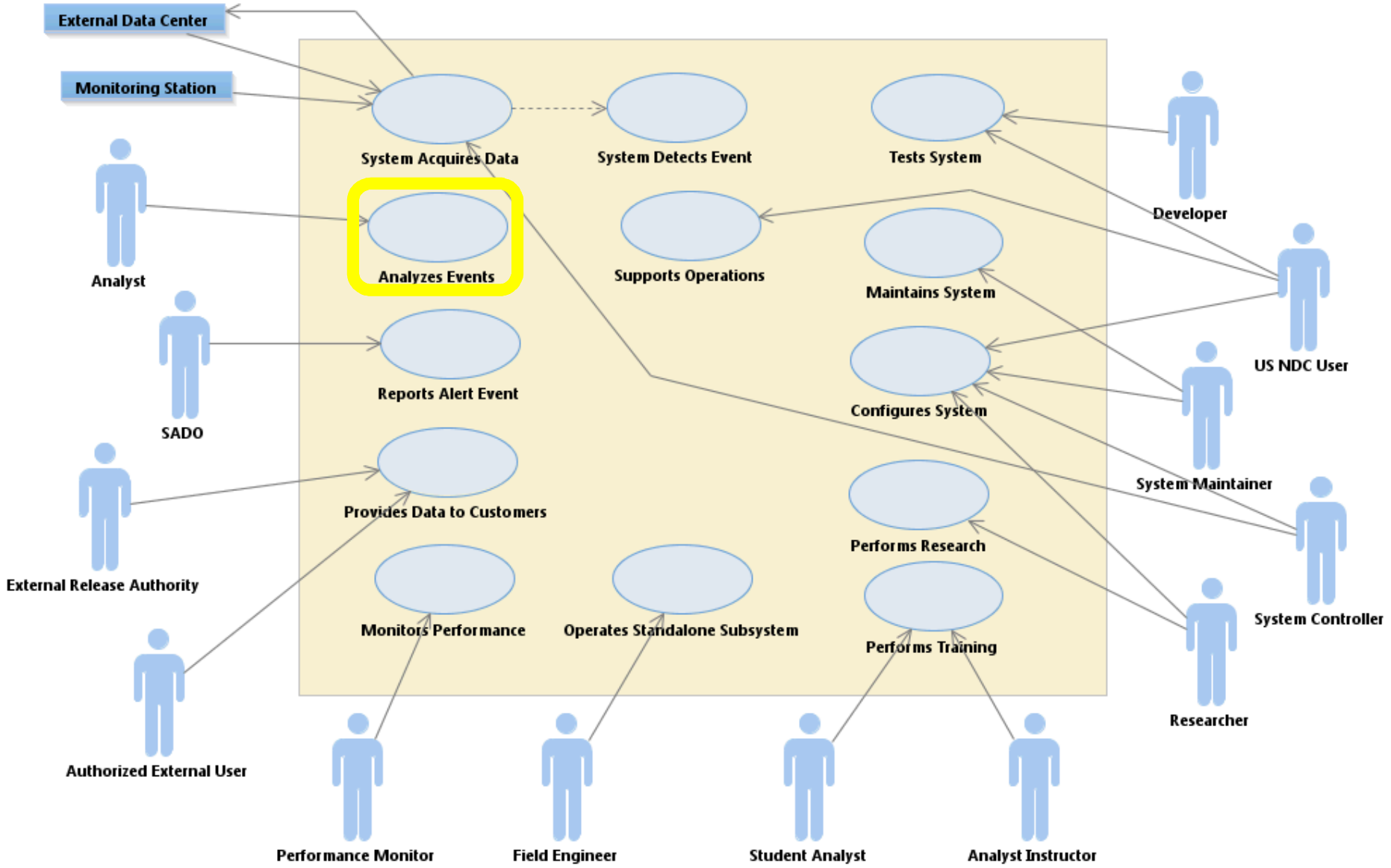
SSD Items linked to SRD

SSD	SNL Owner	State
The System shall provide the user the capability to select the earth model used for an earth model prediction.	brhamle	Reviewed Internal
The System shall store which earth model was used to compute an earth model prediction.	brhamle	Reviewed Internal
The system shall store the predicted travel-times computed from a base model.	jwoodbr	Reviewed Internal
The system shall store the uncertainties of a predicted travel-times computed using a base model.	jwoodbr	Reviewed Internal
The system shall compute the predicted travel-times using a three-dimensional phase-specific base model.	jwoodbr	Reviewed Internal
The system shall compute the uncertainties of a predicted travel-times computed using a three -dimensional phase-specific base model.	jwoodbr	Reviewed Internal

Use Case Model

- Use Case Hierarchy defined
  - 85 Use Cases identified and brief descriptions written
  - 17 “architecturally significant” Use Cases selected and defined
- Actors Hierarchy complete
  - 15 actors identified
- Both managed in DOORS
- Use Cases modeled in Rational Software Architect
  - Full Description
  - Use Case Diagram
  - Actors
  - Activity Diagram
  - Requirement Trace

Top-Level Use Case Diagram



Use Case Hierarchy Example

Sandia National Laboratories

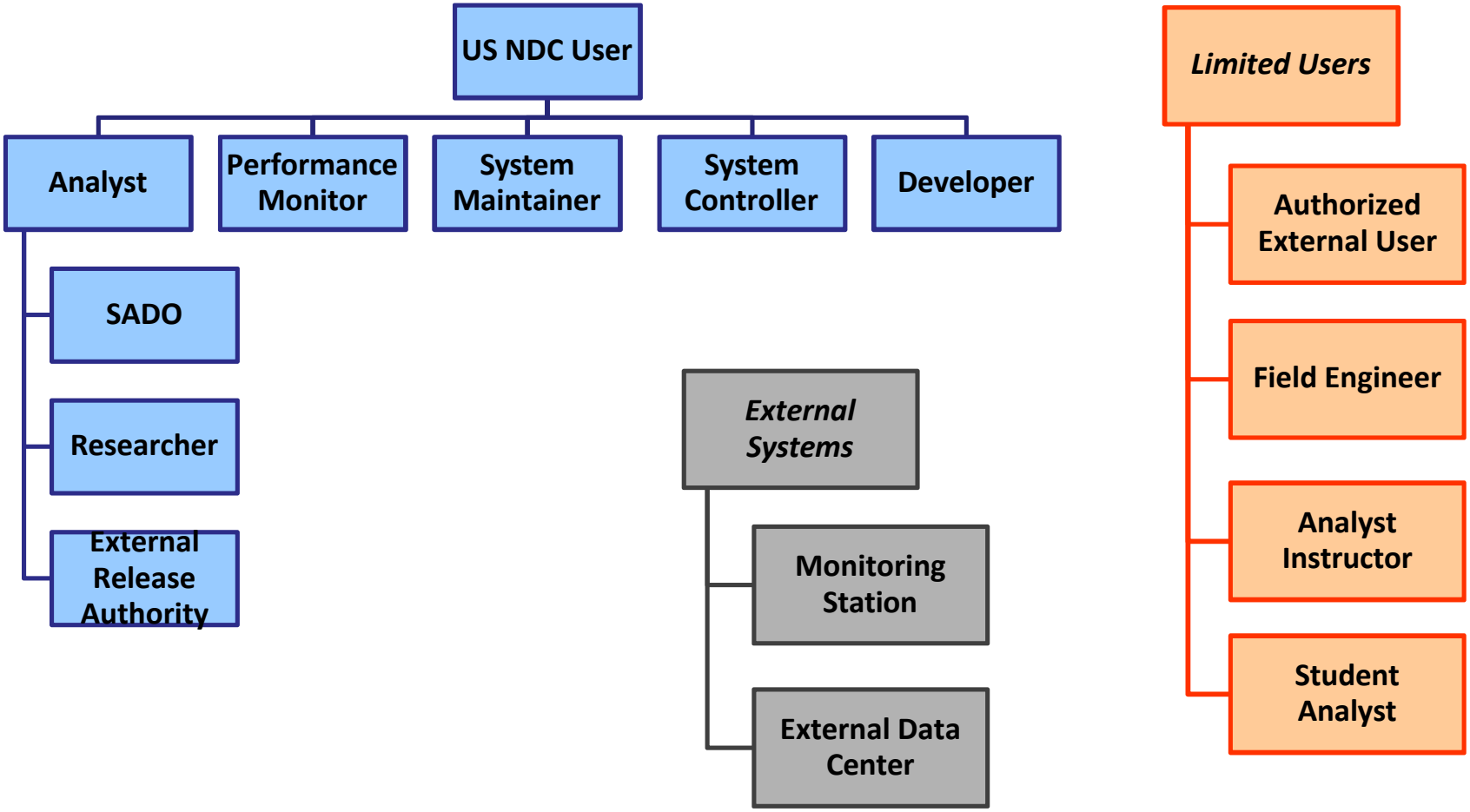
- **3 Analyzes Events**
  - **3.1 Selects Event Set**
  - **3.2 Refines Event**
    - **3.2.1 Determines Waveform Data Quality**
    - **3.2.2 Enhances Signals**
    - **3.2.3 Detects Signals**
    - **3.2.4 Measures Signal Features**
    - **3.2.5 Refines Event Location**
    - **3.2.6 Refines Event Magnitude**
    - **3.2.7 Determines Potential Alert Event ***
    - **3.2.8 Compares Events ***
    - **3.2.9 Identifies Event ***
    - **3.2.10 Assesses Yield ***
  - **3.3 Scans Waveforms and Unassociated Detections**
  - **3.4 Builds New Event**
  - **3.5 Marks Processing Stage Complete**

*** Difference in US NDC and IDC Conops**

IDC Use Cases could be:

- **Analyzes Special Event**
- **Screens Event**

Actor Hierarchy

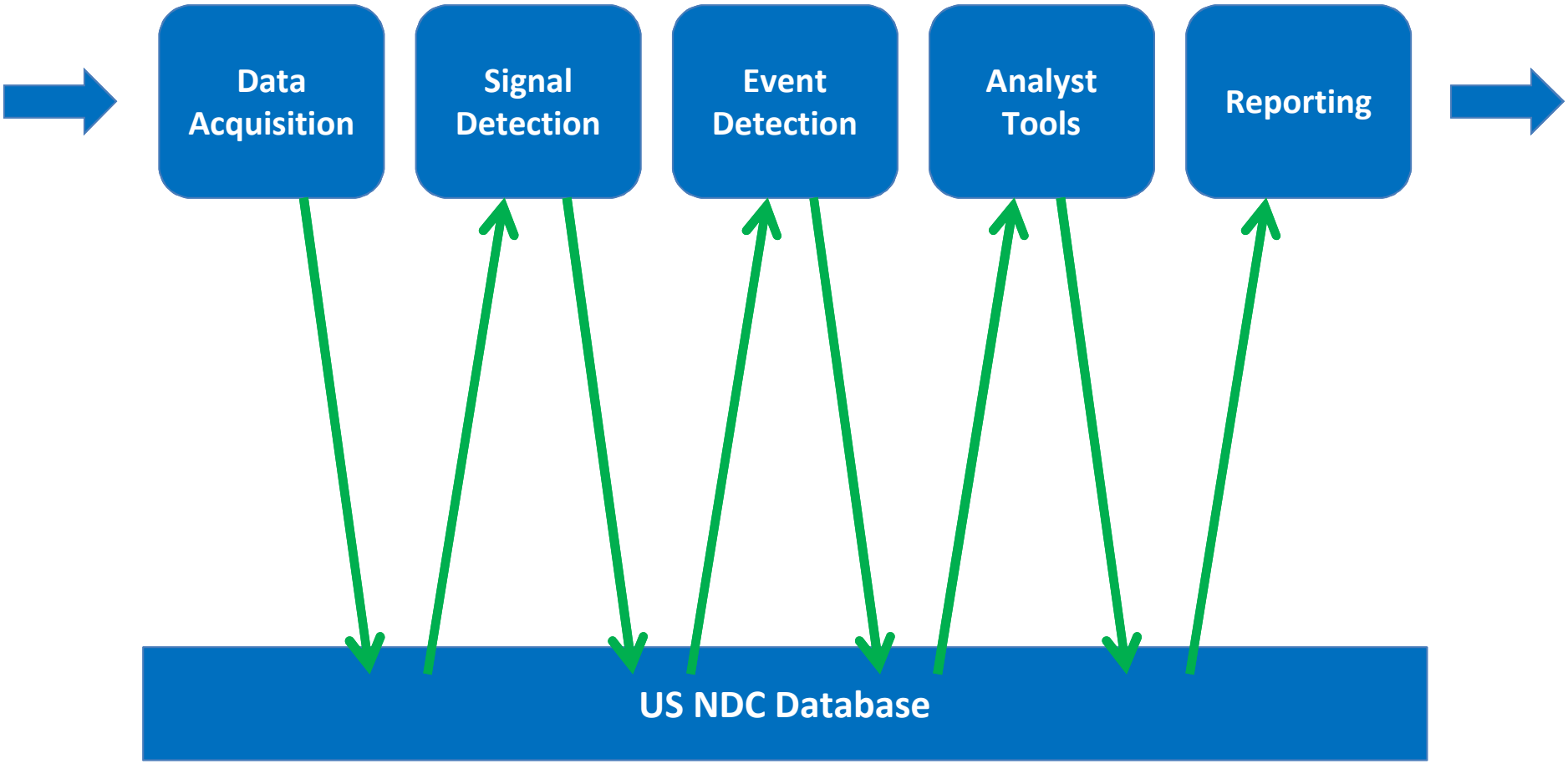


Construction/Transition Concept

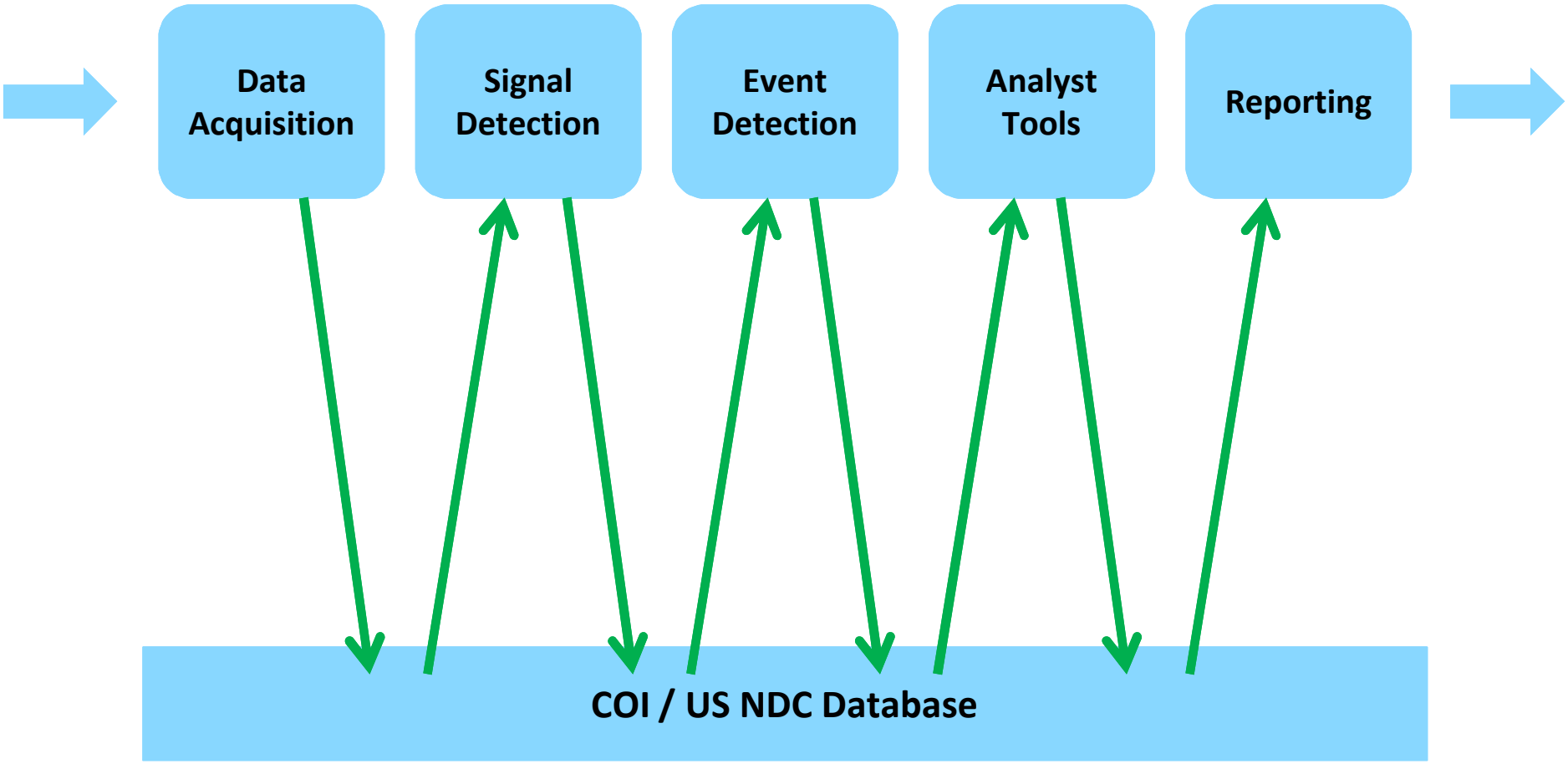
Sandia National Laboratories

- New system components will be developed and transitioned over time
  1. Develop and deploy service-based framework and control components
  2. Encapsulate data access with Common Object Interface (COI) layer
  3. Wrap some existing components to transition to 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

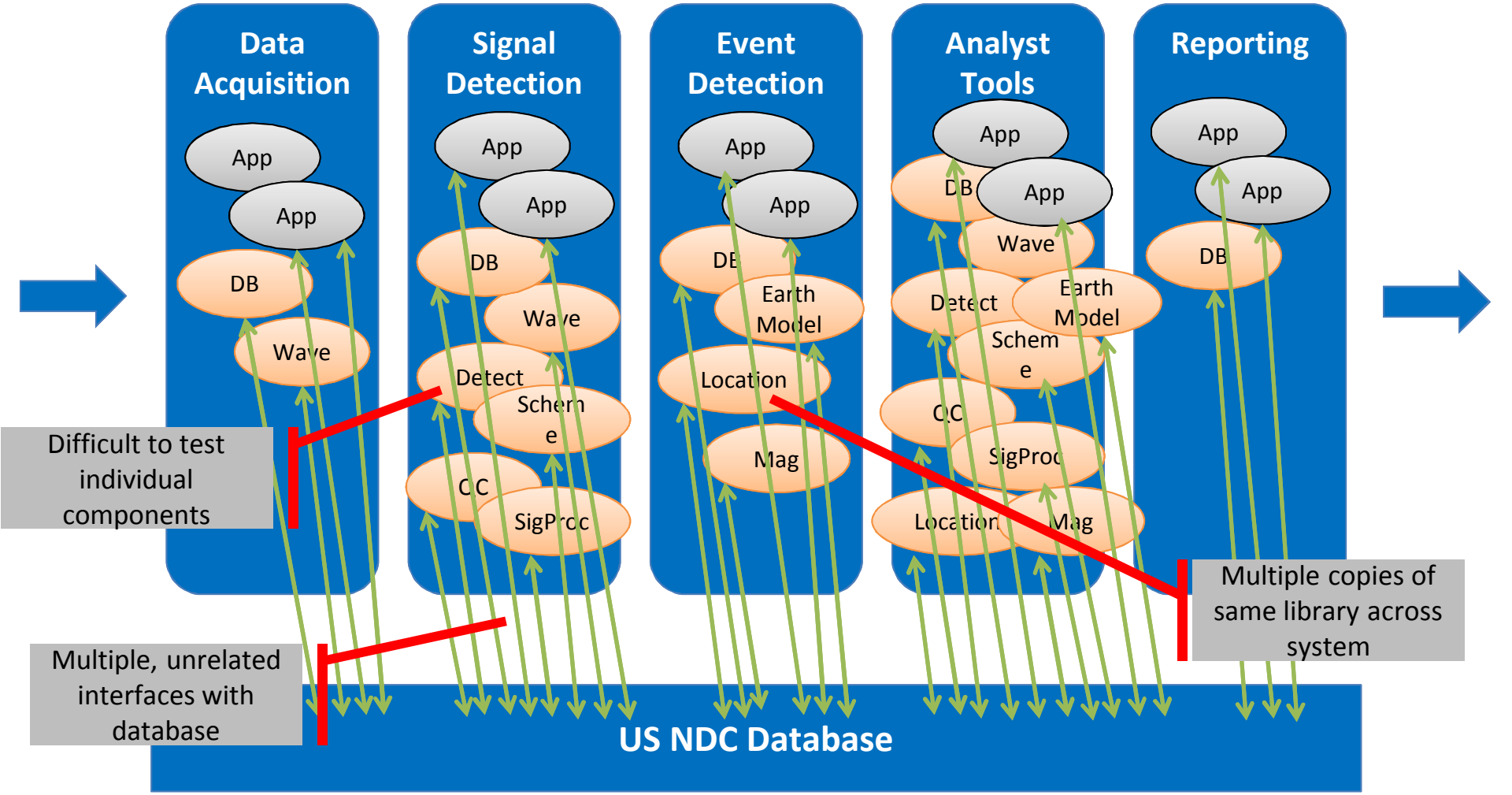
Current US NDC



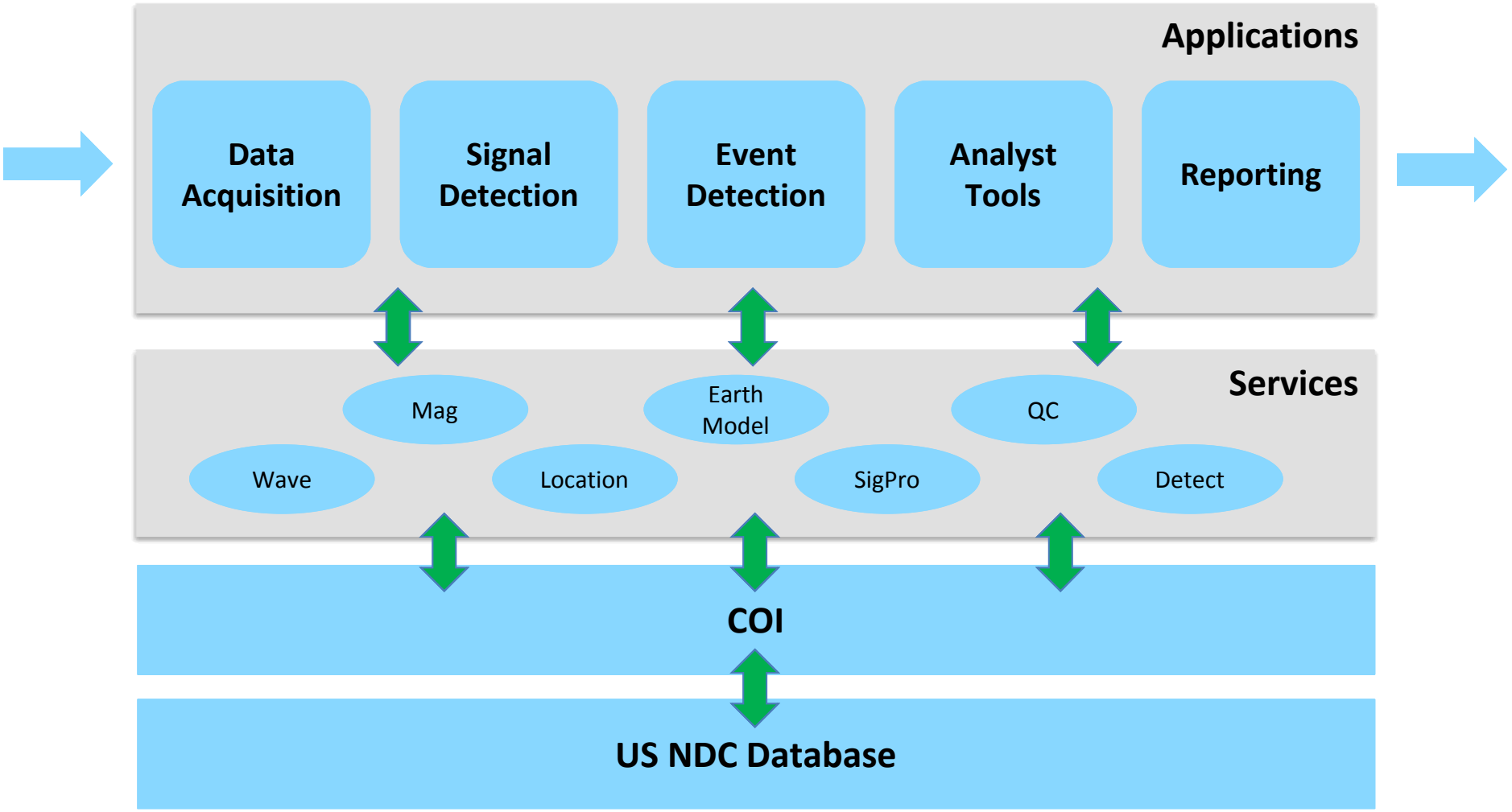
Modernized US NDC



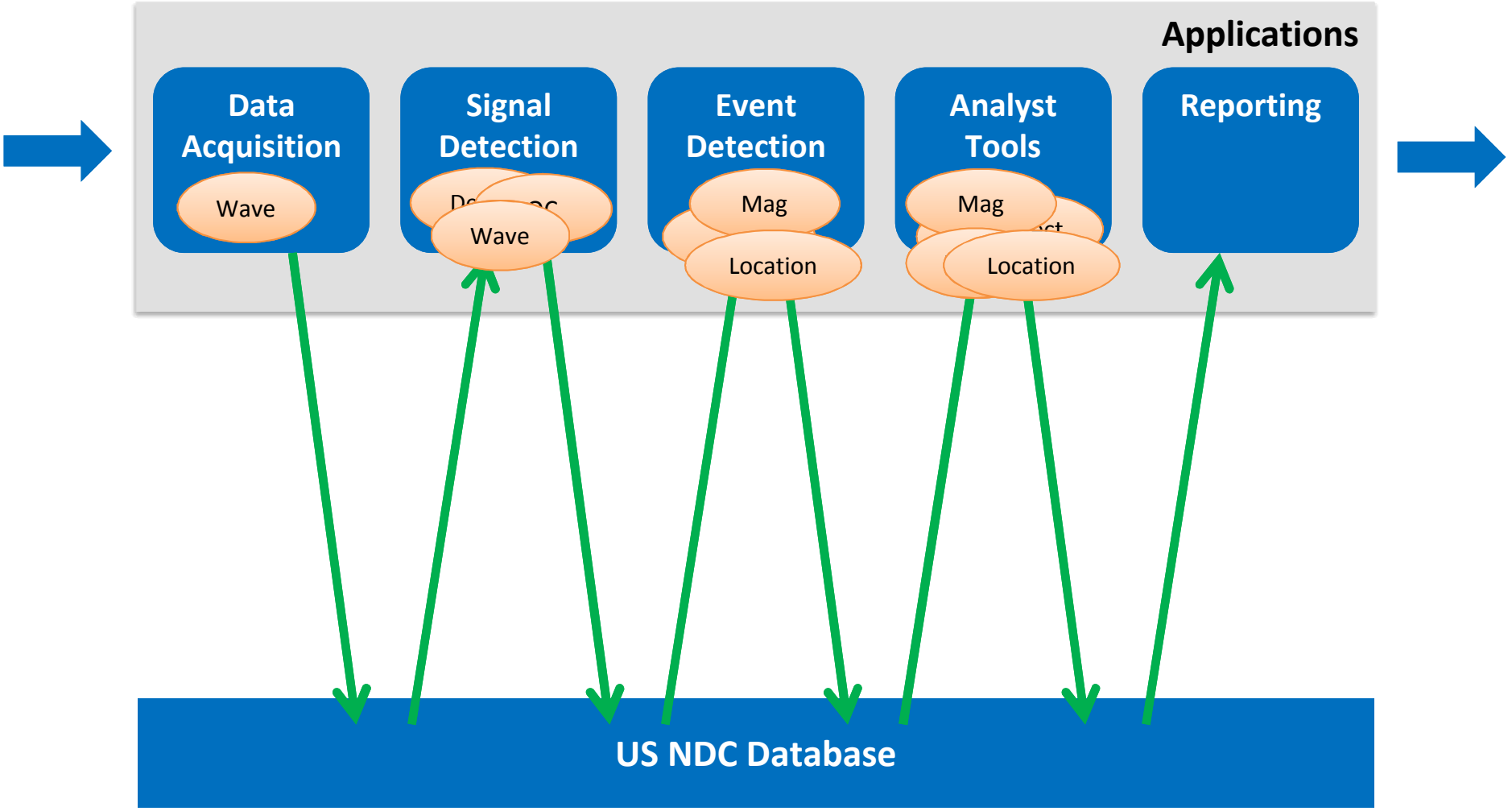
Current US NDC



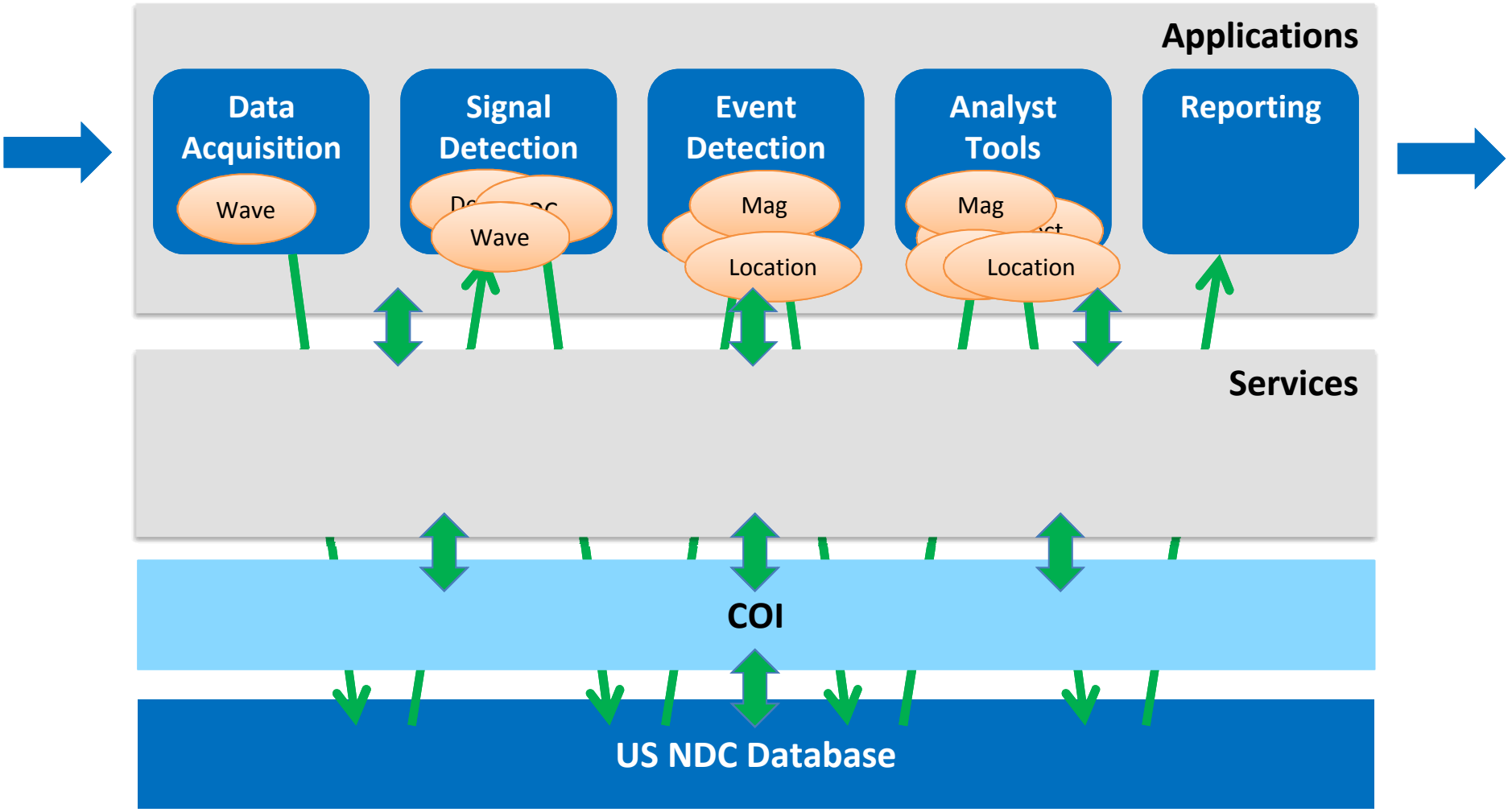
Modernized US NDC



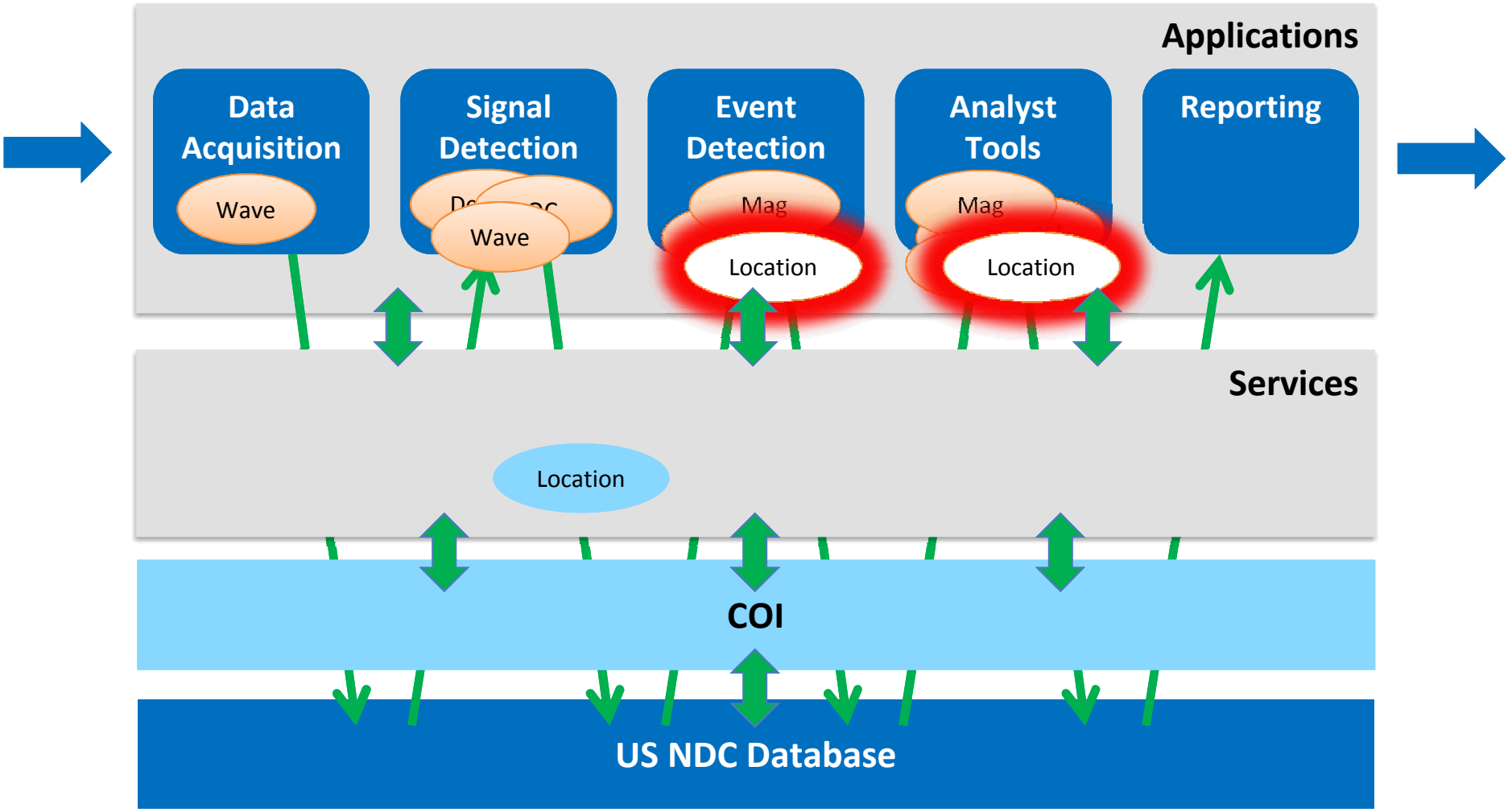
US NDC Transition



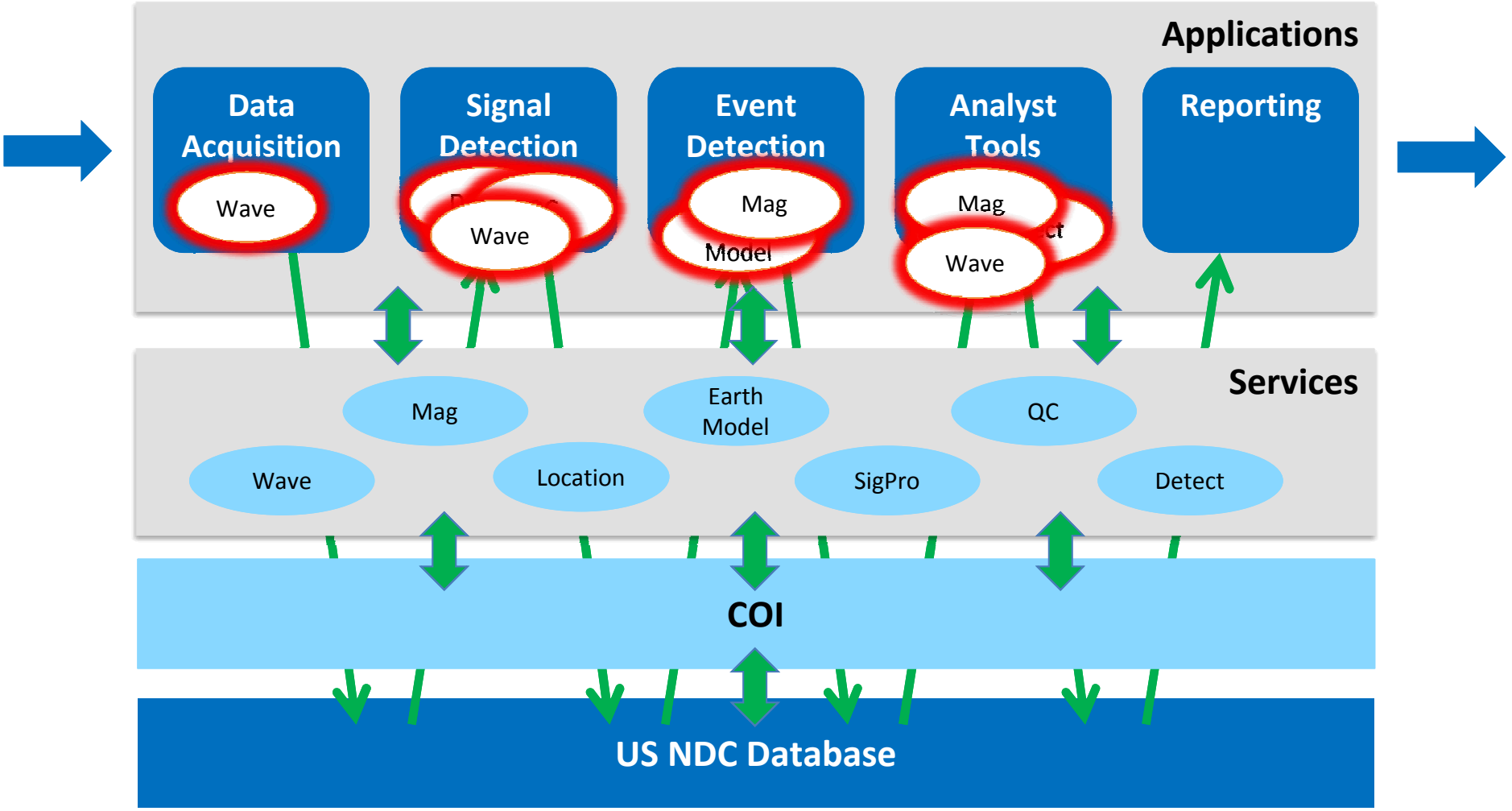
US NDC Transition



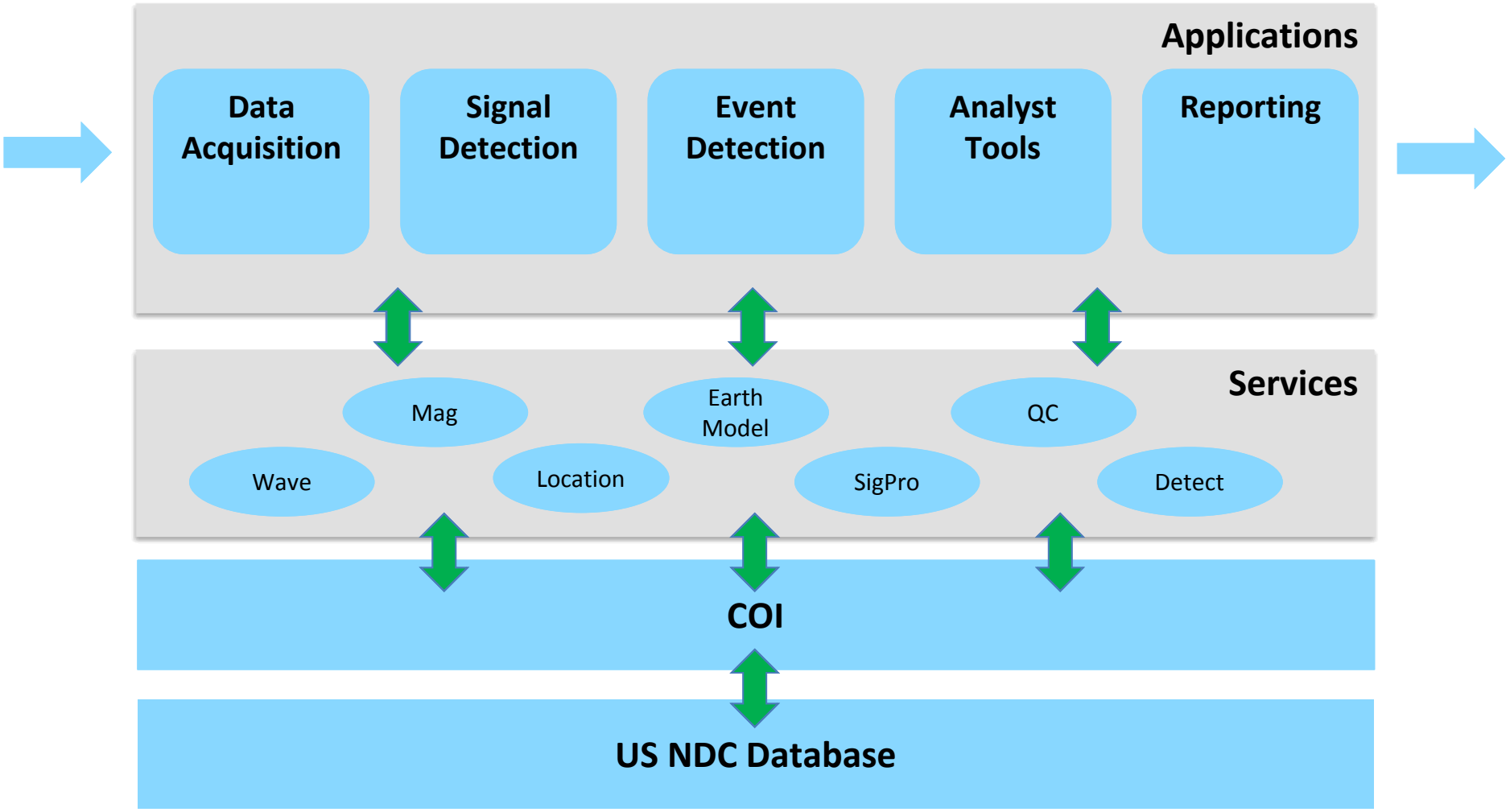
US NDC Transition



US NDC Transition



US NDC Transition



Summary

- Inception Iteration 2 is near completion
  - Baseline System Specification Document delivered
  - Use Case Model delivered with architecturally significant UCs described
  - Technology Studies completed
  - Cost Estimate updated
  - Project Planning documents delivered
- Elaboration Iteration 1 begins Oct 2013
  - Architecture description document drafted
  - Begin development of:
    - Use Case realizations for architecturally significant Use Cases
    - User Interface Guidelines and storyboards for Use Cases
    - Architecture prototypes