

EPICS 7

Provides Major Enhancements to the
EPICS Toolkit



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EPICS 7 Outline

- EPICS 7 Introduction
- Status
- Services Support Application Development
- Community Use
- Conclusions

Why EPICS 7

- Integrate all data into microservices: real time, processed, and configuration.
- Support services for data acquisition, data management, and analysis.
- Continue to provide regular data types for common clients
- Provide the ability to define arbitrary data structures for more complex data sets.
- Continue to provide these capabilities in a robust, high performance environment.

What Is EPICS 7 (not)

- EPICS 7 is not a replacement for V3
- EPICS 7 does not introduce a new IOtC database
- EPICS 7 does not require you to rewrite all your drivers
- EPICS 7 does not break existing systems

What is EPICS 7

EPICS 3 is a set of tools, libraries and applications to create a distributed control system with IOtCs that have always been able to identify all fields of all records to other devices.

EPICS 7 extends V3, enabling other data stores to expose their data to other devices. It does **not** require upgrading any of your applications.

EPICS 7 adds structured data and RPC services to EPICS V3

EPICS 7 Improves EPICS V3

- **Structured data:**
Extending the scope of EPICS from I&C to data acquisition, image processing, and beyond
- **Efficient network transfer:**
High performance archiving and image transfer
- **RPC type services:**
Service oriented architecture: archiver, snapshot, database backends
- **Complex control:**
Communicating with devices (groups of PVs on an IOC) in an always-consistent, transaction type way

EPICS 7 Supports Structured data

V4 can do everything V3 can do (but better):

Can construct pvData structures analogous to DBR types. For example the equivalent of a DBR_TIME_DOUBLE would be the structure:

```
NTScalar
  double value
  alarm_t alarm
    int severity
    int status
    string message
  time_t timeStamp
    long secondsPastEpoch
    int nanoseconds
    int userTag
```

EPICS 7 Provides Efficient network transfer

pvAccess operations only send deltas on the wire.

So if the value of the structure in the above example is modified to:

```
NTScalar
  double value          8.1
  alarm_t alarm
    int severity        2
    int status          3
    string message      HIHI_ALARM
  time_t timeStamp
    long secondsPastEpoch 1460589145
    int nanoseconds      588698520
    int userTag          0
```

only changed values (in **bold**) need be sent, plus a bitset indicating which fields have changed value.

EPICS 7 Supports RPC type services

RPC type services can use structures that are different for every call and different for put (request) and get (response).

pvData can encode more complex data types like a table:

```
NTTable
```

```
string[] labels [value, seconds, nanoseconds, status, severity]
```

```
structure value
```

```
double[] value [ 1.1, 1.2, 2.0]
```

```
long[] secondsPastEpoch [1460589140, 1460589141, 1460589142]
```

```
int[] nanoseconds [ 164235768, 164235245, 164235256]
```

```
int[] severity [ 0, 0, 1]
```

```
int[] status [ 0, 0, 3]
```

EPICS 7 Base Status

Build System builds EPICS 3 and pvAccess into the single EPICS 7 Release

pvAccess and pvData run alongside of Channel Access and DBR_types

pvData supports structured data

NTypes are standard pvData for DBR_types, Tables, N-D Arrays, Heterogeneous Arrays, etc..

pvAccess provides improved metadata for the IOC Database

pvAccess provides communication to Relational DB and No SQL DB Services

pvAccess Gateway Alpha Release

pvAccess Database Links (2018 Q2)

Access Security (Not Yet Scheduled)

Data Aggregation is planned for Java Client API (2018 Q2)

Data Aggregation is planned for C++ Client API (Not Yet Scheduled)

EPICS Records To Take Advantage of NTypes (Not Yet Scheduled)

EPICS 7 Standard Service Status

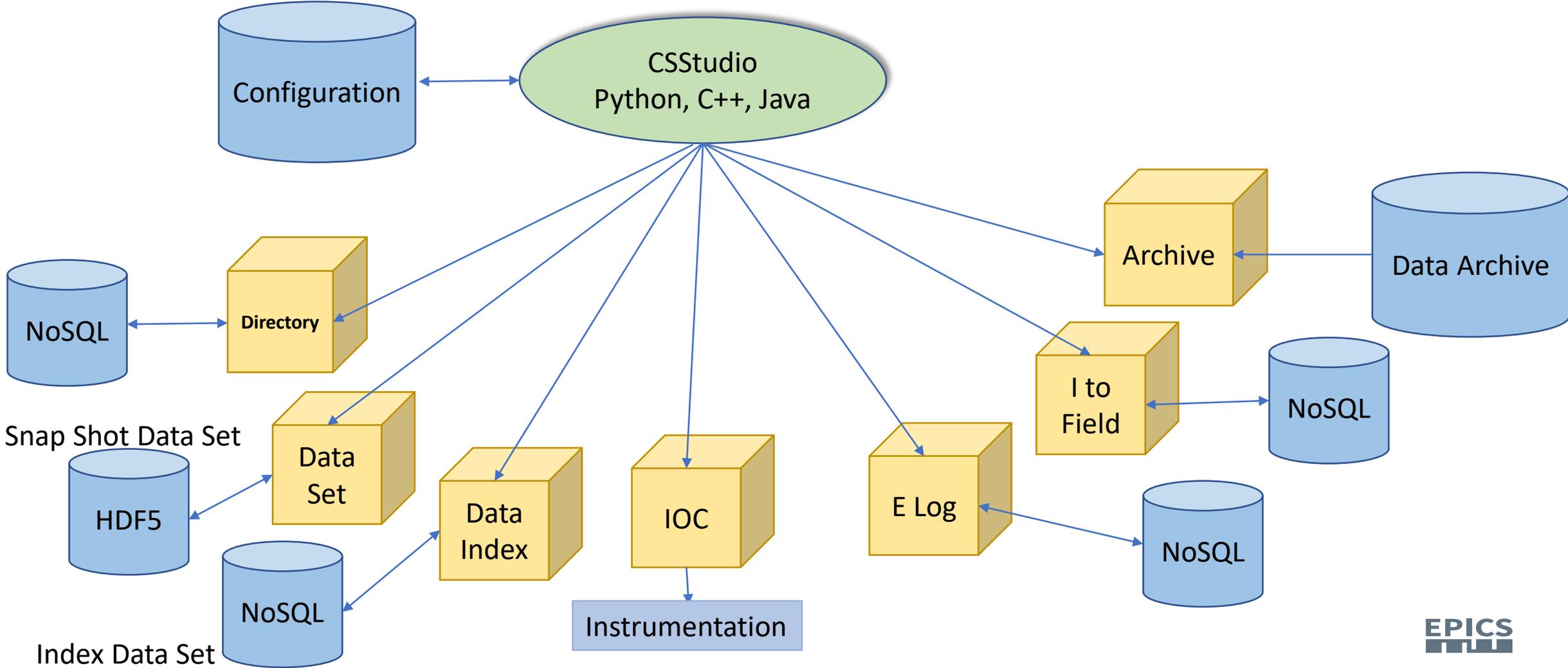
Standard Services are developed to demonstrate the use of these mechanisms:

IOC (QSRV)	2017, Q3
areaDetector	2017, Q1
Directory	2017, Q3
Save Sets	2017, Q3
Data Index	2017, Q3
Archive	2018, Q2
Log Book	2018, Q2
Snap Shot	2018, Q2
Alarm	Not Yet Specified

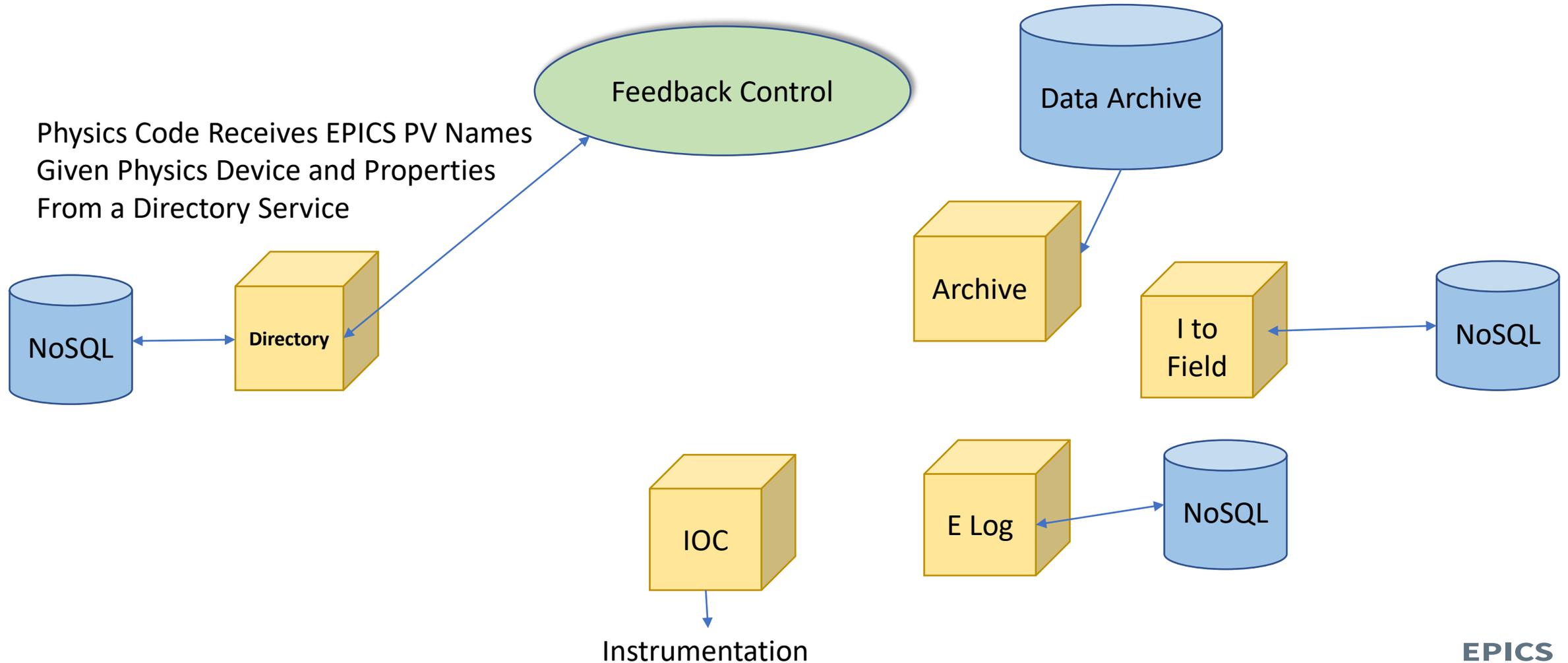
Unit Tests and Performance Tests are provided with most code

Python, Matlab, C++, and Java APIs available for client and service development

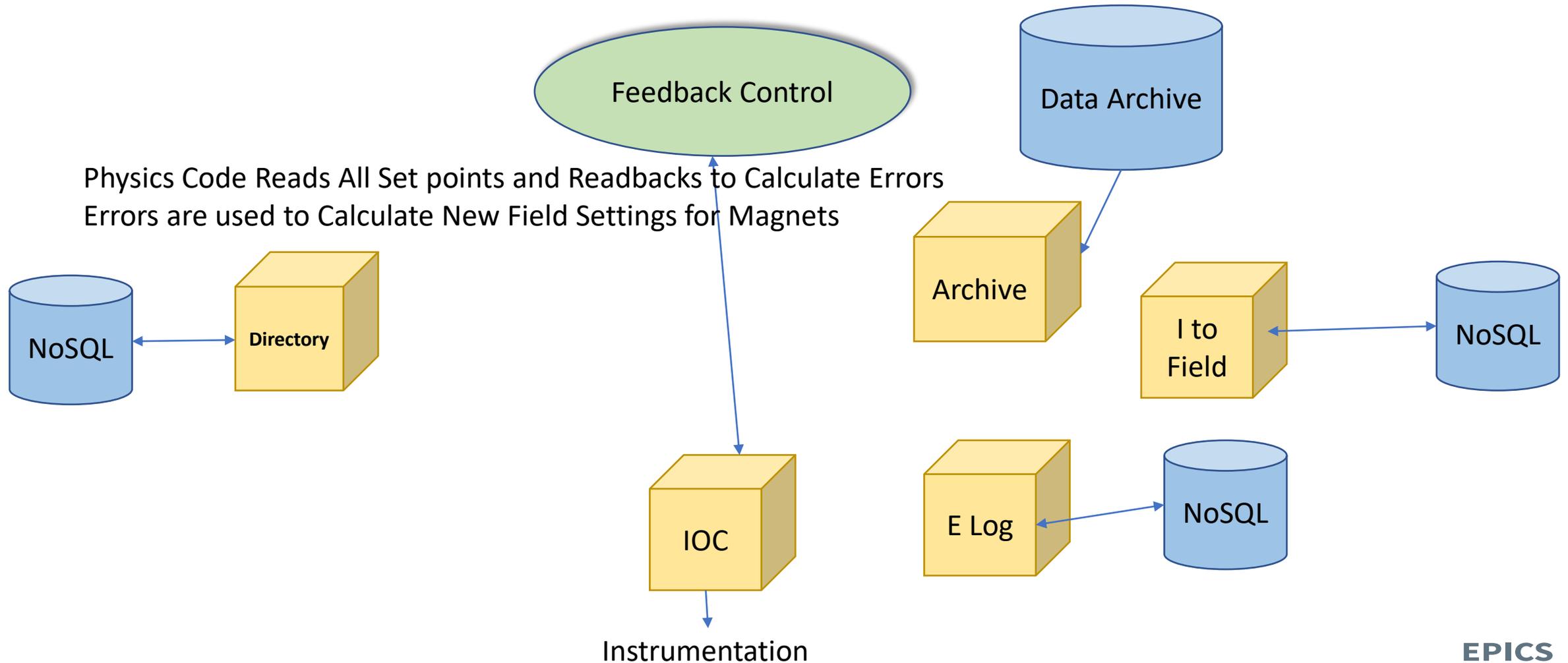
Standard Clients Connect to Services Large and Small



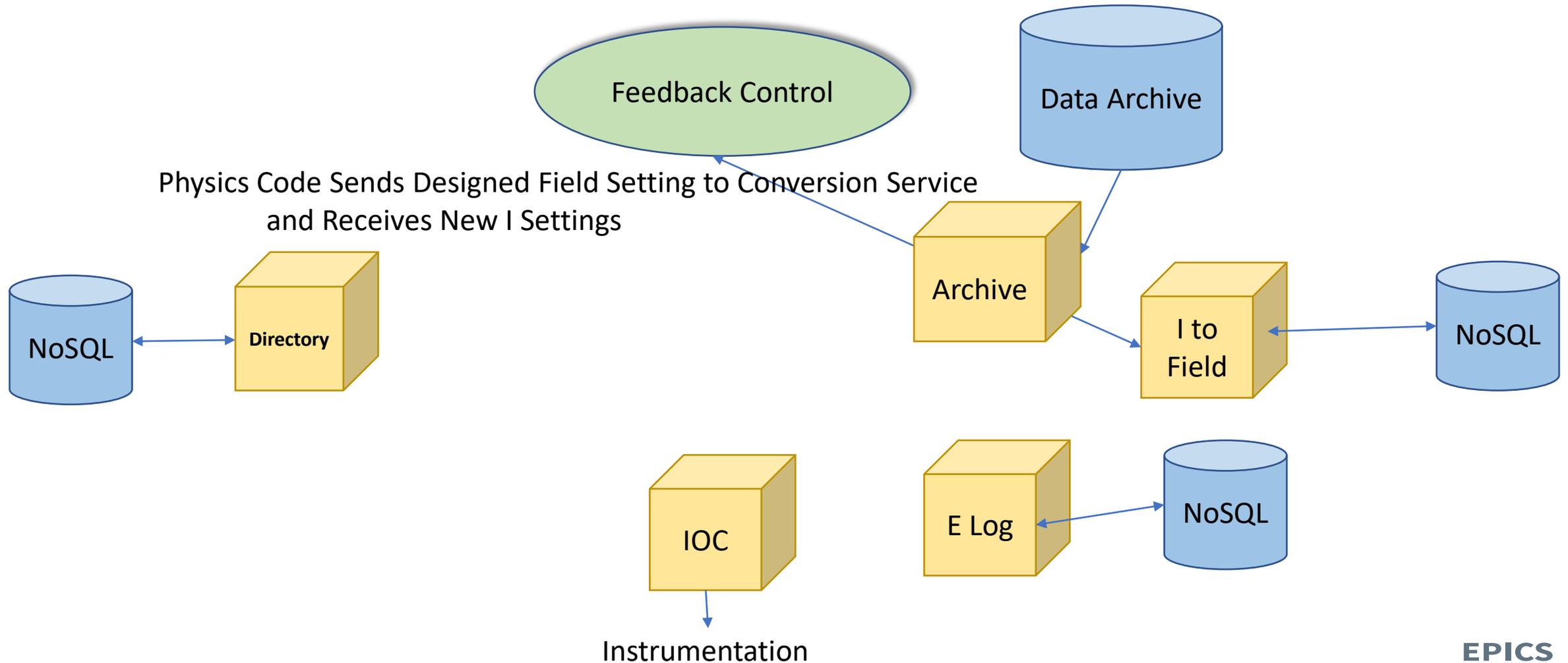
Micro Services Support Application Development – Name Mapping



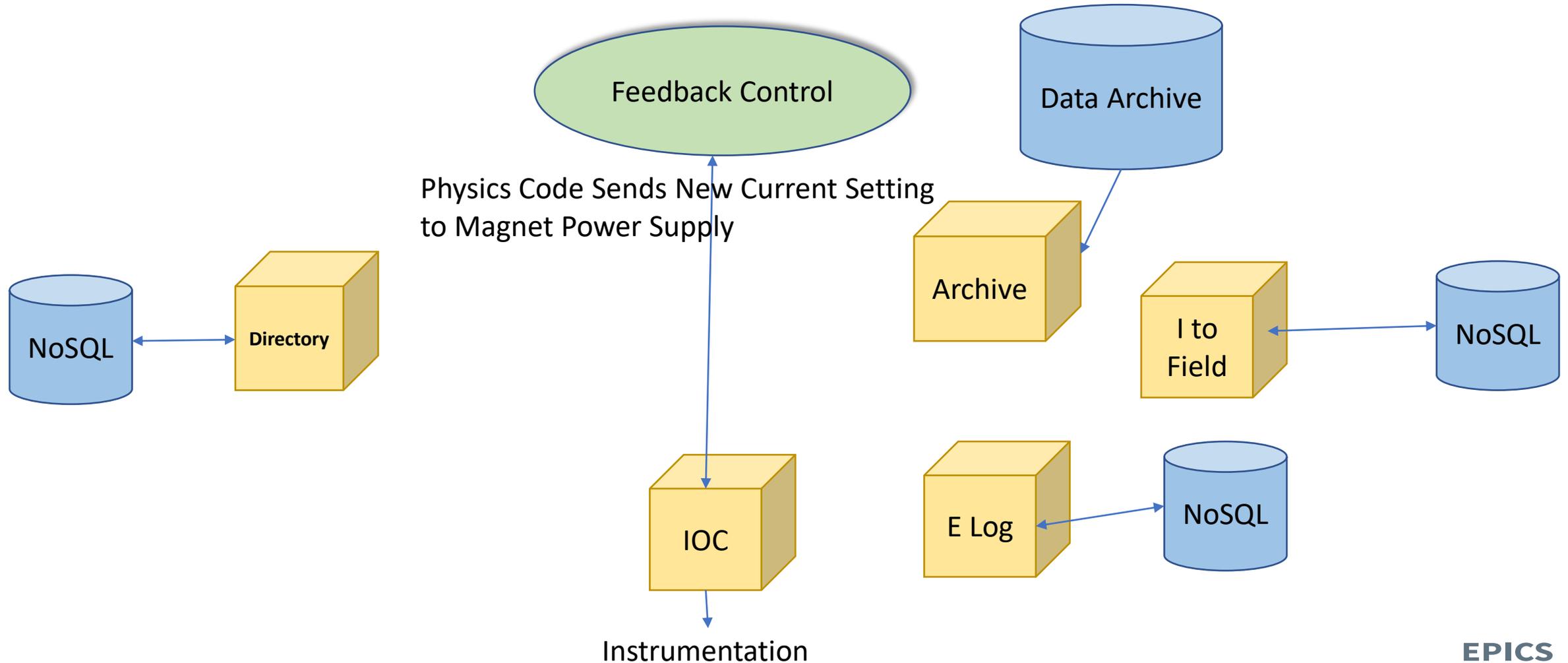
Micro Services Support Application Development – Read Instrumentation



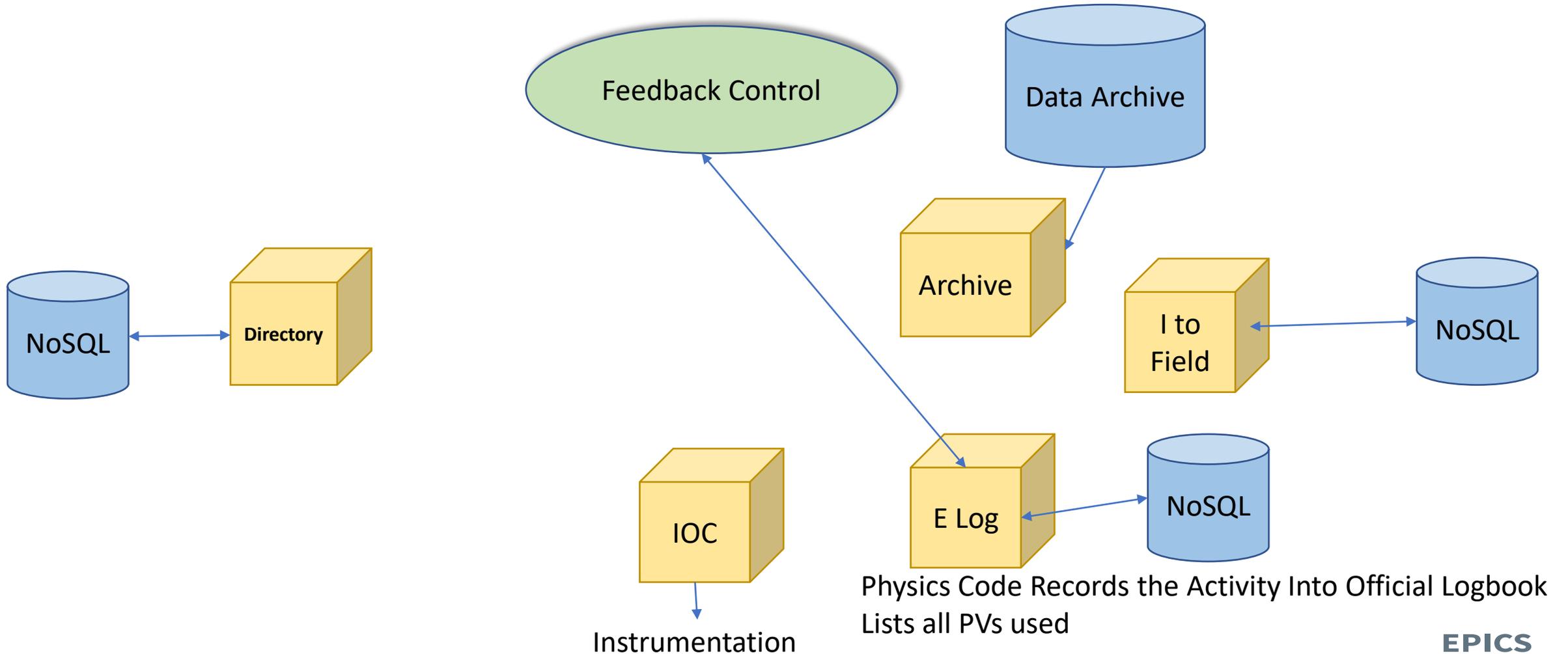
Micro Services Support Application Development – Conversion Service



Micro Services Support Application Development – Write Instrumentation



Micro Services Support Application Development – Electronic Log Book



Who is using EPICS 7 at this time?

- **ESS** plans to deploy a full scale EPICS 7 control system
- **NSLS-II/FRIB/RAON**: middle-layer services using structured data
 - In production: Channel Finder, MASAR service for save sets, Data Index
 - More services planned (archiver, snapshot data, elog, ...)
- **SNS Beamlines**: implementing next generation of controls and data acquisition
- **LCLS I/LCLS II**: re-implementing all high-level physics database access using pvAccess and middle-layer services
- **FHI**: using archiver appliance with pvAccess and structured data
- **APS**: uses v4 RPC services for large buffer transfer
- **Diamond/NSLS-II**: transferring areaDetector images across the network / between processes using pvAccess
 - Using >90% of physical bandwidth on 10Gb ethernet (no compression)

Conclusions

- EPCS 7 enables the integration of all data through microservices
- Normative Types is Set of well-defined containers for generic clients
- Standard microservices exist for integrating standard data stores
- EPICS 7 continues to provide a robust, high performance network protocol and data interface.
- Instrumentation continues to be easily configured and integrated
- EPICS 7 is in use for physics applications and DAQ at multiple sites..