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EPICS 4 Progress Report

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for the **EPICS 4 Collaboration**

Outline

- Introduction
- System structures
- Modules
- Data handling and transport
- Interoperability
- Services
- Summary & Outlook

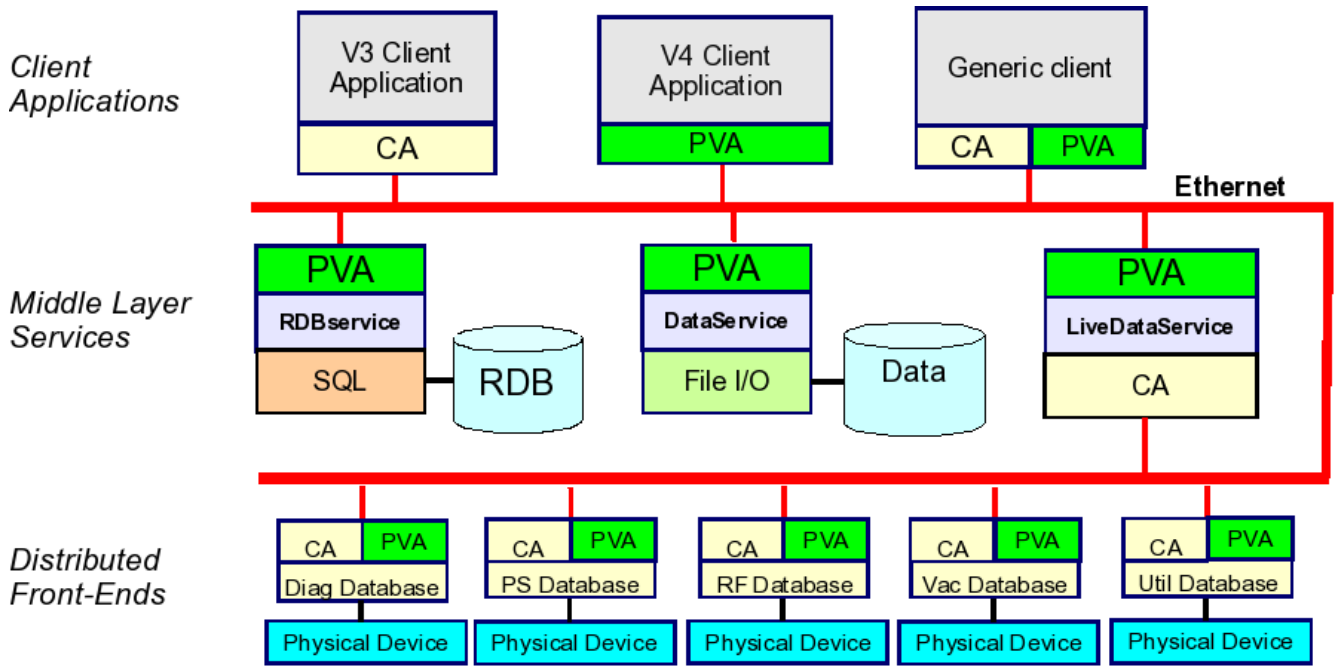
Introduction

- EPICS version 3 structure
  - Flat database of records
    - Enables development of lightweight controls applications
    - Combining data into larger entities is cumbersome

- Scientific applications have different requirements than controls applications
  - Data integration facility-wide, from diverse data sources
    - Beam orbit at a certain pulse from distributed front-ends
    - Facility information in relational databases
  - Large data sets with meta-data and values
    - Detector image with dimensions, trigger conditions, etc.
    - AD converter data with sampling rate, bit depth, environment data

- EPICS 4 aims to bring controls and scientific applications closer
  - Structured data support and new network protocol: pvAccess
  - Services for data processing and aggregation

System structures with EPICS 4



- Systems can consist of
  - Traditional IOCs, talking both Channel Access and pvAccess
  - Services serving complex data, possibly aggregated from different sources
    - Infrastructure services (RDB), model services, live and archive data, etc.
  - Client applications can use either protocol (CA, PVA) for easier migration
    - But only pvAccess can provide complex data

Structure of EPICS 4

- EPICS 4 is a combination of EPICS 3 and modules providing new features
  - New modules on top of EPICS 3 make a version 4 IOC
  - Services that are not IOCs can be programmed using the additional modules

- Single codebase for IOCs and services
  - One set of APIs instead of separate ones

- EPICS 3 infrastructure can be used as is
  - Huge investment in infrastructure that does its job well
  - Re-implementing all that is not realistic for many sites
  - Add what is missing, keep what works well

- In the future, the additional modules will be merged into the EPICS base release

Modules

- Modules that make up the base infrastructure of EPICS 4 (at the moment)
  - Build on top of EPICS base release; at the moment 3.14.12 and higher
  - **pvData**: API manipulating of data structures
  - **pvAccess**: network protocol to transport pvData over the network
  - **pvaSrv**: provides to Version 3 records via pvAccess
  - common utilities for the above, example services, etc.

- Specifications and conventions to complement the above
  - Normative types, specification of general-purpose structures
  - pvAccess protocol specification

- See the project website (epics-pvdata.sourceforge.net) for documentation and code

Data creation and manipulation (pvData)

- Structured data support (pvData)
  - Data entities can be
    - Scalar, array of scalars, structure, array of structures
      - Structures can contain any of the above
      - Top-level entity with a published name is always a structure
  - APIs for structure introspection and data manipulation

```
structure beamOrbit
    alarm_t alarmStatus
        int severity 0
        int status 0
        string message
    time_t timeStamp
        long secondsPastEpoch
        int nanoSeconds
        int userTag
    structure [] positionData
         string  bpmName
         double zPos
         double X
         double Y
         double I
```

Top-level structure contains two structures and one array of structures

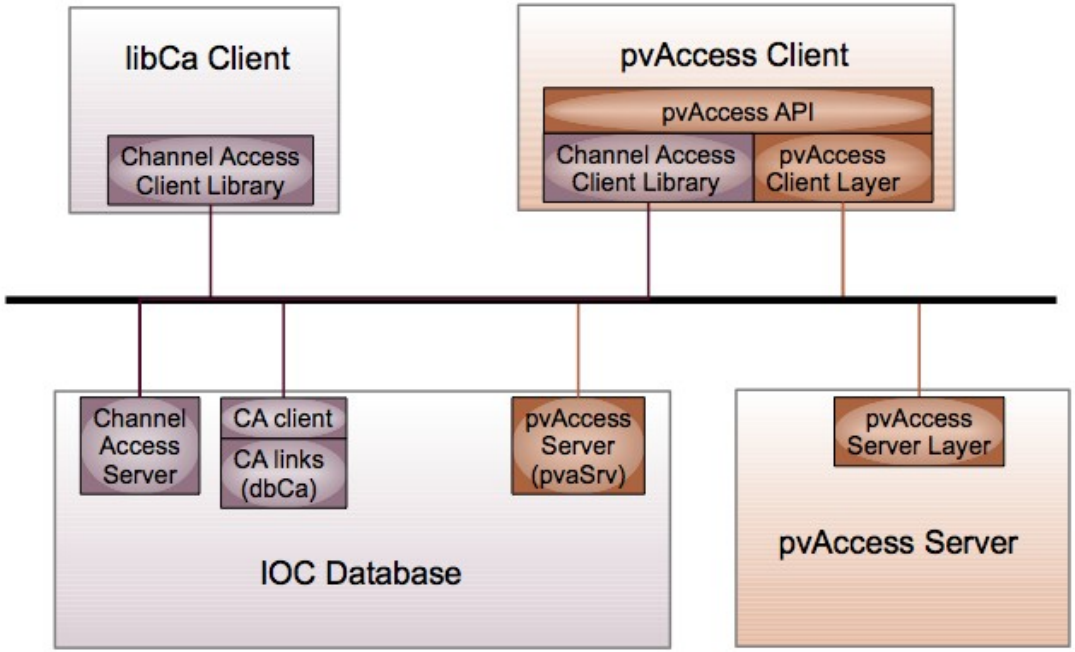
structure containing scalars of primitive data types

Data Transport (pvAccess)

- Network protocol to transport pvData: pvAccess
  - Wire protocol for efficient data transfer over the network
    - Even for high-volume data (e.g. pixel detectors)
  - New operations in addition to put, get and monitor (subscription)
    - ChannelRPC: query with parameters
    - PutGet: put-process-get, get back results after doing I/O operation
- Structure vs. data content
  - Client and server exchange introspection information before exchanging data
    - Data on the wire is not self-describing, for efficiency
- Focus on efficiency
  - Transfer large amounts of data
  - Queuing to support reliable data acquisition

Interoperability of Version 3 and 4

- How to deploy version 4 in existing facilities
  - Co-existence of protocols (Channel Access, pvAccess)
    - V3 Channel Access, V4 pvAccess
  - IOCs can deploy pvaSrv to serve record data and metadata
    - and thus become V4 IOCs
  - pvAccess client can use Channel Access protocol
    - No changes to IOC necessary



Interoperability of services

- Interoperability of services and IOCs depends on
  - Talking the same protocols
  - Introspection facilities
  - Knowing what the structures represent

- Normative Types (NT) enable implementation of generic clients
  - Knowing the structure only does not specify what the data represents
  - Define a set of standard structures
  - Specify also what they represent
    - Receiver can handle the data without knowing where it came from

- Services exchange NT structures
  - e.g. NTURI with query parameters
  - Results returned in a NTTable

Services

- Services provide integration of
  - Different sources of data (aggregation)
  - Data processing and manipulation (modelling, conversions, etc.)
  - Facility data, metadata (device lists, device parameters, etc.)
  - Logbooks, utilities,...

- Service-based architecture has several advantages
  - Modular, single source of data
  - Uniformity of communication IOC to facility services
  - Management: internal changes do not affect clients
- Services, existing or planned
  - Channel Finder service provides device views
    - See next talk (TUCOCB05)
  - MASAR: machine snapshot and retrieve (in MOPPC155, Monday)
  - Gather: Collect data from different sources (IOCs, services)
  - Database services: Serve data from relational databases
- And many others, all talking the same protocol

Summary and Outlook

- EPICS version 4 has taken a firm shape
  - base infrastructure for data handling, pvAccess protocol essentially complete
    - Features are being added: Multicasts, access security, etc.
  - Integration into the base is foreseen
- Working groups continue to build on top of v4 facilities
  - Services
    - Modelling, data manipulation, data integration
  - Utilities for facility management
    - Logbooks, etc., that interface directly with EPICS
  - User interface tools
    - Control System Studio interfaces for services, etc.
- Services are being deployed in production
  - Real-life testing brings maturity to the products
- Consult the project website for information about progress and activities
  - http://epics-pvdata.sourceforge.net

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Thank you for your attention!