

- [1. Dirk Zimoch - Fun With Macros](#)
 - [1.1. In-line Expression Support](#)
 - [1.2. IOCSH Function Support](#)
 - [2. Andrew Johnson - Extensible Link-Types](#)
 - [2.1. V3/V4 Roadmap Discussion \(part I\)](#)
 - [3. Jeff Hill - Enhancements](#)
 - [4. Michael Davidsaver - pvAccess demos.](#)
 - [4.1. Gateway Performance Demo](#)
 - [4.2. Atomic Access and DB Groups Demo](#)
 - [5. Core Team Support from the Community](#)
 - [6. Elke Zimoch : Quo Vadis EPICS ?](#)
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1. Dirk Zimoch - Fun With Macros

Dirk presented two slides on 'fun with macros' with proposals to make life a little easier.

1.1. In-line Expression Support

Typical use case : hardware numbering 0..N-1, preferred indexes running 1..N. Wouldn't it be nice to be able to write $\$(1 + \$(i)*3)$ or equivalent in the record definition ? Dirk has made a prototype implementation for restricted expressions and operators.

Discussion : this overlaps Jeff's Lua work, but for simple cases this would be a lower overhead. Kay asked if this might be a slippery slope with an expression engine requiring to support string manipulation... Dirk agreed that the scope would need to be kept tight. Andrew open to a proposed contribution in principle.

1.2. IOCSH Function Support

When implementing support for IOC functions, there is a lot of boilerplate code. Dirk has implemented a macro that helps alleviate the pain with support for up to 20 arguments (extensible to more if required, subject to the general "limits are evil, so help us avoid them" principle referenced by Michael later in the meeting). Dirk finds it helps avoid errors. Andrew would welcome the patch. Comment from the audience stated that a request for this feature came up on tech-talk a couple of days ago. Dirk has ambitions to take the approach further to simplify registration, but has yet to complete this.

2. Andrew Johnson - Extensible Link-Types

To integrate V3/V4 there is a use case to reference pvAccess link-types. Andrew presented a demo of a plugin based approach which is more generic to allow anyone to implement custom link types. The concept proposes a simplified json object syntax in which excessive quoting/escaping is minimised to make the database format entry human readable. A key/value format then specifies the required link-type metadata. Lists are supported, and the information strings can be arbitrarily long (it was noted that the iocsh dbpr command may require a bug fix to support introspecting this). Nesting is possible, so one link-type plugin may rely on a second. The implementation requires a double parsing strategy so that the internal representation is pure JSON (and hence can use a standard parser).

Additional benefits of the system were brought out during the demo, including :

- Possibility of a syntax to describe alternate PV as a failover if not located locally (Kay proposed that this be handled explicitly rather than implicitly, and was warmly welcomed to implement this by Ralph, thus proving the wisdom of the generic plugin approach, and the risk of asking good questions at collaboration meetings). A subtle point in the V3/V4 integration path is that although at present a CA link cannot fail by definition (the PV may be there, but the IOC offline), in future, an IOC without CA support could come into existence, so this failover handling could become more complex.
- Fanout support
- Immediate support for constant arrays (currently lacking)

During the discussion the general question of hard coded limits was identified as frustrating. Andrew requested that anyone finding such limits should please as a minimum submit a bug report. Michael encouraged that the community work together to eliminate such remaining cases.

Elke asked when this new link-type feature would be available. Promised soon, since it will be needed for 3.16.x. This resulted in a general discussion on the V3/V4 roadmap, at this point from a purely technical perspective.

2.1. V3/V4 Roadmap Discussion (part I)

Greg hinted at the pathway towards “one EPICS”. I.e. An integrated V3/V4 distribution. It was noted that for backwards compatibility reasons with facilities requiring specific older V3 versions, and a need to pull in some V4 add-ons, this is technically a subtle issue. Ralph’s build system has taken great steps to support such bundles. This topic was debated in more detail during Elke’s presentation with some concern about how to market/represent this issue to managers. It was clear that for some users, the difference between V3/V4 remains unclear with “should we migrate?” questions that slightly miss the point being raised. Of course pvDatabase raises the question of whether such questions may become more valid.

3. Jeff Hill - Enhancements

Jeff gave a run down of a number of projects he has worked on to extend/enhance various parts of EPICS including :

- Preview of his Lua IOC shell extension talk. Implementation seems mature and nicely integrated with base. Dirk commented that he did a Tcl variant of this previously (maybe we should also encourage him to release this as a module too). Ralph commented that iocsh limitations have been an issue for a while and welcomed the approach of using a low footprint scripting language to provide better functionality. Andrew encouraged Jeff to package this as a module so as to be easily deployable. Consensus was this should be straightforward.
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- Jeff has a CA server with a number of bug fixes and improvements. The implementation relies on C++ 11 features. It supports easy interfacing to third party data types, is very efficient, resolves an queue event ordering bug, supports arrays on the event queue, multicasting to discover IOCs, lua filtering through CA name suffix support through Boost for older VxWorks (where C++11 not available) and is transparent to CA gateways without requiring their recompilation. The lua queue filtering function was required to support specialised beamlines with multiple species where users needed to get their client to pull only the relevant data.

4. Michael Davidsaver - pvAccess demos.

Michael presented two demos contributing to the V3/V4 integration path. He thanked RAON (via Han) for having sponsored the contracts that underpinned some of the work shown in the demos.

4.1. Gateway Performance Demo

An IOC comprising rSrv (CA) and qSrv (PVA) servers is established and feeds CA and PVA gateways beyond which CS-Studio clients display an updating frame counter and images coming from an AD simDetector in the IOC. The PVA feed shows a smooth increment, but the CA feed is laggy/jerky. The demo illustrates that pvAccess is a better mechanism for transporting data, particularly through gateways.

Discussion: the performance issues in CAS servers arise from their limitation of being single threaded. CA clients, which can be multithreaded can generate a load on the CA server that cannot be adequately serviced. In addition, resource contention between different PV types (scaler vs image) can result in unbalanced treatment of updates. Once a gateway starts to exhibit this instability, it is difficult to eliminate the behaviour. pvAccess has improved performance because the server is multithreaded, treats data types in a balanced way and has a reduced overhead due to handling arrays more efficiently by reference.

(An audience member asked for a video of the demo. I have a shaky mobile phone version if this is really of value, but I suspect Michael could provide better evidence if really of value)

4.2. Atomic Access and DB Groups Demo

V3 operations that involve multiple PVs can be problematic due to lack of atomicity. Michael showed a demo of a solution to work around this using V3/V4. An IOC is constructed which an angle counter theta in degrees from 1..359 and computes $x=\sin(\text{theta})$, $y=\cos(\text{theta})$ and thus traces out a unit circle coordinate. Mathematically the invariant $\sqrt{x^2+y^2} = 1$ ought to hold true for any acquisition, but CA non-atomicity will break this intermittently. A solution is presented introducing the concept of database groups. Two CSS views are contrasted. A CA client proves that on occasion, the updates for x and y are separated, and the invariant breaks. The proposed (and prototyped) solution involves adding an infotag to the records for the x and y calc variables to create a circle group, triggered on changes in y. A second CSS view based on a pvAccess client accessing the group thus created proves that the invariant is maintained.

Discussion. This prototype was agreed to demonstrate one of the migration path benefits for mixed V3/V4 use. Questions as to establishing similar atomicity across multiple IOCs were raised. Distributed locking, though possible in theory, is out of scope of current plans. A workaround noted by Andrew would be for one IOC to monitor a second, and then create an atomic group within the first IOC.

Dirk commented that this new syntax opens the door to fully user definable records with even more sophisticated behaviours. Ralph and Michael acknowledged that this discussion has been explored, but obtaining consensus on what the rules for record processing would be as the behaviour space expands was impossible even in a small core group. Andrew agreed that this direction would lead to complete IOC rewrites, and effectively, what would be created would not be EPICS V3 as we know it. Michael emphasised that a design goal constraining extensions is to maintain the large body of value existing in the EPICS drivers. Greg pointed out that for complex/new behaviour, the V4 pvDatabase is an arena where this can be accommodated.

A general comment that a difference between using CA/V3 and PVA/V4 applies to default limits for array sizes. Andrew acknowledged the point and observed that APS environments set the limits to a suitably high (400k) value. However, he also noted that for some low memory architectures, it is important to keep default limits within feasible ranges. A revised higher default limit per architecture is a likely improvement on his todo list.

5. Core Team Support from the Community

Ralph pointed out that partly due to the significant V4 development work, the core V3 support team load is falling primarily on Ralph, Michael and Andrew. Requests on tech-talk for test/review support, particularly for non-standard platforms/architectures were receiving few or no volunteers. This is slowing progress and release. In general, the community were encouraged to volunteer effort, in the following areas :

- Testing of modifications, particularly on non-standard platforms

- Participation in code review of changes
- Housekeeping contributions towards bug tracker triage/cleanout
- Documentation contributions - technical writing.
- Web update. EPICS wiki write accounts are available - just ask Andrew or Michael
- Technical contributions/ideas/effort also welcome : managers please note

6. Elke Zimoch : Quo Vadis EPICS ?

Elke presented a non-technical challenge raising a wide variety of questions as to how the collaboration should take a longer term view of plans/requirements/engagement. This included the following observations.

1. Established facilities may have a tendency to run to caution, and to be risk averse in adopting/promoting change. This can create an inertia.
2. The EPICS logo represents only a subset of the components actually required in a control system when viewed in a more holistic way. Trends for connected hardware to include embedded intelligence may demand a need for a deeper model.
3. What defines an “accelerator control system” ? Should this also take into account :
 - a. The development environment
 - b. Simulation/testing tools.
 - c. Software repository management, build and deployment infrastructure
 - d. Configuration management, databases
 - e. Hardware, Firmware : not just the CA/PVA integration glue
 - f. File structures
 - g. Boot philosophy
 - h. Naming conventions
 - i. Data acquisition and data management and distribution (AD making inroads but..)
 - j. Security - of data, of systems, of control
 - k. HW choices/recommendations for IOCs, servers, clients, FPGA fast logic..
4. What is the community vision for EPICS scope in the next (N) years ?
5. What are we doing to attract new projects to select EPICS, which in turn can drive innovation, injected effort, ... ?
6. How do we reconcile aspirations for any/all of the above with commitments and constraints.

Discussion

1. Michael commented that he has had success with adopting the Debian project standards on file structure/layout. Andrew cautioned against stressing this too much to avoid putting off other distribution users.
2. Andrew noted that EPICS base remains very portable, even to the extent that the Windows 10 Linux Kernel support can allow a build chain using Windows->Ubuntu kernel mode->gcc toolchain->IOC running as linux arch under Windows OS. Going further, the “Linux” can be used to install mingw tools, cross compile back for Windows and build an executable that runs natively back in the original (still running) OS.

3. In terms of engaging new users, it was noted that in spite of (2) it remains the case that tech-talk sees questions from adoptees needing help with getting started. Do aspects of EPICS technicalities arise from a 'nerd' culture? To quote Michael "It's EPICS, obscure syntax is what we do". Are the perceived technical barriers an inevitable consequence? After all, if you can't work around them, perhaps controlling accelerators should not be something you are attempting? Equally, it's not realistic to continuously improve and change everything, and still maintain backwards compatibility for production systems, and our machines necessarily have very long lifecycles, so there is a tension between easier for new adopters and feasible for existing stakeholders.
4. Matthias commented that Elke makes a valid point, but also that this kind of community introspection and planning does have a history. Google("EPICS 2010") to locate the discussion document written in 2003 previewing the future at that time, which came out of a 2-3 day workshop. Since then, much of the plans set out have been achieved. Perhaps a new workshop to prepare the vision for EPICS 202X should be arranged?
5. Audience comment highlighted that we should recognise that notwithstanding some rough edges, the capabilities and features of the EPICS toolkit do receive very positive feedback in many cases.
6. Elke reiterated the need for a strategy discussion forum. Michael commented that there are constraints on how wide the scope can be taken, since much of the effort to build new features is only funded on an as-needed basis, and partly from insightful decisions to invest a little beyond the strict scope of project requirements. Elke raised the question of what can be done to encourage wider contribution and better sharing of (perhaps private) code that could be of value to the community? Andrew pointed out that the drivers/hardware database is one of the means by which a core shared resource is maintained, and encouraged all who have such code to declare it.
7. Greg summarised a number of project management techniques that have successfully been employed by the V4 group to bridge this path. The V4 group have an open management approach and do build both short term (2 year) and long term (10 year) plans or 'charters'. He commended Timo and Bob for having achieved financial backing for the efforts, and noted that having a concrete/specific short term goal was a means by which progress could be measured, and hence senior management persuaded of the merits of such investment. He noted that the V4 output was ahead of schedule.
8. The question of V3/V4 'branding'/roadmap/strategy and how this is perceived (whether technically accurately or not) by managers and stakeholders resulted in lengthy debate. It was emphasised that V4 provides add-ons that allow the creation of new services, to support and augment control systems based on V3. Exactly how, and when, and why V4 will be added to a facility/project is very project dependent. The technical view is that arguments over branding/perception risk missing such subtleties, or raising perceptions of risk unnecessarily. The manager/funder oriented criticism is that V3/V4 appear to generate uncertainty, and so the issue does need to be addressed. On the whole, there appears to be a degree of consensus (not unanimous) that at some stage, relatively soon, an integrated V3+V4 distribution with a clearer badge will come, and that this will

address the concerns. Greg/Andrew stressed that there are a lot of practical issues that merit appropriate preparation to underpin this (necessary/important) PR aspect of the collaboration without causing technical/production issues. Ensuring that the technical/management perceptions/expectations are well managed is clearly a challenge for the collaboration.