ARM Resources: CMS Status and Prospects

Adriano Di Florio
(on behalf of CMS Collaboration)

12 June 2024   WLCG - GDB

Summary

1. The outcomes of the ARM resources validation round done in late 2023 (not conclusive)

2. A sketch the plan for 2024 to have the a better understanding.

Software Validations in CMS

- In CMS release validation is one of three main tasks of PPD/PdmV group

- Every new (pre)release includes lots of changes from many developers in many (sub)packages.
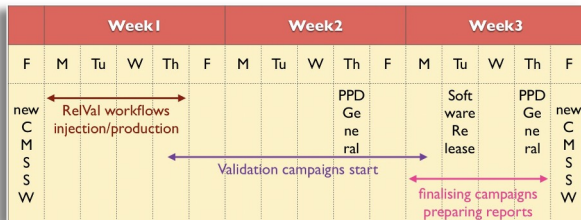

Prompt response from physics groups is key to spot unexpected changes.

- This timeline is a slightly optimistic but gives good a picture
- Typical validation campaign has sub-campaigns:
    - MC: Run3, Phase2 and HeavyIon samples (with and without pileup).
    - Data: 2023 and 2022.
    - Both offline RECO + HLT.
- Release Validation (RelVals) samples are running at T2_CERN with the highest production priority.

Validation Procedure

- Validate for us means running on the same sample twice and providing the physics groups with a comparison of the Data Quality Monitoring plots.
- A first step of the comparison in automatized via the Release Monitoring (RelMon) system. Plots compared and categorized based on a χ^2 score.
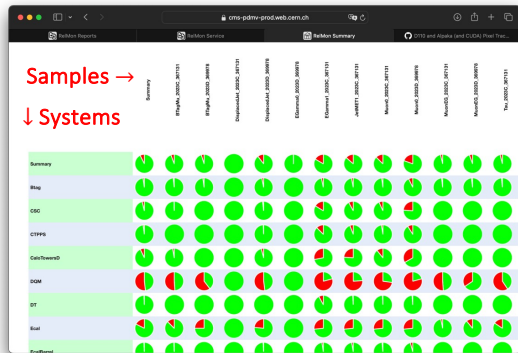
Validation Procedure

- A **first step** of the comparison in automatized via the Release Monitoring (RelMon) system. Plots compared and categorized based on a χ^2 score.
- A **second step** is done manually (at the moment) by each group inspecting (mostly) the failing comparisons.
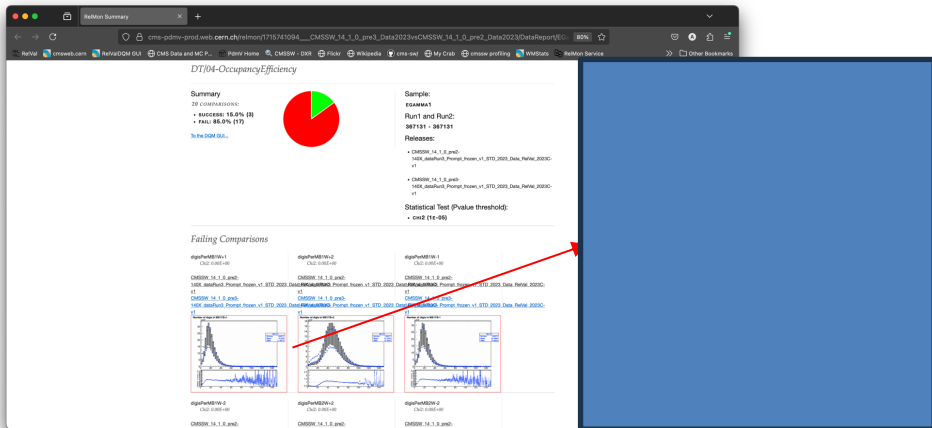
ARM Validation

- `cms-sw` supports since 2016 ARM architectures (and POWER since 2014).
- In October/November 2023 CMS got access to ATLAS unused ARM resources at Glasgow T3 (T3_UK_ScotGrid_GLA).
- We went for an high stats statistics production for Run3/HIN MC and 2023 Data.
- Using (of course) the same release (13_3_0_pre4).
- Not straightforward to setup but successful:
    - **MC**: $\sim 7 \cdot 10^6$ (for 40 processes) reconstructed events (produced $\times 10^2$, gen filter efficiency).
    - **Data**: $\sim 4 \cdot 10^6$ events with 2023 (eras C and D) re-Reco/re-HLT data workflows.

T3_UK_ScotGrid_GLA
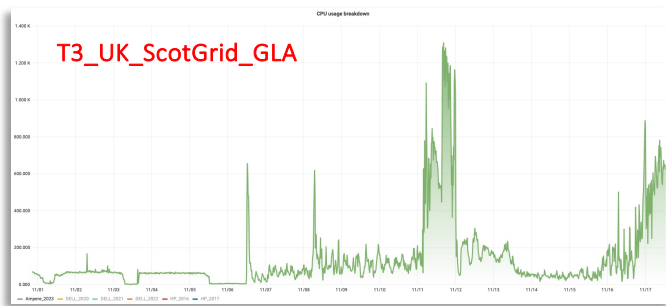
ARM Validation - MC

✅

- For MC two flavors offered:
    - Regenerated GEN-SIM: to check also simulation level. So whole chain run on x86 (at CERN) and ARM (at Glasgow).
    - "Reco-only" samples: generation, simulation, digitization on x86, reconstruction on ARM. Kills fluctuations, but probing only reconstruction.
    - Each wf have O(10k) events.
- We got green light from almost all the groups (all those who reported).

ARM Validation - Data

- For data samples many reports went red instead. Few factors here:
    1. Physics groups are (rightfully) more "demanding" on data since the whole chain is (in principle) always run on exactly the same events.
    2. Fewer workflows with more events, O(100k) == much longer runs. $\oplus$ Data are at CERN (so needed staging) $\rightarrow$ More prone to failures.
    3. Being the resources available for a limited span of time makes recovery tricky.
- Non negligible discrepancies found. Big enough that we can't rule out they are genuine (and not only due to a different number of events).

ARM Validation – Plan 2024

- Bottom line: as CMS we have not been able to actually validate ARM architectures.

- One of problem there was the fact that we had no "steady and stable" access to ARM resources so we couldn't go back and check carefully and granularly what happened for those runs that failed.

- During 2024 we have access to resources both at CERN and CNAF. For sure having access to stable resources will help to have a better understanding.

- Everything has been setup in the latest weeks and we are ready to start the production (we already have)

- The plan for 2024 is to more granular processes in more runs being very careful to use exactly the same events in input for the two chains. We will have a clearer understanding by the end of the year.

- First round expected in 1.5 months (production + reports).

fin

CMS Position on Readiness to Use ARM Resources in Production

The CMS physics validation on ARM was mostly successful for Monte Carlo simulated events, but significant differences which are not understood at this time have been found for detector data in several subsystems, including muons, tracking, and the electromagnetic calorimeter. Further investigations will be enabled by using the ARM resources at CNAF during 2024, subject to finding the necessary extra effort, but at this time CMS is not in a position to be able to use ARM processors in production.

N.B. As presented at the WLCG MB on April 16, 2024. Minutes link.