Metadata in ATLAS

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Metadata … Outline

- Metadata
  - What is it ? Challenges in ATLAS
  - Survey some user oriented systems using Metadata
  - Describe a few areas: metadata in evolution
    - Dataset Nomenclature, PhysicsShort, AMI tags
      - Delicate balance between constraints and usability
      - Focus on Datasets containing events in this talk
    - Transforms and metadata
    - AMI Hierarchical Search
      - New interface … aim to help metadata issues in MC
    - COMA Content evolution and aggregation
      - Runs, Periods, and Conditions DB management metadata
  - Summary and Conclusions

Metadata ?

- What is **metadata** ?
  - Concisely:
    - “data about data”
  - More precisely:
    - “data used to describe the context, content or structure of data”
      - Structural or Descriptive
- Metadata: used extensively in ATLAS … in fact, no process in ATLAS doesn’t use metadata … examples range from:
  - Upstream: data taking with the correct calibrations …
  - Downstream: physicist finding Events of interest …
- Metadata challenges:
  - Size/Scope of ATLAS data … Volume/Diversity of metadata
  - Data/metadata: has grown organically as the experiment evolved
  - Try to offer a coherent / integrated view to physicists while devising strategic placement for processing and analysis
- Impossible to inventory all ATLAS Metadata in reasonable time
  - Today: highlight a few areas of user metadata which play important roles in ATLAS which are currently evolving
  - Note: unable to cover many areas

ATLAS Metadata User Application Overview

- **Subsystem specific metadata**: driven by subsystem specific needs
  - Trigger: TriggerTool … Web: trigconf and trigger timelines
  - Geometry DB: Detector Description Browser
  - Conditions DB:
    - runQuery (Run information from Conditions DB)
    - ATLAS WEB DQ
    - COOL Tag Browser
  - Data Summary Reports (Luminosity, Beam)
  - Beam Spot Summary
  - GANGA and PAthena
  - Panda / monitor
  - DQ2 Client
  - Tag Collector – software releases
  - ... (not a complete list !)
- **Dedicated Metadata Catalogs**
  - **TAGs (and TAG Catalog)** – event level metadata
    - iELSSI and Suite of TAG Services
  - **AMI** – Datasets, processing … other metadata
    - And the AMI Suite of services
  - **COMA** – Run/LB level Conditions and configuration
    - Plus Conditions DB management metadata
- **Important metadata facilitator: ATLAS Job Transforms**

Dataset Names

Project.runNumber.streamType.productionStep.dataType.AMItag[/]

Project.datasetNumber.physicsShort.productionStep.dataType.AMITag[/]

dataNN_* or mcNN_*

ESD, AOD, …

Concatenation of configurations

- Dataset names used extensively:
  - Storage and operating systems, DDM, ProdSys, Metadata repositories
  - But needs to be mnemonic from user point of view
- Dataset naming rules: http://cdsweb.cern.ch/record-restricted/1070318/
  - Carefully defined by experts, evolved somewhat, has served us well
  - But was last updated in 2010 … needs of ATLAS have grown
    - 2012 Task Force formed to try to amend the rules to address these needs

    → https://twiki.cern.ch/twiki/bin/viewauth/Atlas/DatasetNomenclature
- Overall length < 231 characters (base directory name): Hard limit !
  - If each field at field limit, overall limit is exceeded !
- Many pressures on component lengths … highest areas of concern:
  - "physicsShort" – for MC datasets
  - AMI tag – for both data and MC
- Importance of Name: coherence must be understood at all ATLAS levels
  - From Management to Users … and sometimes limits are good
    - Keep a rational balance !!!

"PhysicsShort" for MC

Project.datasetNumber.physicsShort.productionStep.dataType.AMITag[/]

- Example of one proposed "Physics Short":

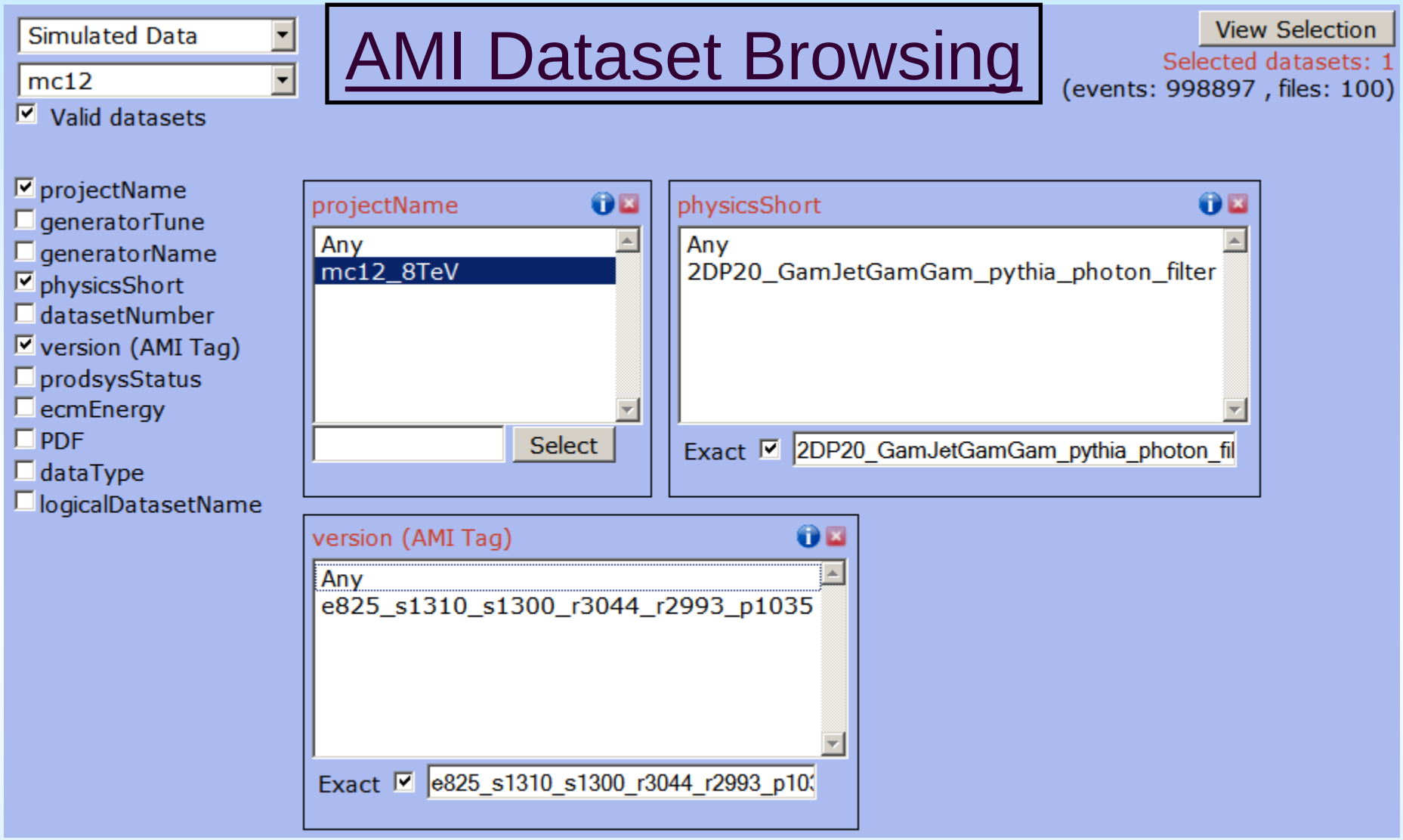
  MadgraphPythia8_NNPDF21NLOME_AU2NNPDF21LOMPI_SingleTopTChanWelenu_LeptonFilter
  - Rules: physicsShort field must not exceed 40 characters."
  - This one: 78 characters (and is it really user friendly ?)
    - This kind of 'growth' is oblivious to the rules, shows addiction of experts/users to depending entirely on the Dataset Name to identify/find their data
- General frustration
  - finding MC needed, Twiki pages, understanding the MC they use, and identifying additional MC samples they need or what exists …
- Jamie Boyd:

  "General feeling is this level of info should be encoded in AMI rather than the filename – need to follow up with generators group on this"
- Progress in 2012:
  - "Simulation Metadata Workshop" – held in April 2012
  - Commendable effort by MC Coordination: add more metadata to AMI
  - Metadata systems need to provide better tools which
    - Better explains relays the metadata behind the dataset AND
    - Better allows browsing of the datasets and the metadata

AMI Introduction

- AMI: 'ATLAS Metadata Interface'
  https://twiki.cern.ch/twiki/bin/viewauth/Atlas/AtlasMetadataInterface
  - AMI Portal Page: http://ami.in2p3.fr/
- Means of finding datasets to use in analysis using physics metadata predicates
  - Not just dataset names, but also the underlying metadata
- AMI contains a LOT more than just a list of datasets
  - Dataset provenance
  - Files
  - Lost Lumi blocks
  - Links to other applications
  - Nomenclature reference tables
- New AMI interface: Dataset 'browsing' (hierarchical search)
  - Now available to users (first version !)
  - Good feedback from users … important for evolution
    - AMI team working on refining this tool based on feedback

AMI Dataset Browsing



- User is guided to the AMI catalog specific to the project of interest
  - Information varies according to project
  - Allows users progressive selection to iteratively narrow result set

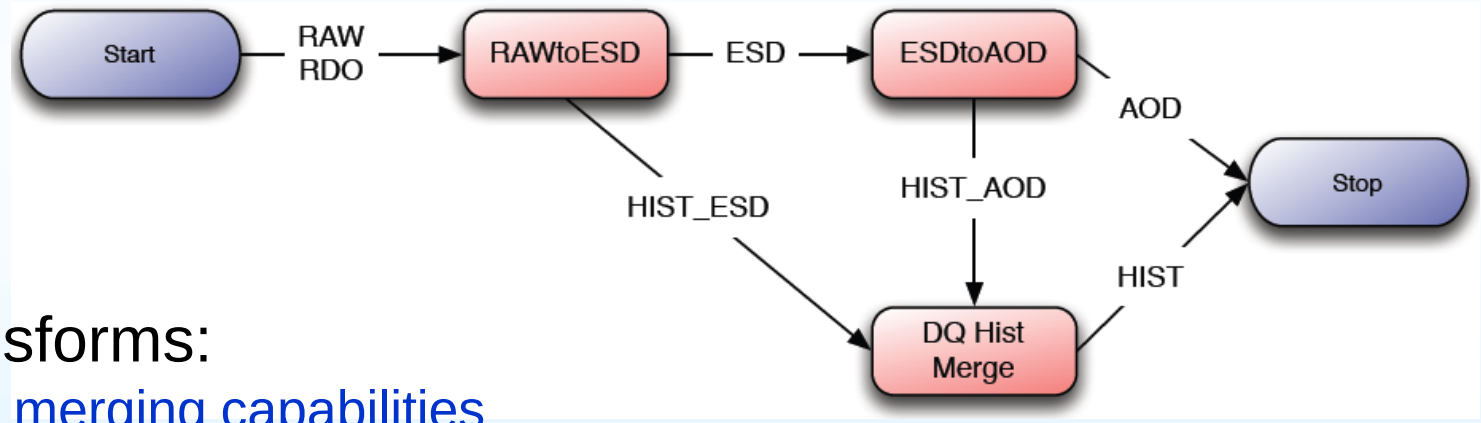
AMI ("Config") Tags

- The AMI Tag:
  - Definition:
    - Is composed of concatenated strings encoding processing steps
  - Example: r2713_p705 … encodes information about
    - which ATLAS releases (17.0.3.3)
    - which database releases (16.9.1.1)
    - which transforms (reco_trf.py), job configurations, …
  - Why is it called the "AMI tag" ?
    - AMI provides interfaces for its interpretation
  - Rules for AMI tags also listed in Nomenclature doc
    - Original specification now also needs revision
      - Max length sometimes exceeds limit (22) – multiple factors driving this …
- Highlight some issues to be addressed:
  - Running out of lower case letters
  - Numeric parts … require more characters (99 … 999 … 9999 ….?)
  - More processing/merging steps: add more/more fields
    - Must find a way to consolidate steps in a managed way
- These issues also being discussed in the Task Force
  - Solveig Albrand: evolving document describing issues/possibilities

  → https://twiki.cern.ch/twiki/pub/Atlas/DatasetNomenclature/AMItags.pdf

Transforms and Metadata

- "ATLAS Transforms": a wrapper to Athena & python job options
  - Thanks to the Transform Group !
    - Graeme Stewart, Stephen Beal, Thomas Gadfort, Harvey Maddocks, Bjorn Sarrazin
  - See Graeme's talk during Software week (last week)
  - Required, for example, by the ATLAS production system
  - Provides uniform, coherent mechanisms for specifying, executing tasks
    - Even multi-step transforms



- New Transforms:
  - General merging capabilities
    - Also need for the merging of file based metadata
  - Provide important computations
    - Such as Event counts
  - Bridges the gap in metadata communication
    - uniform information transfer to other systems and metadata repositories

What is COMA ?

- COMA: “Conditions/Configuration Metadata for ATLAS”
  - Originally: built to support dynamic queries of TAG DB
  - Evolved: into a standalone system with interfaces
  - Now part of general effort to consolidate/relate ATLAS Metadata
- COMA Components:
  - Relational Database
    - Contains extracted, refined, reduced, and derived information from system specific data sources (e.g. Conditions DB, …) plus information from non-database sources.
  - Interfaces
    - A set of unique Browsers and Reports
- Special relationship to AMI
  - Enhances COMA in many ways (e.g. Data Periods);
  - pyAMI methods make COMA information available to many systems.

- Main Documentation
  https://twiki.cern.ch/twiki/bin/viewauth/Atlas/ConditionsMetadata
- COMA Portal (grid certificate in browser is required)
  https://atlas-tagservices.cern.ch/tagservices/RunBrowser/index.html

COMA: ATLAS Data Periods … + aggregating new content

- A Data Period is a set of ATLAS Runs grouped for a purpose
  - Defined by Data Preparation Coordinators
  - Used in ATLAS data processing, assessment, and selection …
  - Each Period uniquely defined with a combination of
    - Project name (i.e. 'data10_7TeV')
    - Period name (i.e. 'C1', 'C2', 'C', 'AllYear' …)
- Before 2011, Data Periods were
  - Described on TWiki page
    - https://twiki.cern.ch/twiki/bin/view/AtlasProtected/DataPeriods
  - Stored in a file based system
    - Edited by hand by Data Prep Coordination (experts)
    - Structure evolved over 2010 with experience
      - This experience → valuable to decide/define long term solution
- In 2011: Data Periods stored in the COMA DB
  - Coordination/Effort: Data Prep, AMI, COMA experts
- Since then, COMA has enhanced content in many areas
  - Allows for more details reports and information to other systems
  - Enables aggregation of this information by Run, … Period.

COMA multi-Run report: Latest 8 runs

Shows “at a glance”: the latest Period Runs with Magnet states, ‘ready fraction’, link to Stable Beam fill(s), beam information …

COMA Online Runs Report

Run Number (runs) : Latest 8 Online Run(s)

Found 8 Runs matching the input criteria:

Project Run	Run Links	StartTime Events	Duration NLBN	SMK	Fills	Solenoid	Toroid	Period	ATLAS Ready Fraction	Stable Beams Fills	Bunch Count	Bunch dt	StableLum (nb^{-1})	InstLum Range ($10^{30}cm^{-2}s^{-1}$)	μ Range
data12_8TeV 213204	COMA; CRTrig; RQ; LumiDS	12-Oct-23 13:48 4617408	12942 s 3:35:42 LBs:222	1511	3211 : 3212	On	On		0.91	3212	1368	50 ns	21869	5939 - 6868	28 - 33
data12_8TeV 213157	COMA; CRTrig; RQ; LumiDS	12-Oct-23 03:18 13704466	16688 s 4:38:08 LBs:304	"	3210 : 3211	On	On		0.97	3210	1368	50 ns	66353	4792 - 7285	23 - 35
data12_8TeV 213155	COMA; CRTrig; RQ; LumiDS	12-Oct-22 20:52 12797198	18911 s 5:15:11 LBs:326	"	3209	On	On		0.97	3209	1368	50 ns	53691	5124 - 6883	24 - 33
data12_8TeV 213130	COMA; CRTrig; RQ; LumiDS	12-Oct-22 08:49 19140057	25152 s 6:59:12 LBs:428	"	3208	On	On	AllYear, H, H3	0.98	3208	1368	50 ns	76145	4086 - 6287	19 - 30
data12_8TeV 213092	COMA; CRTrig; RQ; LumiDS	12-Oct-21 19:22 20347563	32282 s 8:58:02 LBs:558	"	3205 : 3207	On	On	AllYear, H, H3	0.98	3207	1368	50 ns	88300	4592 - 7585	22 - 36
data12_8TeV 213079	COMA; CRTrig; RQ; LumiDS	12-Oct-21 08:18 28813949	34066 s 9:27:46 LBs:582	"	3204	On	On	AllYear, H, H3	0.98	3204	1368	50 ns	110111	2109 - 6497	10 - 31
data12_8TeV 213039	COMA; CRTrig; RQ; LumiDS	12-Oct-20 11:42 43389818	66742 s 18:32:22 LBs:1141	"	3202 : 3203	On	On	AllYear, H, H3	0.98	3203	1368	50 ns	172879	2526 - 7016	12 - 33
data12_8TeV 213037	COMA; CRTrig; RQ; LumiDS	12-Oct-20 11:17 10434	695 s 0:11:35 LBs:10	"	3202	On	On		No	No					

COMA Period Documentation Report: enhanced content

New aggregated information

COMA Period+ Description Report

Project Name (fnt) : data12_8TeV

Period Name (pn) : H

Period	Stat	Links: Runs, Containers	Description	Date Range	Run Range	#	StableLum (pb^{-1})	Ready Lum	MaxInstLum ($10^{30}cm^{-2}s^{-1}$)	μ Max (Avg)	Fills	Bunch Count	Bunch dt (ns)	Machine Mode BeamE
data12_8TeV **H** **(H1:H3)**		COMA; runQuery	Data taking after October 2012 MD. 14 EMBPresampler regions (0.4*0.2 each) lowered further to 800V All EMECPresampler lowered to 1600V One new tile module off (LBA35)	12-Oct-13: 12-Oct-22	212619: 213130	14	1374	1347 (98%)	7585	36	3169: 3208	72 : 1368	25 : 50	Proton 4000
data12_8TeV **H1**		COMA; runQuery	Data taking starting 13/10/2012	12-Oct-13: 12-Oct-16	212619: 212742	5	354	349 (99%)	6816	32	3169: 3188	72 : 1368	25 : 50	Proton 4000
data12_8TeV **H2**		COMA; runQuery	Data taking starting 16/10/2012: New AtlasP1HLT 17.1.5.19, trigger menu with new VBF triggers (new L1 menu). 6 more EMB presampler HV regions reduced to 800V. Few EMEC presampler HV lines lowered to 1200V.	12-Oct-16: 12-Oct-18	212809: 212858	3	335	328 (98%)	6656	32	3191: 3194	1368	25 : 50	Proton 4000
data12_8TeV **H3**		COMA; runQuery	Data taking starting 19/10/2012	12-Oct-19: 12-Oct-22	212967: 213130	6	685	670 (98%)	7585	36	3200: 3208	1368	50	Proton 4000

Conditions DB Management Metadata

ATLAS Conditions Database:

Non-event wise conditions and configuration information

- Designed for primary purpose, extensive documentation
  - Processing of event-wise data
    - IOV (interval of validity) based structure is ideal
- To non-experts
  - Mysterious, cryptic, specialized
  - What's a COOL Global Tag ???
- DB and COOL Tag Coordination need overview
  - Storage, tools based on individual schemas: make Overview difficult

- Extra part of COMA: COOL Management Metadata (for Folders & Tags)
  - July 2011 SW week - Discussion with Lasha Sharmazanashvili
    - Then with Misha Borodin, Andrea Formica, Paul Laycock … other experts
  - NOT intended to replace existing Storage or tools
  - Makes possible:
    - Quicker access to overview information from external systems
    - Web based reports
      - A different view and can offer links to other metadata tools
  - Since then
    - In production operation (daily synchronization)
    - Other applications start development to incorporate it (Such as COOL Tag Browser)
  - Now working on:
    - Improving content and interfaces
    - Speeding up synchronization
    - Possible incorporation of "Current", "Next" … COOL Tags into COMA (move from AFS files)

COMA Conditions DB Folder Browser Menu

... Link to COMA Conditions Folder Browser Help.

Criteria	Selection	Available values / Description
System related inputs		
System		Calorimeter: CALO, LAR, TILE Muon: CSC, MDT, MUONALIGN, RPC, TGC Tracking: INDET, PIXEL, SCT, TRT Other: DCS, FWD, GLOBAL, TDAQ, TRIGGER
Online / Offline		COOLOFL Conditions data needed Offline COOLONL Conditions data needed Online
Instance		COMP200: Real data (not simulation) replicated to Tier-1 MONP200: Real data NOT replicated to Tier-1 (monitoring) OFLP200: Monte Carlo / Simulation (replicated to Tier-1)
Folder related inputs		
Folder Name		Options are displayed if some criteria is entered.
Path Name		Options are displayed if some criteria is entered.
Payload Column		Options are displayed if Payload Column Name criteria is entered (wildcards allowed) ... Example: %noise%
Folder Versioning		0 (single version folder) 1 (multi version folder)

COOL Tag related inputs		
Folder tag name		i.e. DetStatusDQMFOFL-Muon_Calibration-pass1
Global tag name		i.e. OFLCOND-MC12-SDR-04

COMA Conditions DB Folder Browser Menu

- Enter criteria into textbox at left:
  - → Type manually or
  - → Click on options at right

  <return> or MENU;

  re-generates Menu applying selection
- Choose GlobalTagReport;

  for the Global Report
- Choose GetFolders;

  for the Folder Report

COMA (Multi) Global Tag Report

- COMA_CBAMI_GTAGS table
  - AMI Team has populated with counts showing Global Tag usage in dataset processing

COMA Conditions DB Global Tag Report

COOL Instance (cbi) : COMP200

COOL folder tag name (cbft) : OflLumi-UPD2-003

13 global tags found meeting the input criteria.
Choose Global tag name of interest to generate the full report.

Global_Tag_Name	Lock Stat	Folder Tag Count	Description	Create Date	AMI Count	AMI Date Range
COMCOND-BLKPA-006-01	1	259	Based on COMCOND-BLKPST-005-09, first tag for 2012, single global tag, mag field config now in IoVs	12Mar01_17:49		
COMCOND-BLKP-005-09	1	258	Based on COMCOND-BLKP-005-07, with updated btag calib	12Feb09_17:11		
COMCOND-BLKPS-005-09	1	258	Based on COMCOND-BLKPS-005-07, with updated btag calib	12Feb09_17:11		
COMCOND-BLKPT-005-09	1	258	Based on COMCOND-BLKPT-005-07, with updated btag calib	12Feb09_17:11		
COMCOND-BLKPST-005-09	1	258	Based on COMCOND-BLKPST-005-07, with updated btag calib	12Feb09_17:12		
COMCOND-BLKPST-005-08	1	256	Based on COMCOND-BLKP*-005-07, for 2011 HI running	11Nov03_17:52	592	11Nov14: 12Jan13
COMCOND-BLKPT-005-08	1	256	Based on COMCOND-BLKP*-005-07, for 2011 HI running	11Nov03_17:52		
COMCOND-BLKPS-005-08	1	256	Based on COMCOND-BLKP*-005-07, for 2011 HI running	11Nov03_17:52	20	11Nov12: 11Dec08
COMCOND-BLKP-005-08	1	256	Based on COMCOND-BLKP*-005-07, for 2011 HI running	11Nov03_17:50		

Summary and Conclusions

- A lot of progress in many areas using metadata:
  - Transforms, Data Processing, Dataset related metadata
  - Dedicated Metadata Catalogs: AMI, COMA, (TAGs)
- Metadata in ATLAS continues to evolve
  - Naming conventions/rules
    - Important to form coherent view over datasets, runs, periods, …
  - Increased cooperation between systems
    - Upstream and downstream
  - Use cases continue to expand
  - Improvements in metadata
    - Storage
    - Consistency
    - Delivery
    - Usage
- Challenges ahead
  - Offer coherence at Management and User levels
  - To keep pace with
    - system evolution (such as DDM → Rucio, ProdSys, … upgrades)
    - Analysis pattern evolution and use cases

Backup

COMA COOL Folder&Tag Metadata: Report improvements

- Motivated by: COOL Tag Coordination, Upcoming reprocessing, LS1
  - Significant new “Expert level” selection criteria:
    - allows viewing of Folders, Folder Tags, and Global tags by, for example, creation dates (or ranges) by themselves or in combination with any of the other criteria.
  - New selection criteria: Open Expert Section of the Folder Browser Menu
    https://atlas-tagservices.cern.ch/RBR/rBR_CB_Report.php

- Example links:
  Global Tags created since March 2012:
  https://atlas-tagservices.cern.ch/RBR/rBR_CB_Report.php?CBAction=GlobalTagReport&cbgtdate=2012-03-01
  Global Tags created in the last 30 days:
  https://atlas-tagservices.cern.ch/RBR/rBR_CB_Report.php?CBAction=GlobalTagReport&cbgtdate=latest30
  Global Tags for MC:
  https://atlas-tagservices.cern.ch/RBR/rBR_CB_Report.php?CBAction=GlobalTagReport&cbgt=OFLCOND*
  Global Tags for real data:
  https://atlas-tagservices.cern.ch/RBR/rBR_CB_Report.php?CBAction=GlobalTagReport&cbgt=COMCOND*