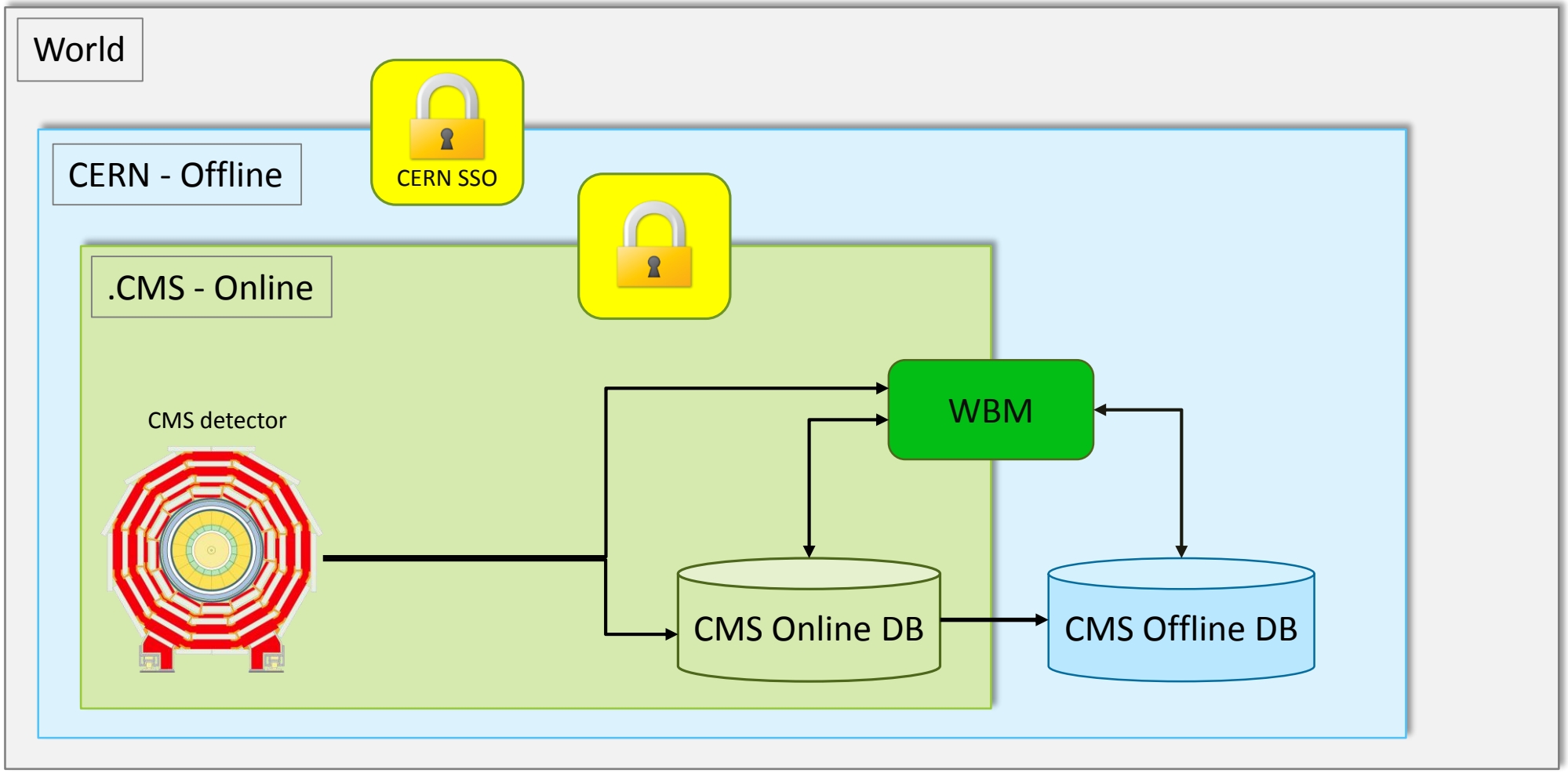
# Web Based Monitoring

MANTAS STANKEVIČIUS

# What is Web-Based Monitoring

- WBM – suite of tools to monitor CMS operations
- User interface – web
- Main function – correlate and display non-event data

# Structure


World
CERN - Offline
CERN SSO
.CMS - Online
CMS detector
WBM
CMS Online DB
CMS Offline DB

# Funcionality

## FRONT-END

Around 80 services

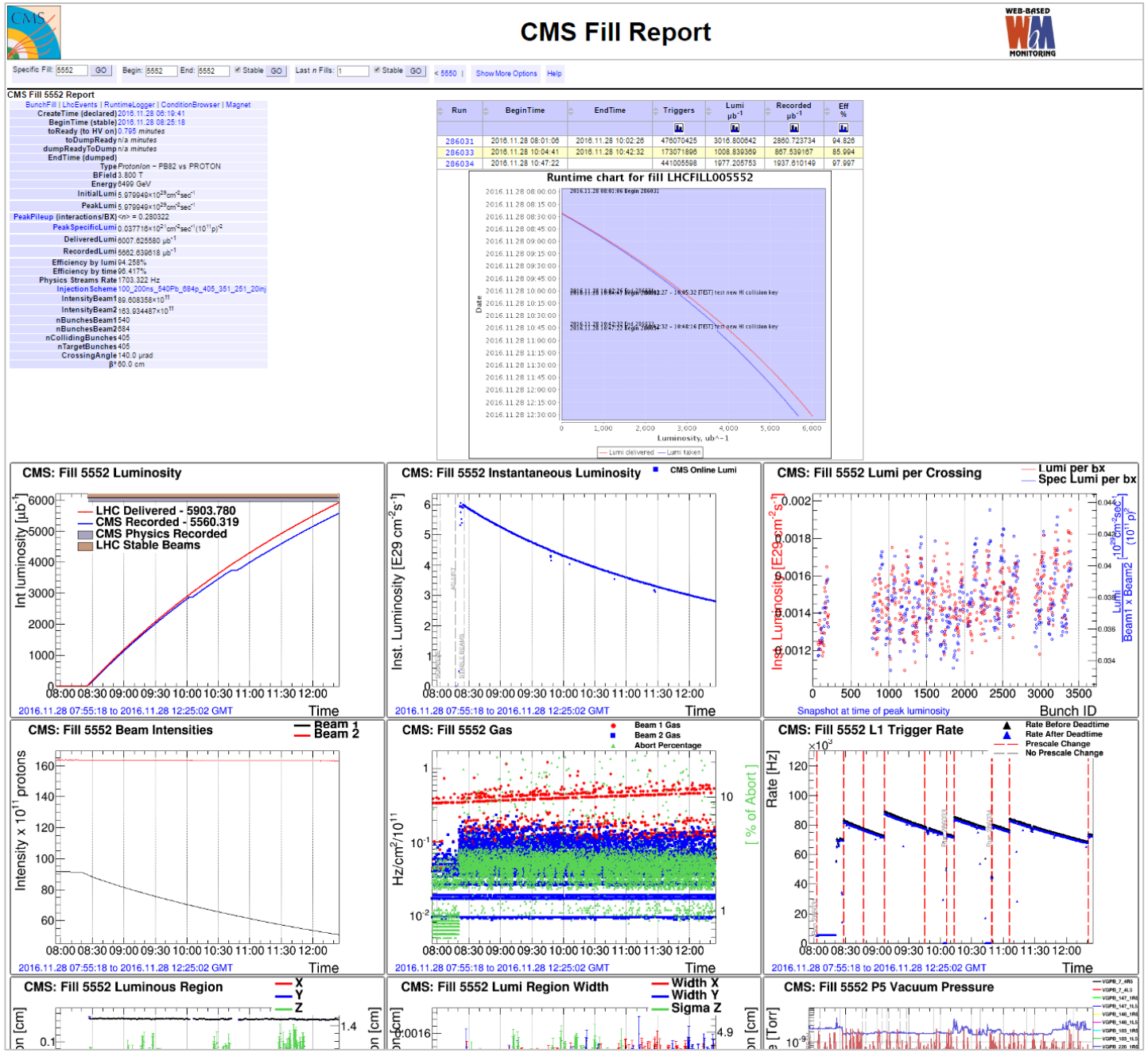
- Display real-time data
- Browse historical data
- Data summary (daily, weekly, yearly, custom)
- Plotting tools

## BACK-END

- Record DIP data (non persistent real-time) into database
- Inject data into event
- Publish data into DIP
- Monitor beam and trigger status
- Email notification system
- Generate plots

## MID-WARE

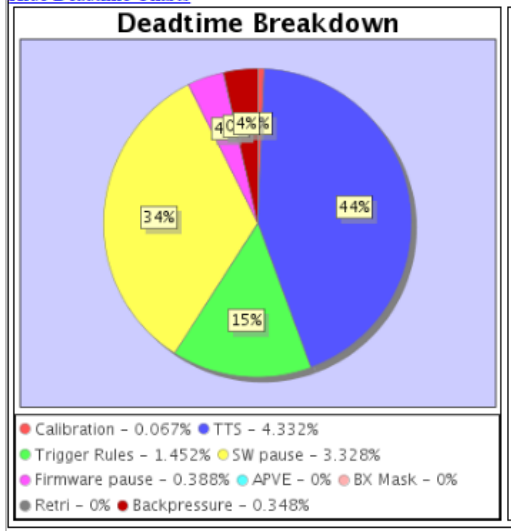
- RTL GUI
- RunRegistry*

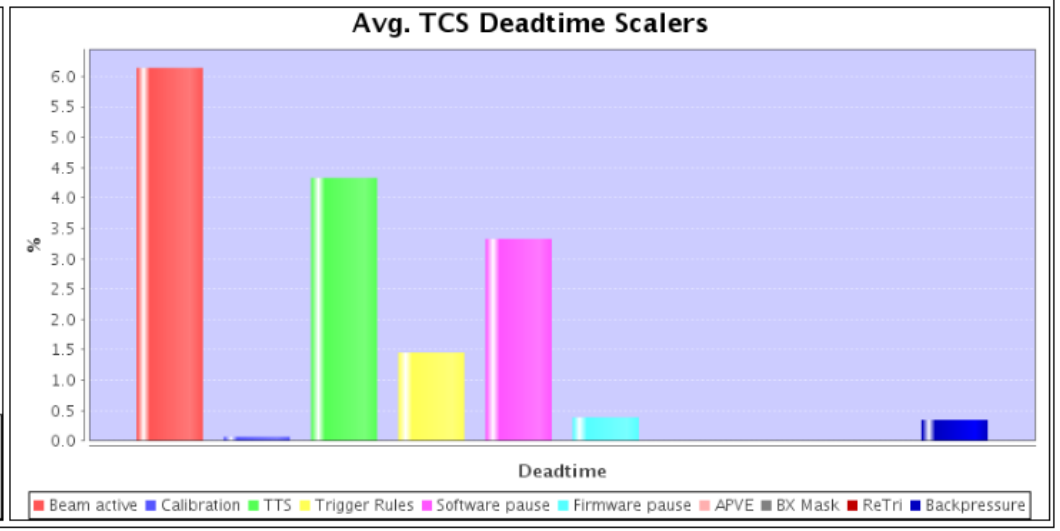

CMS Fill Report
WEB-BASED MONITORING
Specific Fill: 5552 GO Begin: 5552 End: 5552 Stable GO Last n Fills: 1 Stable GO < 5550 | Show More Options Help
CMS Fill 5552 Report
BunchFill | LhcEvents | RuntimeLogger | ConditionBrowser | Magnet
CreateTime (declared) 2016.11.28 06:19:41
BeginTime (stable) 2016.11.28 08:25:18
toReady (to HV on) 0.795 minutes
toDumpReady n/a minutes
dumpReadyToDump n/a minutes
EndTime (dumped)
Type ProtonIon − PB82 vs PROTON
BField 3.800 T
Energy 6499 GeV
InitialLumi 5.979949×10^28 cm^-2 sec^-1
PeakLumi 5.979949×10^28 cm^-2 sec^-1
PeakPileup (interactions/BX) <n> = 0.280322
PeakSpecificLumi 0.037716×10^-21 cm^2 sec^-1 (10^11 p)^-2
DeliveredLumi 6007.625580 μb^-1
RecordedLumi 5662.639618 μb^-1
Efficiency by lumi 94.258%
Efficiency by time 96.417%
Physics Streams Rate 1703.322 Hz
Injection Scheme 100_200ns_540Pb_684p_405_351_251_20inj
IntensityBeam1 89.608358×10^11
IntensityBeam2 83.934487×10^11
nBunchesBeam1 540
nBunchesBeam2 594
nCollidingBunches 405
nTargetBunches 405
CrossingAngle 140.0 μrad
β* 80.0 cm
Run | BeginTime | EndTime | Triggers | Lumi μb^-1 | Recorded μb^-1 | Eff %
286031 | 2016.11.28 08:01:06 | 2016.11.28 10:02:26 | 476070425 | 3016.800642 | 2860.723734 | 94.826
286033 | 2016.11.28 10:04:41 | 2016.11.28 10:42:32 | 173071896 | 1008.839369 | 867.539167 | 85.994
286034 | 2016.11.28 10:47:22 | | 441005598 | 1977.206753 | 1937.610149 | 97.997
Runtime chart for fill LHCFILL005552
Date
Luminosity, ub^-1
Lumi delivered Lumi taken
CMS: Fill 5552 Luminosity
Int luminosity [μb^-1]
LHC Delivered - 5903.780
CMS Recorded - 5560.319
CMS Physics Recorded
LHC Stable Beams
2016.11.28 07:55:18 to 2016.11.28 12:25:02 GMT
Time
CMS: Fill 5552 Instantaneous Luminosity
CMS Online Lumi
Inst. Luminosity [E29 cm^-2 s^-1]
2016.11.28 07:55:18 to 2016.11.28 12:25:02 GMT
Time
CMS: Fill 5552 Lumi per Crossing
Lumi per bx
Spec Lumi per bx
Inst Luminosity [E29 cm^-2 s^-1]
Lumi [10^29 cm^-2 sec^-1 (10^11 p)^-2]
Beam1 x Beam2
Snapshot at time of peak luminosity
Bunch ID
CMS: Fill 5552 Beam Intensities
Beam 1
Beam 2
Intensity x 10^11 protons
2016.11.28 07:55:18 to 2016.11.28 12:25:02 GMT
Time
CMS: Fill 5552 Gas
Beam 1 Gas
Beam 2 Gas
Abort Percentage
Hz/cm^2/10^11
[ % of Abort ]
2016.11.28 07:55:18 to 2016.11.28 12:25:02 GMT
Time
CMS: Fill 5552 L1 Trigger Rate
Rate Before Deadtime
Rate After Deadtime
Prescale Change
No Prescale Change
Rate [Hz]
2016.11.28 07:55:18 to 2016.11.28 12:25:02 GMT
Time
CMS: Fill 5552 Luminous Region
X
Y
Z
CMS: Fill 5552 Lumi Region Width
Width X
Width Y
Sigma Z
CMS: Fill 5552 P5 Vacuum Pressure
[Torr]

# Deadtime Summary

Runtime period type: All
Begin date: 2016.11.20 00:00:00 End date: 2016.11.29 00:00:00
LHC FILL from: to:
Name:
Exclude runtimes:
Submit

Hide Deadtime Charts




| Fill | | | BeamActive | Calibration | FW Pause | TTS | Trigger Rules | APVE | BX Mask | ReTri | Backpressure | SW pause | Runs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fill | Begin time | End time | Fraction, % | Fraction, % | Fraction, % | Fraction, % | Fraction, % | Fraction, % | Fraction, % | Fraction, % | Fraction, % | | |
| 5552 | 2016.11.28 08:25:18 | 2016.11.28 12:29:48 | 5.42 | 0.09 | 0.11 | 3.51 | 0.94 | 0.00 | 0.00 | 0.00 | 0.35 | 3.78 | 286034 286033 286031 |
| 5550 | 2016.11.27 23:20:00 | 2016.11.28 04:36:21 | 2.22 | 0.09 | 0.10 | 0.36 | 0.96 | 0.00 | 0.00 | 0.00 | 0.33 | 0.71 | 286023 |
| 5549 | 2016.11.27 11:08:57 | 2016.11.27 20:17:25 | 5.08 | 0.09 | 0.08 | 3.60 | 2.29 | 0.00 | 0.00 | 0.00 | 0.22 | 3.81 | 286010 286009 |
| 5547 | 2016.11.26 22:48:56 | 2016.11.27 06:36:23 | 9.87 | 0.06 | 0.07 | 8.61 | 1.89 | 0.00 | 0.00 | 0.00 | 0.19 | 3.45 | 285995 285994 285993 |
| 5546 | 2016.11.26 17:34:02 | 2016.11.26 20:06:46 | 5.30 | 0.00 | 0.09 | 0.74 | 0.87 | 0.00 | 0.00 | 0.00 | 0.99 | 3.75 | 285975 |
| 5545 | 2016.11.26 12:35:46 | 2016.11.26 13:16:00 | 59.88 | 0.03 | 27.16 | 53.38 | 6.03 | 0.00 | 0.00 | 0.00 | 0.00 | 25.47 | 285956 285955 285954 285953 285952 |

L1 Summary

## L1 Algorithm trigger rates for L1_BptxPlus_NotBptxMinus: run 286030, bit 1

LS time from  to
LS number from  to
Rate, Hz: Min.  Max.
Counts: Min.  Max.

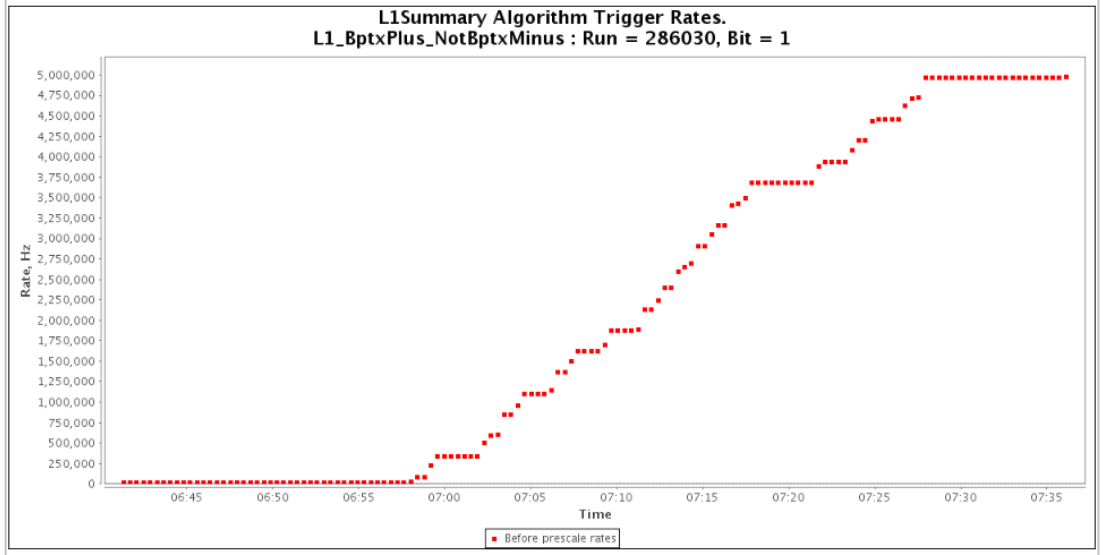
☑ Before Prescale rates ☐ Pre Dead-time rates ☐ Post Dead-time rates (HLT) ☐ Post Dead-time rates (uGT)

☐ Logarithmic scale ☐ Lines Draw: Rates per Timestamp ☐ Post/Pre Ratio ☐ Debug

Submit

| Run | Bit | Name | LS length, sec. | First Timestamp | Last Timestamp | First LS | Last LS | Min. Count | Max. Count | Min. Rate, Hz | Max. Rate, Hz |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 286030 | 1 | L1_BptxPlus_NotBptxMinus | 23.3104 | 2016.11.28 06:41:20 | 2016.11.28 07:36:07 | 1 | 142 | 214427 | 115923611 | 9198.7659 | 4973040.5037 |

| Type | Entries | Avg. Count | RMS Count | Min. Count | Max. Count | Avg. Rate, Hz | RMS Rate, Hz | Min. Rate, Hz | Max. Rate, Hz |
|---|---|---|---|---|---|---|---|---|---|
| Pre DT | 142 | 48298801.4930 | 66298936.8534 | 214427 | 115923611 | 2071984.2492 | 2844177.2602 | 9198.7659 | 4973040.5037 |

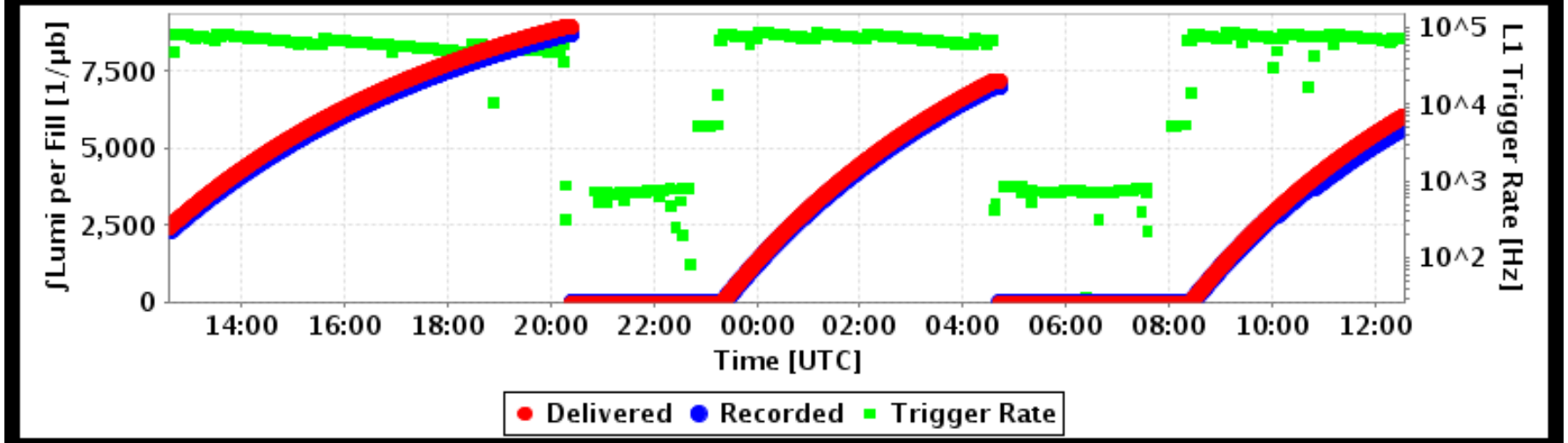



| uGT LS number | LS start time from OC0TIME | Before Prescale Counts | Before Prescale Rate, Hz |
|---|---|---|---|
| 1 | 2016.11.28 06:41:20 | 249820 | 10717.1004 |
| 2 | 2016.11.28 06:41:43 | 249091 | 10685.8268 |
| 3 | 2016.11.28 06:42:07 | 247347 | 10611.0105 |
| 4 | 2016.11.28 06:42:30 | 247349 | 10611.0963 |
| 5 | 2016.11.28 06:42:53 | 247345 | 10610.9247 |
| 6 | 2016.11.28 06:43:17 | 247354 | 10611.3108 |
| 7 | 2016.11.28 06:43:40 | 244883 | 10505.3066 |
| 8 | 2016.11.28 06:44:03 | 244724 | 10498.4856 |
| 9 | 2016.11.28 06:44:27 | 244213 | 10476.5641 |
| 10 | 2016.11.28 06:44:50 | 244238 | 10477.6366 |
| 11 | 2016.11.28 06:45:13 | 241817 | 10373.7774 |
| 12 | 2016.11.28 06:45:36 | 241819 | 10373.8632 |
| 13 | 2016.11.28 06:46:00 | 241773 | 10371.8898 |
| 14 | 2016.11.28 06:46:23 | 241758 | 10371.2463 |
| 15 | 2016.11.28 06:46:46 | 239378 | 10269.1460 |
| 16 | 2016.11.28 06:47:10 | 239374 | 10268.9744 |
| 17 | 2016.11.28 06:47:33 | 236807 | 10158.8520 |
| 18 | 2016.11.28 06:47:56 | 236806 | 10158.8091 |
| 19 | 2016.11.28 06:48:20 | 234404 | 10055.7650 |
| 20 | 2016.11.28 06:48:43 | 234445 | 10057.5238 |
| 21 | 2016.11.28 06:49:06 | 231853 | 9946.3289 |
| 22 | 2016.11.28 06:49:30 | 231849 | 9946.1573 |
| 23 | 2016.11.28 06:49:53 | 229462 | 9843.7567 |
| 24 | 2016.11.28 06:50:16 | 229450 | 9843.2419 |

CMS Page1 | Fill : 5552 | Run : 286034 | Mon 28-11-2016 12:35:10 UTC

| CMS DAQ Status | LHC Status | Beam Energy | Intensity |
|---|---|---|---|
| Running | STABLE | 6499 GeV | Beam1: $5.1 \times 10^{12}$<br>Beam2: $1.7 \times 10^{13}$ |

History of Data-taking with Stable Beams for Last 24 Hours




CMS Comments Mon 28-11-2016 04:38:12 UTC

ramp down

LHC Page1 Comments Mon 28-11-2016 11:31:43 UTC

Physics with 540Pb 684p

Sub-System DAQ / DCS

| | | |
|---|---|---|
| CSC | IN | ON |
| DT | IN | ON |
| ECAL | IN | ON |
| ES | IN | ON |
| HCAL | IN | ON |
| HF | IN | ON |
| PIXEL | IN | ON |
| RPC | IN | ON |
| TRACKER | IN | ON |
| CASTOR | IN | ON |
| DAQ | IN | |
| DQM | IN | |
| SCAL | IN | |
| TRG | IN | |
| CTPPS_TOT | OUT | |

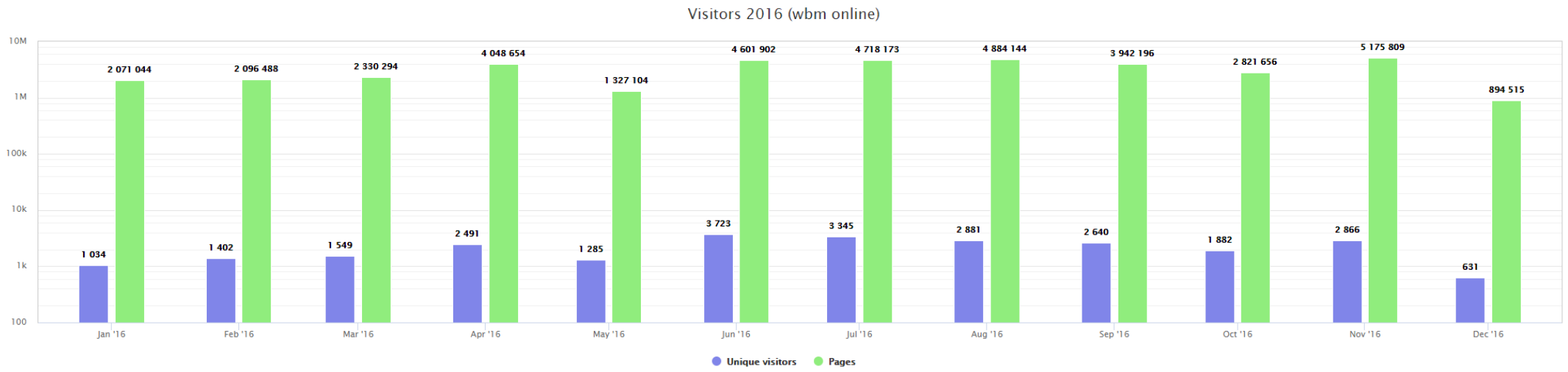
Run/Trigger/DAQ Status

| | |
|---|---|
| Fill Number | 5552 |
| Run Number | 286034 |
| LumiSection | 275 |
| Physics Bit Set | ON |
| Magnet [T] | 3.801 |
| Total L1 Rate [Hz] | 70258 |
| Total L1 Triggers | 472363305 |
| Instant Lumi[E29] | 2.70 |
| ∫Lumi Rec[1/μb] | 5730.00 |
| Tier0 Transfer | ON |

# Usage statistics

## Visitors (Nov 2016)

| | |
|---|---|
| Unique | 2866 |
| Pages | 5,175,809 |
| Average | 60 pages/s |



# VU FMI participation at WBM

- Since 2010
- Manpower
  - 5+ employees
  - 10+ students
- Responsibilities
  - Develop new functionality
  - Maintain existing services
  - On-call shifts

# WBM upgrade

# Motivation for upgrade

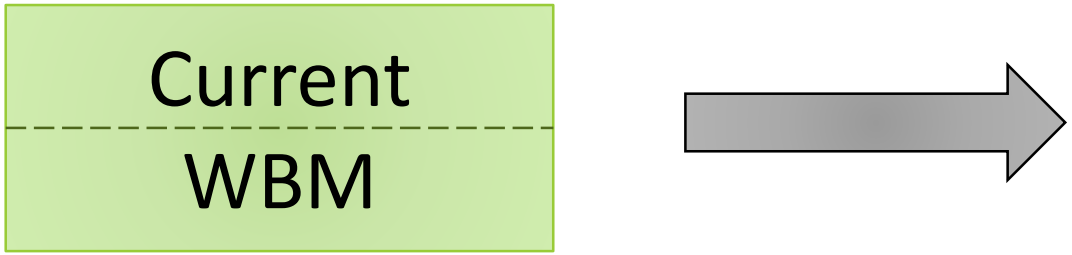
- WBM was designed in 2008 using existing Fermilab monitoring projects
- Services use different technologies and have different look-and-feel
- Code written without a coherent design
- Some services became obsolete or duplicated
- Lack of change control on the input data
- Lack of coherent API
- No tests
- Project is extremely wide and difficult to maintain

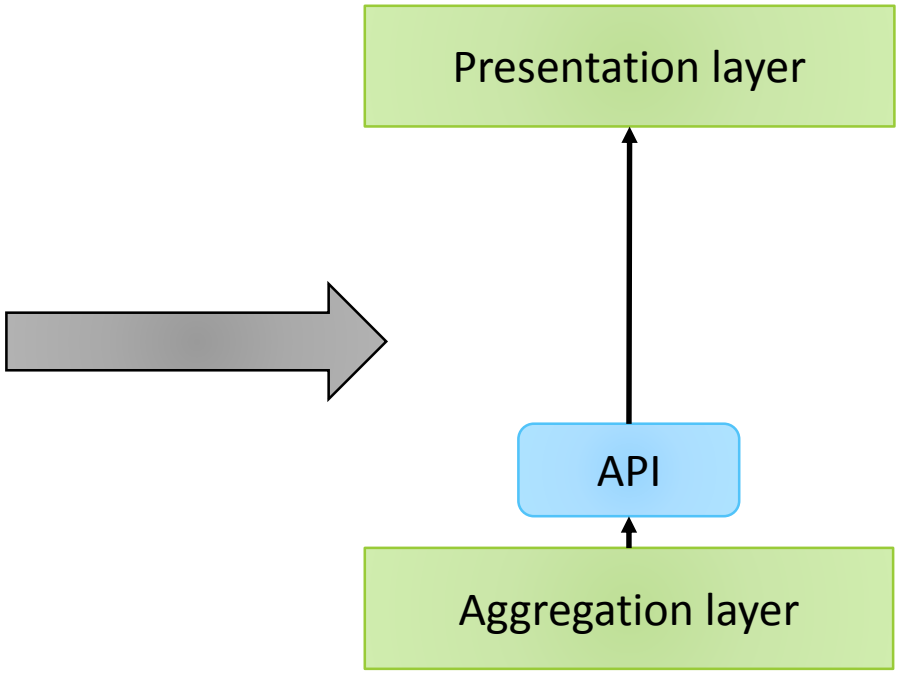
# Timeline

- 2015 September – WBM upgrade mini workshop. CERN
  - https://indico.cern.ch/event/445832/
- 2015 December – Review of CMS Web-Based Monitoring (WBM). CERN
  - https://indico.cern.ch/event/463325/
- 2016 November – WBM upgrade kickoff workshop. Vilnius, Lithuania
  - https://indico.cern.ch/event/548264/

- <2017 Q2 – Prototype specification and development
- 2017 Q2 - Release of prototype!
- 2017-2018 – Development of new WBM
- LS2 – Full migration to new WBM
- Run3 (2021) – Production!

# How WBM upgrade looks like?



# Aggregation layer

"The aggregation layer is responsible to collect and expose non-event data from heterogeneous sources, with different data formats and changing context."

- Responsible
  - CMS DAQ group
- Functionality:
  - Interface with data providers
  - Aggregate data of different formats
  - Change control of input source data
  - Hide minor change of input source from API
  - Expose data to RESTful API

# Presentation layer

“The presentation layer provides user interface and tools to present data exposed by the API ”

Responsible

- VU FMI group. *Vilnius University, Faculty of Mathematics and Informatics*

- Functionality:
  - Interface with users
  - Provide tools to extract data, create user-defined plots over time intervals of
    - Data vs time
    - Data vs data (by time)
  - Provide graphing tools with standard functionalities
    - minY, maxY, log, …
  - Provide simple analysis tools
    - min, max, mean, sum, RMS, variance, …

# References

[1] WBM upgrade mini workshop https://indico.cern.ch/event/445832/

[2] Review of CMS Web-Based Monitoring (WBM) https://indico.cern.ch/event/463325/

[3] WBM upgrade kickoff workshop https://indico.cern.ch/event/548264/

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