

AUG 22, 2012 | ATLANTA, GA



Implementation and Experience of openPDC at ISO-NE

Experiences and Challenges

Qiang “Frankie” Zhang

ASSOCIATE SMART GRID ANALYST



Outline

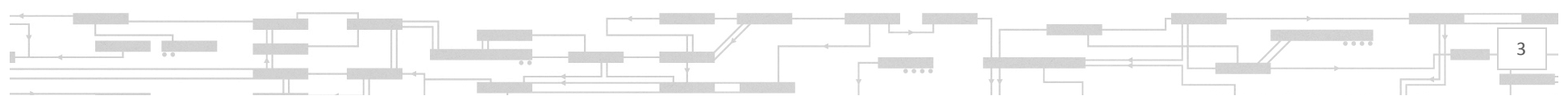
- Project Overview
 - Architectural Overview
 - User Experiences
 - User Development
 - Challenges
 - Suggestions
-
- Other staff: Brock Nubile, Patrick Pentz, et al.



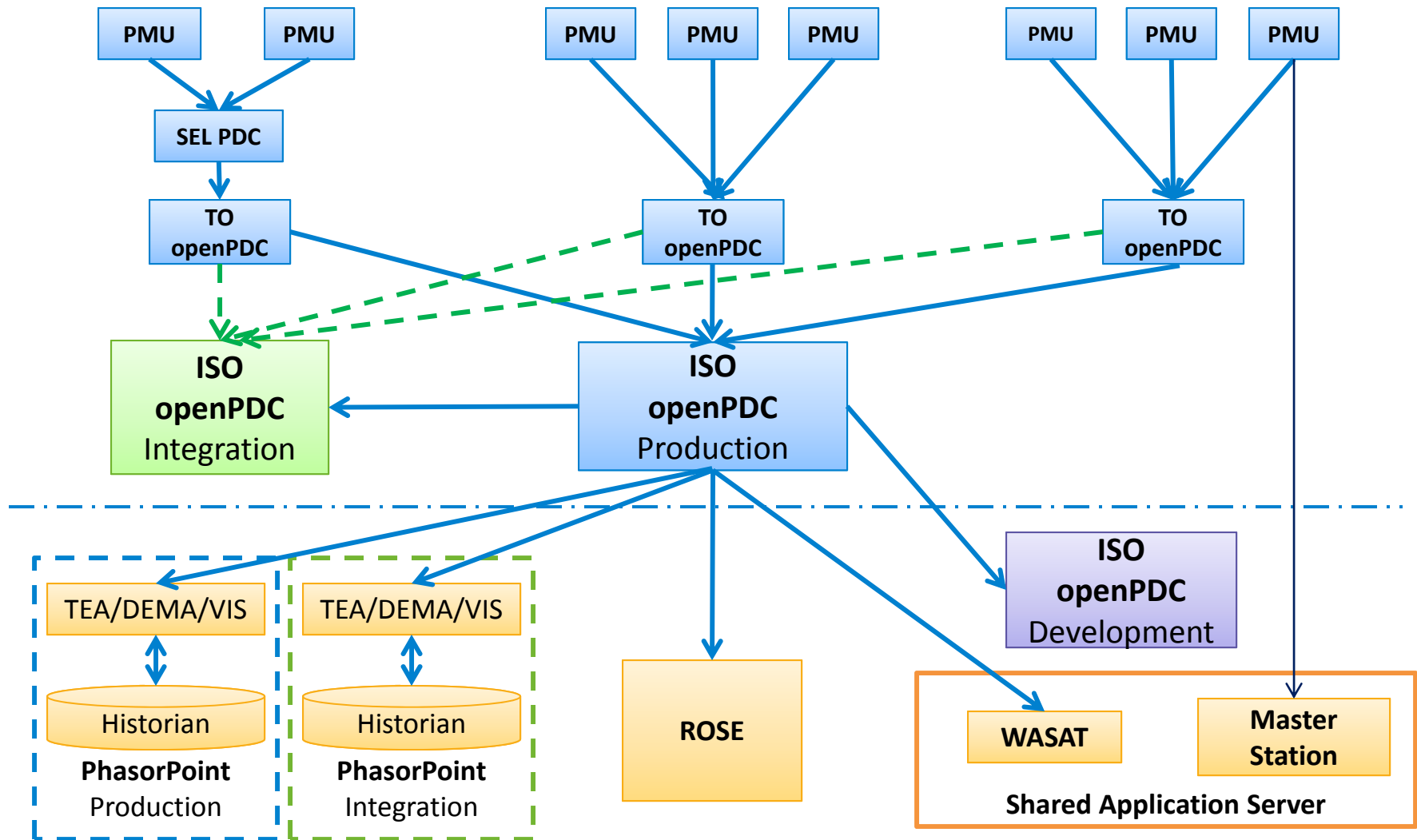
ISO-NE SIDU Project Overview

- PMUs installed at 40 substations.
- Totally 7 TOs.
- Each TO has an openPDC.
- ISO-NE has openPDC in three environments –
Production/Integration/Development
- openPDC support provider – ALSTOM
- Applications:
 - PhasorPoint (ALSTOM)
 - ROSE (V&R)
 - Master Station (MTI)
 - WASAT (EPRI)*

* For evaluation only.

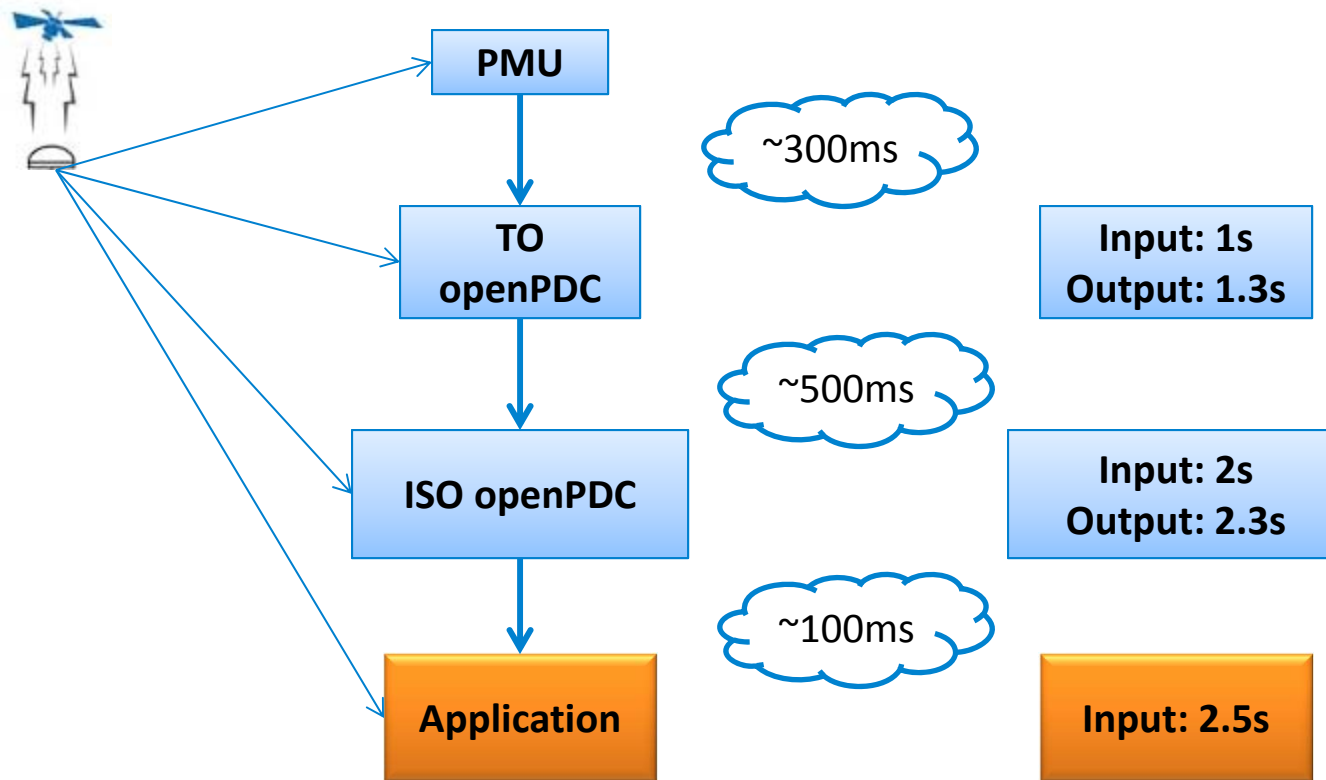


Architectural Overview



User Experiences – time settings

- Time delay increasing rule.



- Tune the settings according to **statistics** and **needs**.



User Experiences – time settings cont.

- Troubleshooting tip: If connected but no data is received...
 - Primary suspect: latency! Don't blame on PMU yet.
 - Phenomena:
 - Data Quality Error – big number
 - Data mostly “NaN”
 - Things to check:
 - Min, Max, Ave latency – openPDC Manager/Stream Statistics
 - Latency statistics from TO side (if apply)
 - Reasons:
 - Time delay settings not properly set along the data chain
 - Communication network (hardware) causing big time delay
 - PMU device not synchronized with GPS time – Time Quality Error
- Recent discovery:
 - Sometimes device time statistics could disappear (no time STAT in the database) – under investigation.
- Lessons learned:
 - Set up network traffic monitor for communication links.



User Experiences – contribution to debugging

- Deleting channels in output stream
 - **Business use case:** TO wants to have both positive sequence (P) and three phase (A, B, C) data; ISO only wants positive sequence data.
 - Input stream has P + A, B, C.
 - Output stream has P only: delete A, B, C.
 - **Error:** some P channels were mapped into different signals.
 - **Discovery:** output stream channels were not dynamically “linked/mapped” to input stream channels. The “mapping” is through counting the index in the “measurement” list, and indices were not updated when deleting. Thus deleting channel w/o deleting corresponding measurements in the list will cause misrepresentation.
 - **Fixed:** ALSTOM (automatically remove corresponding measurements).
 - **Suggestion:** use dynamic referencing rather than a static list.



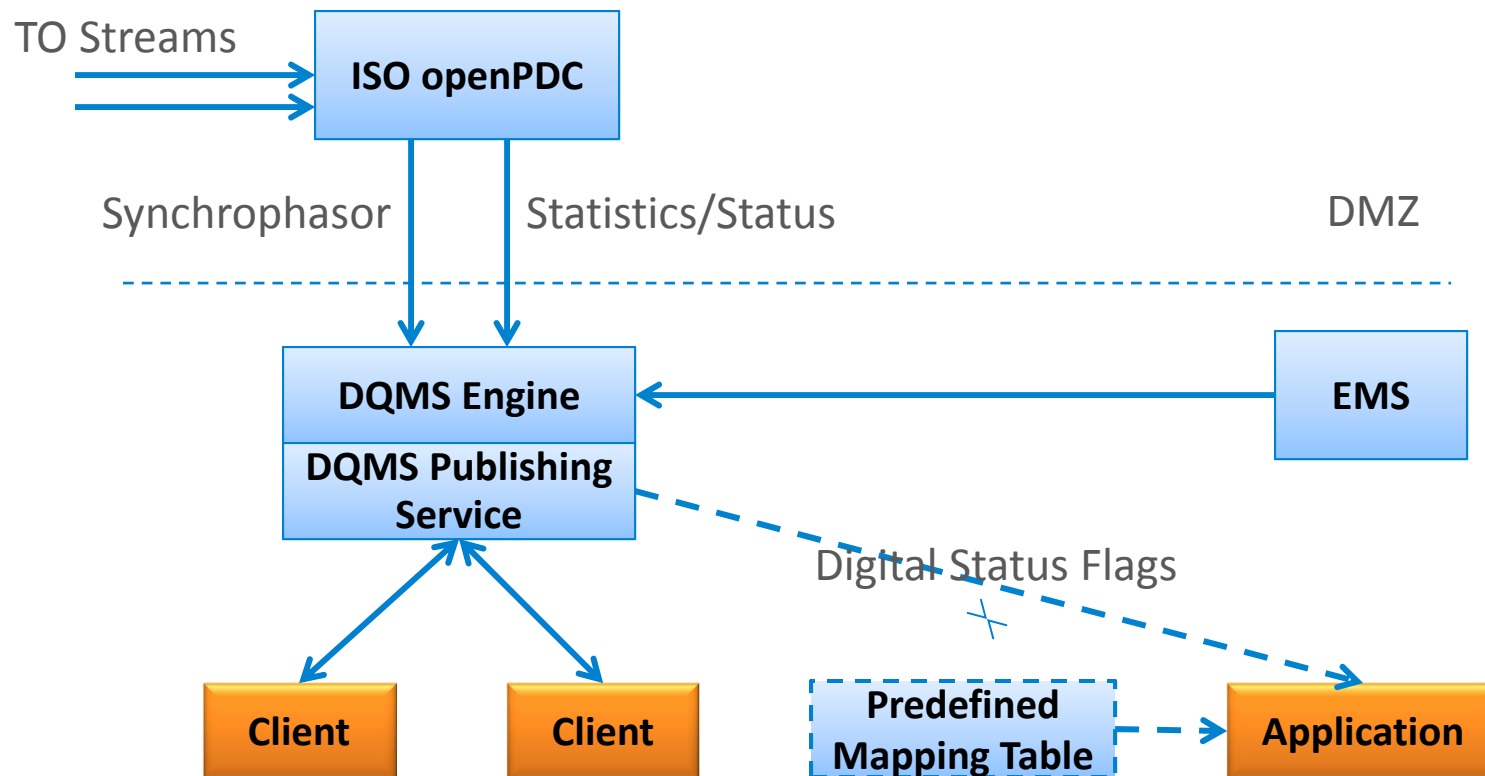
User Experiences – some tricks

- Properly exit openPDC Manager/Console
 - Never log out your server without closing down these services. (why?)
- Close all connections before restarting/stopping PDC service
 - Prevent cascading failure of upstream openPDCs.
- Use different databases to maintain different configuration versions. Useful when:
 - Input and output stream configurations differ.
 - Need to switch functions to accept different streams.
- Switch database between different servers
 - Useful when switching roles.
 - Need to modify settings to make sure one copy works on both servers.



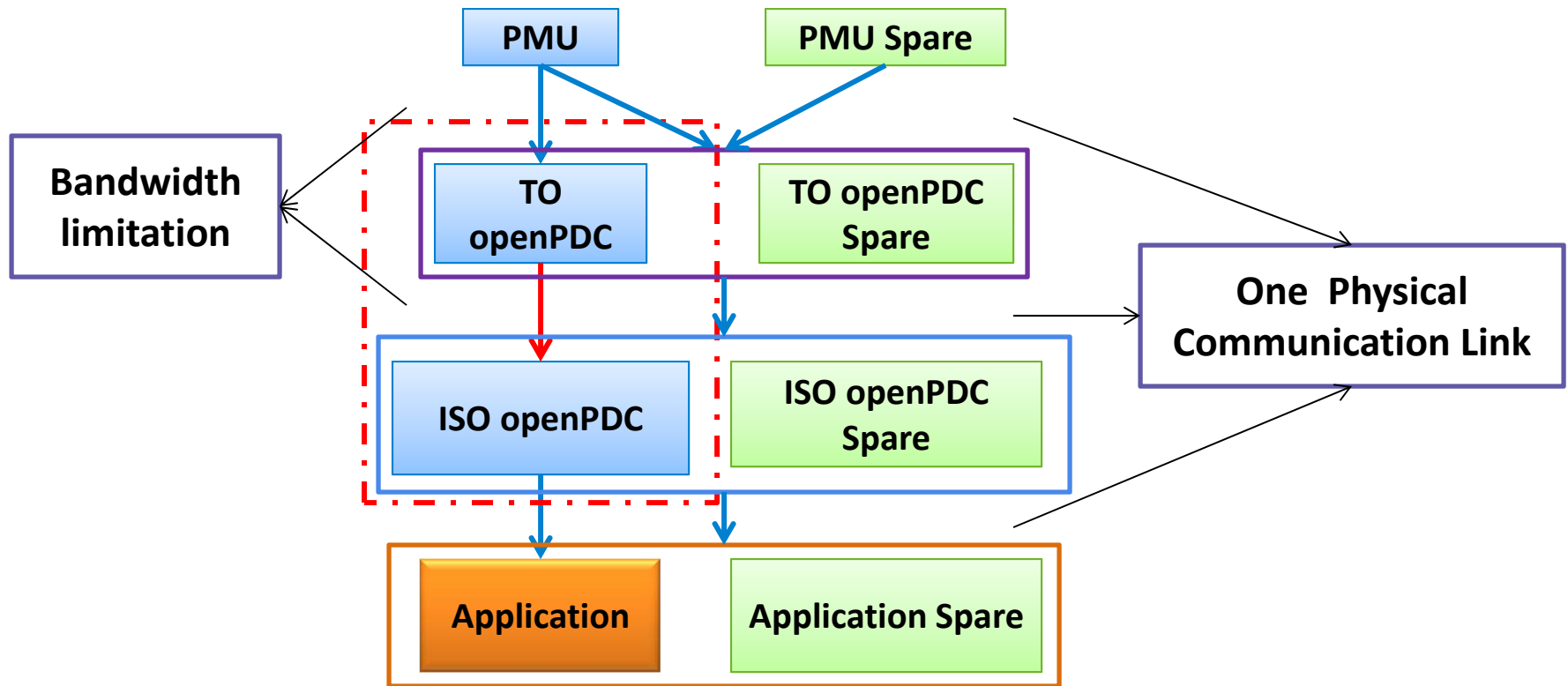
User Development – ISO-NE DQMS

- ISO-NE Synchrophasor Data Quality Monitoring System – ongoing...



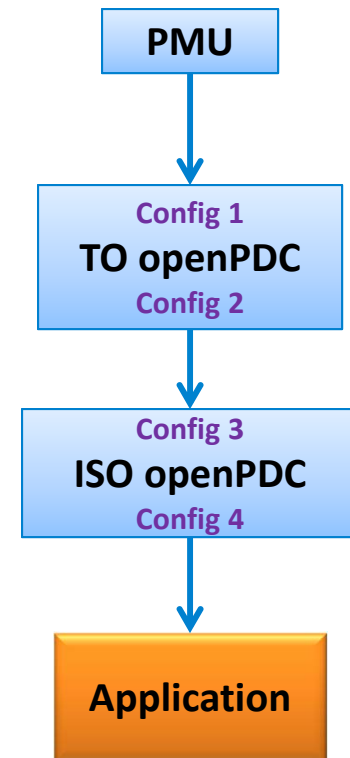
Challenges - high availability

- Hot failover, possible?



Challenges – data recovery

- Communication failure
 - openPDC local historian->file->third party historian?
 - Configuration difference!
 - V1.5 new feature – gap filling?
 - Automatically match configuration changes?
- Late data – still exist in local openPDC historian
 - How to sync TO openPDC local historian with ISO openPDC local historian, and eventually third party historian?



Challenges – TCP or UDP

- TCP
 - Pro: Arrival guaranteed (theoretically) until buffer overflow.
 - Cons:
 - Downstream application could affect upstream device.
 - More cyber security concerns (two way communication).
- UDP
 - Pros:
 - Downstream application has no effect on upstream device.
 - Less cyber security concerns (one way communication).
 - Con: Not arrival guaranteed – one way trip.
- Modified/Improved TCP?
 - Monitor downstream application's status.
 - Other measures to prevent cascading failures.



Challenges – historian

- Changing environment
 - **Business use cases:**
 - Substation change
 - Adding lines.
 - Deleting lines: maintain accessibility in historian w/o showing in current configuration.
 - Name/ID change (same signal)
 - PMU reconfiguration
 - Change channel sequence
 - Same signal moved into a different PMU
 - **Goal:**
 - **Continuity** from end user's point of view.
 - Automatic mapping and user-friendly interface.
- Performance
 - Different business needs have different performance requirements.
 - How to satisfy different requirements simultaneously?



Suggestions

- Decouple openPDC Manager with services
 - Restart openPDC Manager/Console services Only
 - Useful when openPDC Manager/Console hung but PDC functions remain intact.
 - Or provide an alternative way of closing down all connections before restarting service.
- ID Code box wider: able to fit 5 digits (EI convention).
- Output stream: PMUs with changed name/ID shouldn't appear again on the additional devices list.
- Output stream: “copy” function also copies affiliated devices.
- Device/channel lists show in one scroll down page rather than flip over pages – “go back” button brings you back to the first page.
- Make select/group signals easier for output stream – virtual device for output stream.



