Scaling up Capabilities of Smart Grid : Distributed Stream Processing

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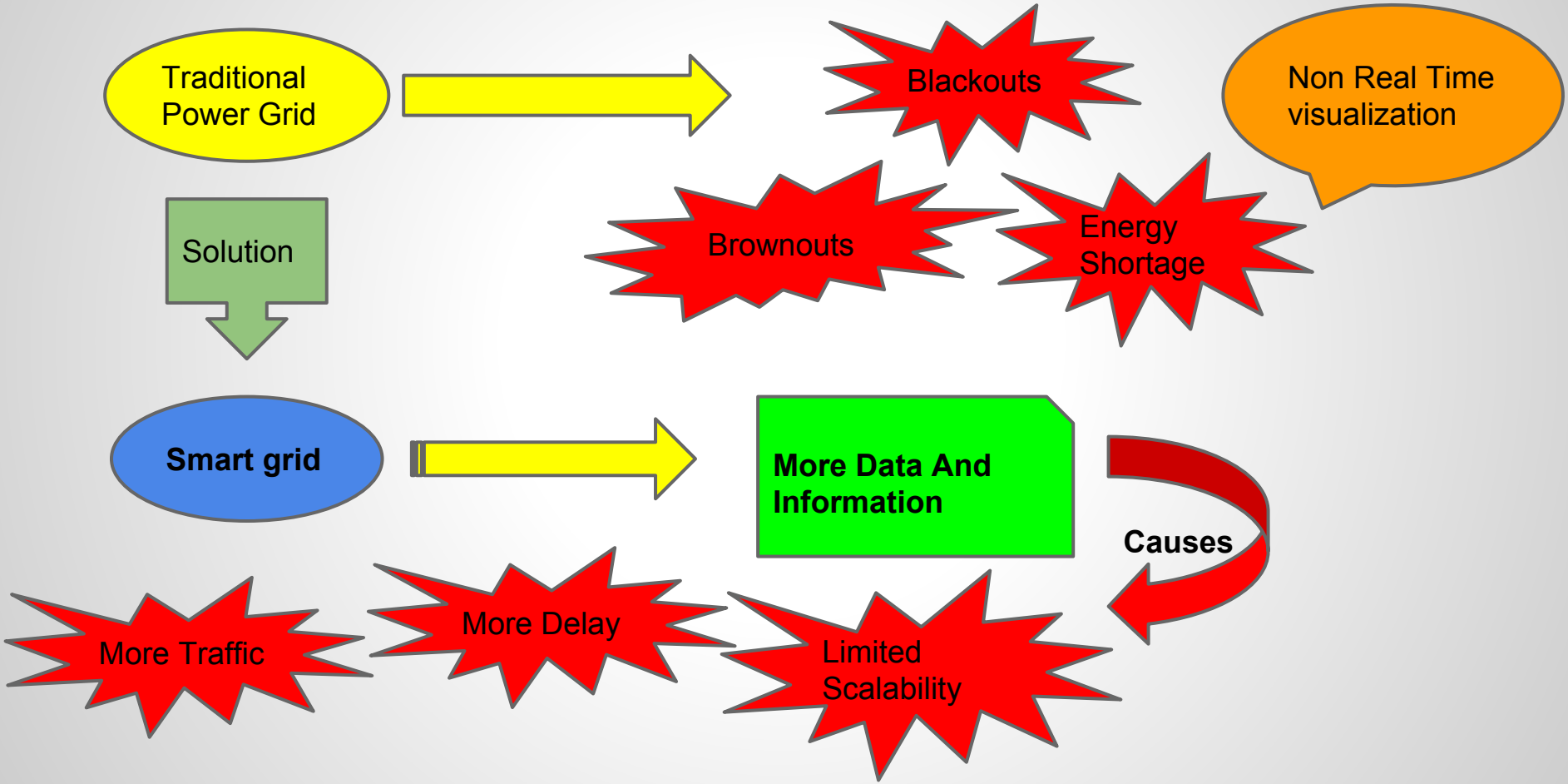
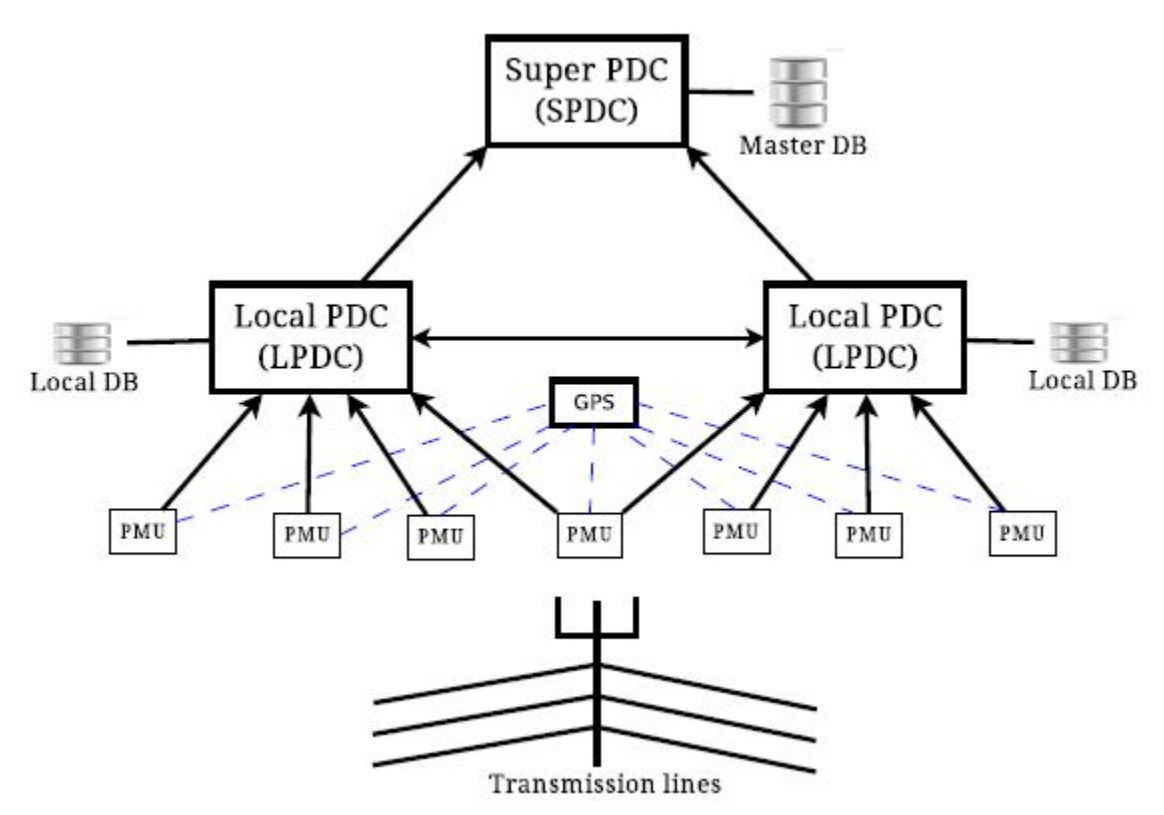
Scalability ?? “Motivation”

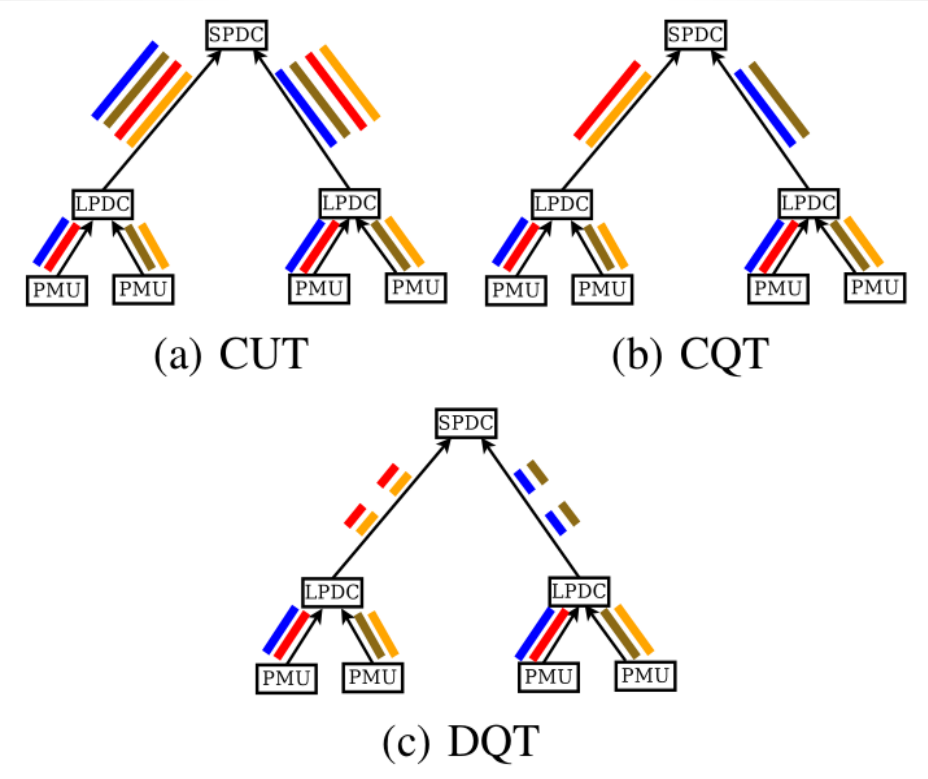


Synchrophasor Network System



Efficient PMU Data Dissemination in Smart Grid: Algorithms

1. CUT (Centralized Unqualified data Transmission)
2. CQT (Centralized Qualified data Transmission)
3. DQT (Distributed Qualified data Transmission)

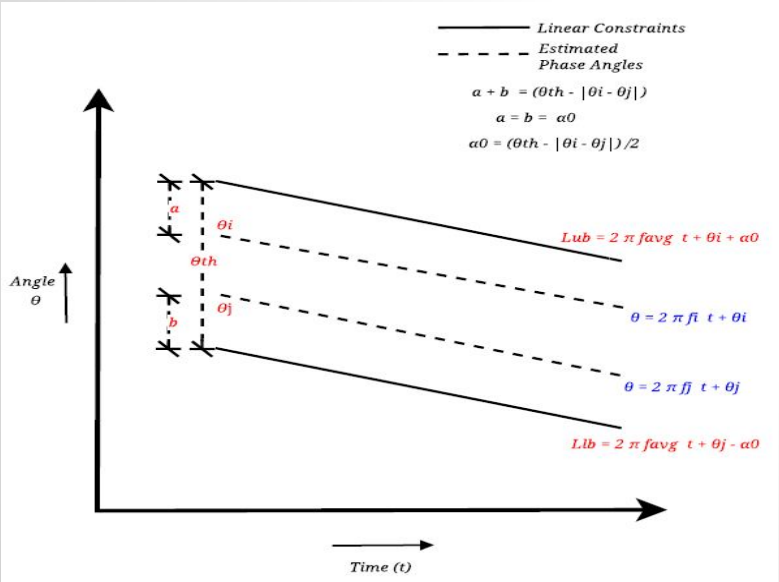


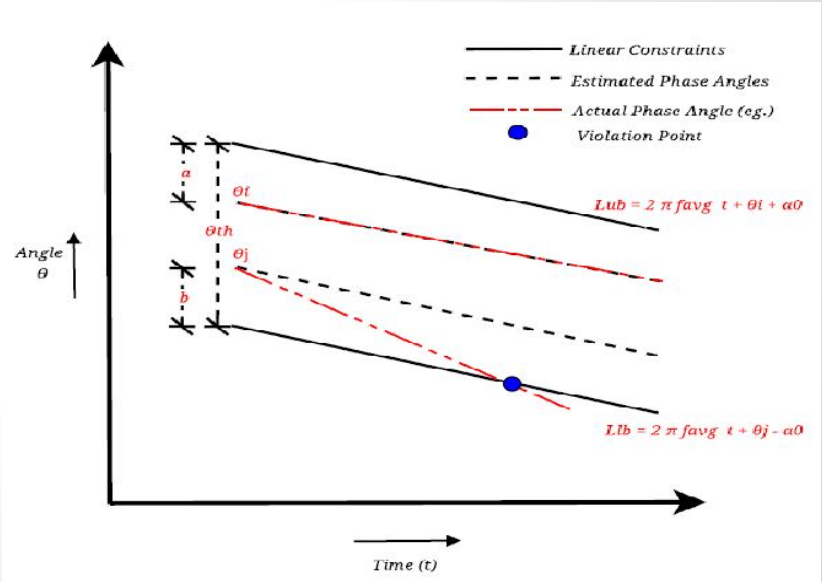
Modeling Local conditions for Distributed Query Execution

Example:

- **Global Constraint :** **Husband + Wife <= 100**
- **Possible Local Constraints :** **Husband <= 50 & Wife <= 50**
- **Current Local violation :** **Husband = 30 & Wife = 60**
- **Not a global condition violation.. !!!!!**
- **Use learning and Recalculate local Constraints…**
- **New Local Constraints :** **Husband <= 35 & Wife <= 65**

Angular stability monitoring : **| Angle1 - Angle2 | <= Threshold**





When use of DQT/CQT will give benefit ??

- Assume A, B, C and D are 4 different applications with following specification.

Application	**A**	**B**	**C**	**D**
Type	RT	RT	NRT	NRT
DQT/CQT Applicable	Yes	No	Yes	No

- Assume all application require complete data from PMUs.
  - #dataitem(A) = #dataitem(B) = #dataitem(C) = #dataitem(D)
- We can have different cases on the bases of applications running at one PDC.
- Note : Applications written in one box running at same PDC.

Continued..

Case	Bandwidth requirement in normal	Bandwidth requirement while using DQT
AB CD	1 RT b/w 1 NRT b/w	1 RT b/w (Because of B) 1 NRT b/w (Because of D)
A BCD	2 RT b/w	1 filtered RT b/w (Because of A) 1 RT b/w (Because of B)
AC BD	2 RT b/w	1 filtered RT b/w (Because of A) 1 RT b/w (Because of B)
ABCD	1 RT b/w (done in many Papers)	1 RT b/w
AD BC	2 RT b/w	1 filtered RT b/w (Because of A) 1 NRT b/w (Because of D) 1 RT b/w (Because of B)

Continued..

- Assume A, B, C and D are 4 different applications with same specification but some difference.
  - #dataitem(A) < #dataitem(D)
  - #dataitem(A) < #dataitem(B)

Case	Bandwidth requirement in normal	Bandwidth requirement while using CQT
A D	1 RT b/w 1 NRT b/w	1 reduced RT b/w 1 NRT b/w
AD	1 RT b/w	1 reduced RT b/w 1 reduced NRT b/w
A B	2 RT b/w	1 reduced RT b/w 1 RT b/w
AB	1 RT b/w	1 RT b/w

Extension for the work (Projects)

1. **Apply CQT / DQT technique on State estimation application and get results of accuracy and bandwidth reduction.**

2. **Choose different applications, like A,B,C,D in example, and implement it on iPDC. Show results to justify the analogy.**

3. **“ Different problems in the smart grid, e.g. out-of step, transient stability etc., can be detected using ML algorithms and pattern recognition. ”**

   OR

   “ State of the smart grid can be find out equivalent to state estimation application by applying ML and pattern recognition algorithms on PMU data. ”

   Prove or disprove the hypothesis.