Paris Session 2022

# Use of Machine Learning on PMU Data for Transmission System Fault Analysis

SC B5, PS2

Question 2.03 What are the experiences to fault identification and location and how to design the scheme to meet the practical application requirement?

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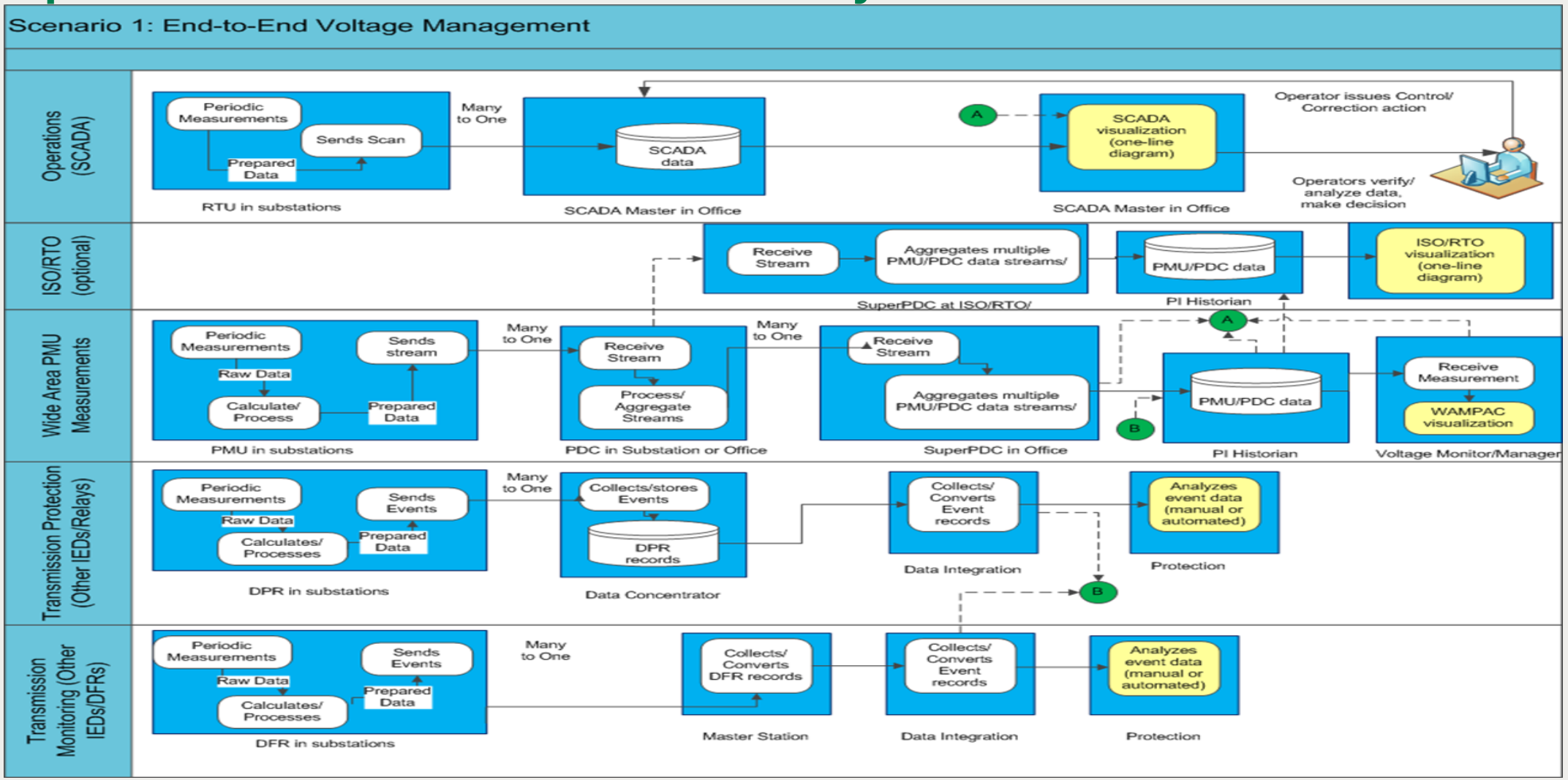
# Options for Fault Detection and Analysis



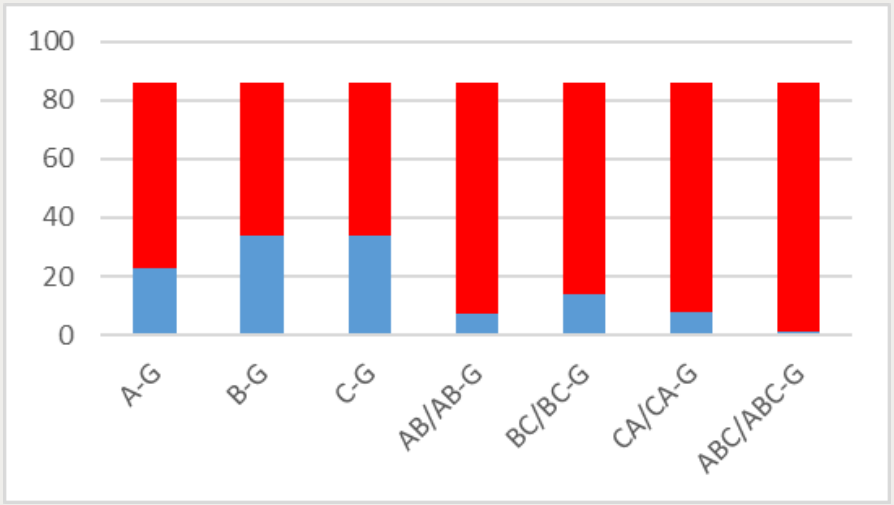
# Using PMUs for Fault Detection and Analysis

- Advantages:
  - System-wide analysis (frequency, voltage dips, oscillations, etc)
  - Continuous data streaming (30, 60, 120 fps)
  - Real-time assessment (instantaneous operator awareness)
  - Accurate time correlations (GPS clock: PPS sampling and UTC reference)

- Challenges
  - PMU measurements are sparse (may be taken far away from fault occurrence)
  - Bad Data (present due to PMU erroneous setting, communication link issues)
  - Huge amount of data to process by an operator (hundreds of PMU traces)
  - Hard to understand cause-effect (have relays operated correctly)

# Machine Learning Solution

- Recommendations:
  - Standardized event labelling
  - Standardized PMU setting selection
  - Point-on-wave for better resolution
  - Simulated cases of rarely seen events




| Field-Recorded Data | | | |
|---|---|---|---|
| **Models** | **Weighted Precision** | **Weighted Recall** | **F1-score** |
| SVM | 83.25% | 91.03% | 86.87.% |
| RF | 83.31% | 91.03% | 86.89% |
| XGBoost | 84.13% | 91.03% | 87.17% |
| Micro_average_of_precision_recall | | | 94.90% |
| **Integrated Data** | | | |
| SVM | **98.69%** | 98.62% | **98.58%*** |
| RF | 98.08% | 97.93% | 97.83% |
| XGBoost | 98.25% | 97.93% | 97.88% |
| Micro_average_of_precision_recall | | | 99.20% |