

# Experiences and Challenges with Practical Usage of Large Scale OPF

David Sun  
ALSTOM Power  
Energy Management Business

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Evolution of OPF

OPF's Presently Used in Production

Experiences

Next Generation of OPF+

Discussions

## Research



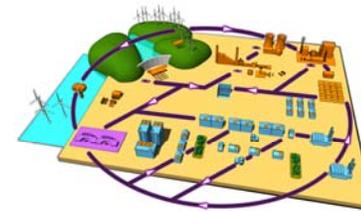
- Classical problems
- Algorithmic advances
- Limited practical usage

## Deployment

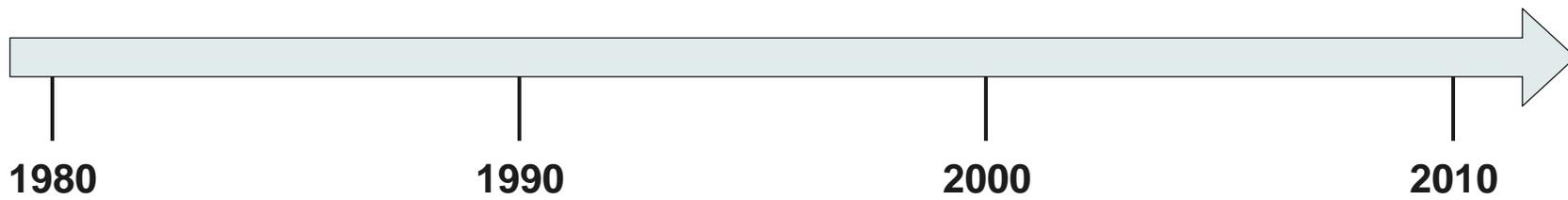


- RTO daily operation
- Extended problem scope
- Validation
- User feedback

## Next Generation

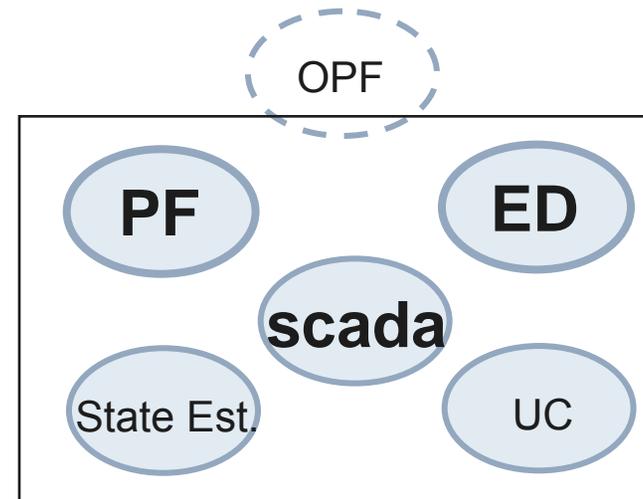
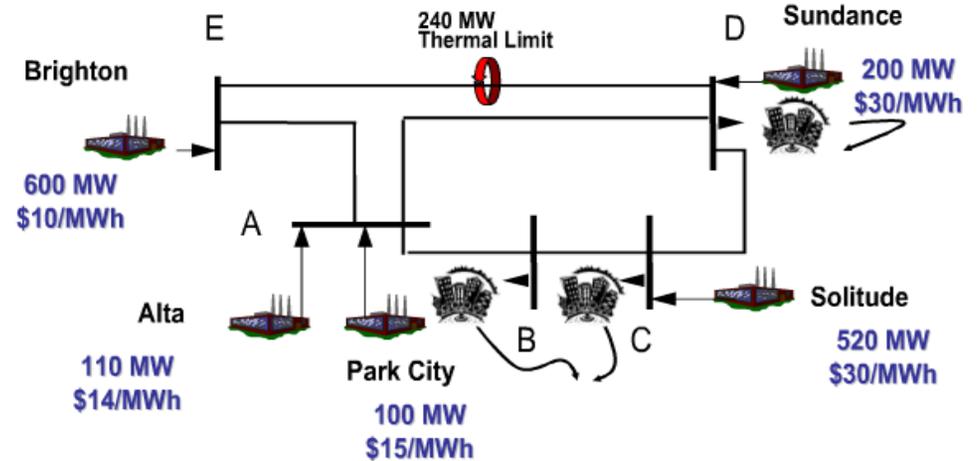


- Re-assess OPF premise
- Usability improvements
- Next generation problems
- Optimization technology



# Basic OPF Premise: in the beginning....

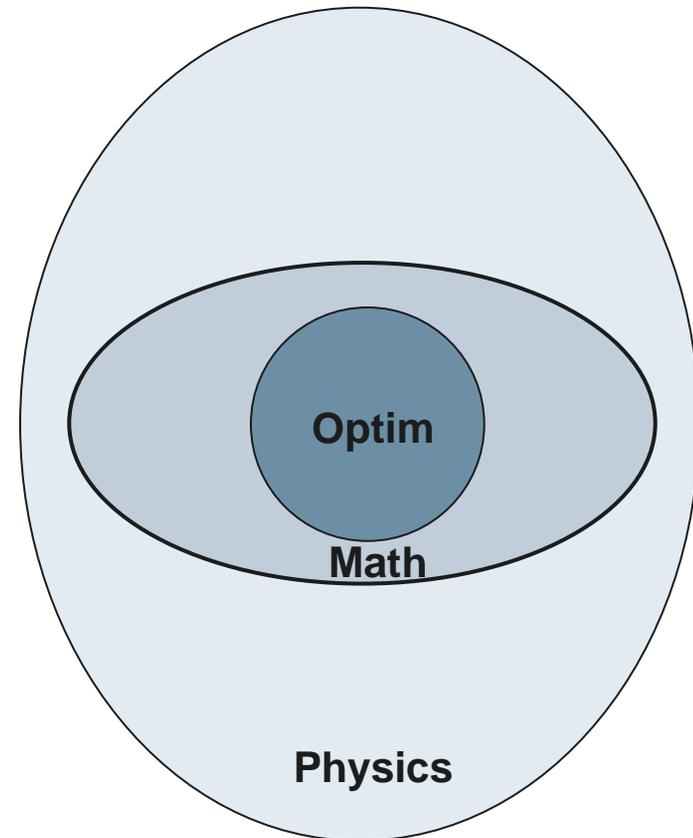
- Power Flow
- Optimization framework
  - Objective
  - Decision Variables
  - Constraints
- OPF User
  - Economic improvements
  - Security enhancements
- Operational context
  - Simultaneous global optimization
  - Consistent solutions
  - Reliable performance



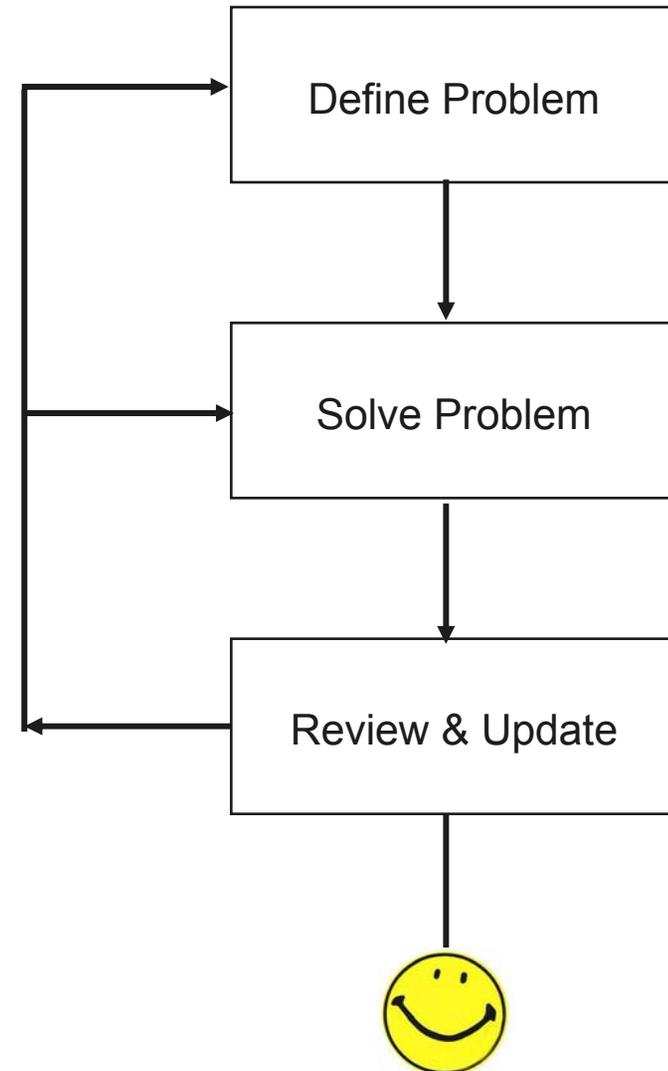
System Operations

# What OPF's are in Production Use?

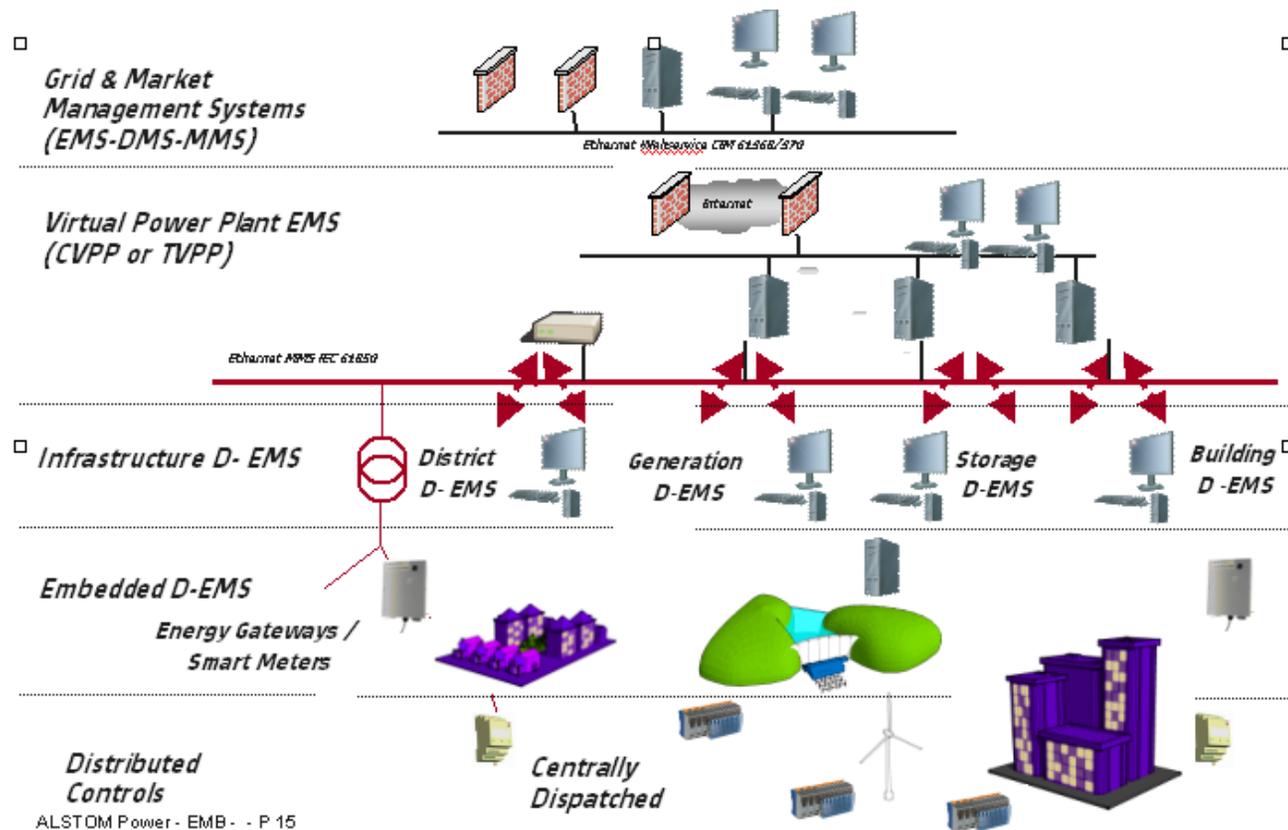
- Real-time Dispatch
  - SCED with contingency security
  - Single or multiple time steps
- Forward Scheduling
  - Financial schedules
  - Physical schedules
- FTR Auction
  - Multi-PF model (on/off peak)
  - Obligations and/or options
- Volt/Var control
  - Voltage profile scheduling
  - Real-time control(?)
- Others: VSA, TTC/AT



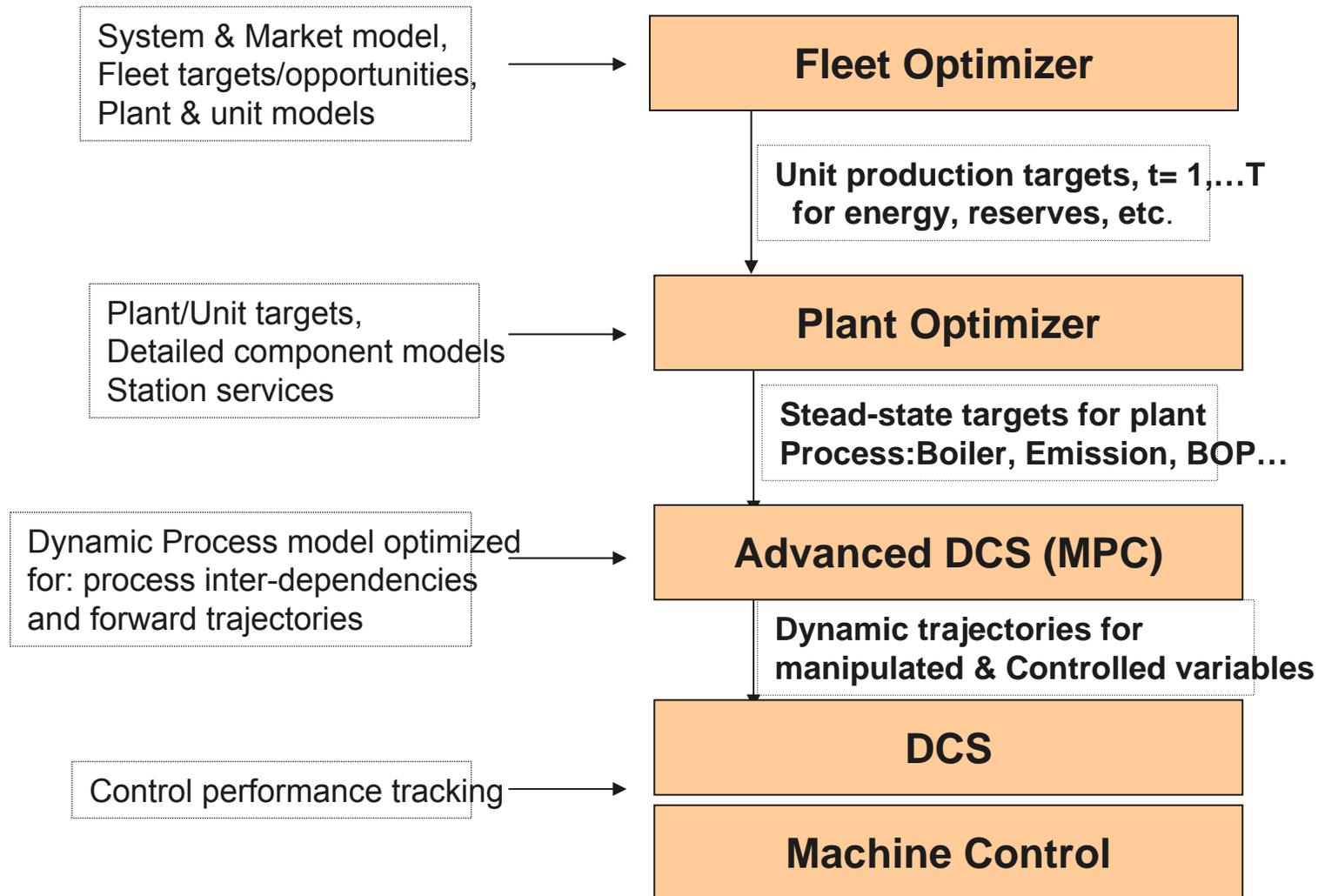
- Solving the Problems Right?
  - LP/QP/MIP performance
    - Dimension, sparsity (10K buses, 1K units, nK contingency)
    - Ill-condition
  - Robustness of solution
    - Primal (MW) / Dual (price) consistency
    - Operational sensibility
  - Leveraging OR/IT advances
- Solving the Right Problems ?
  - Who optimizes what & when?
    - Distributed intelligence
    - Non-uniform business drivers
    - Decision and response time frames
  - Evolving problem definition
    - Probabilistic vs. deterministic
    - System reliability management
- Usability
  - Presentation for situation awareness
  - Decision support facilities



## Multi-Level Decision Framework



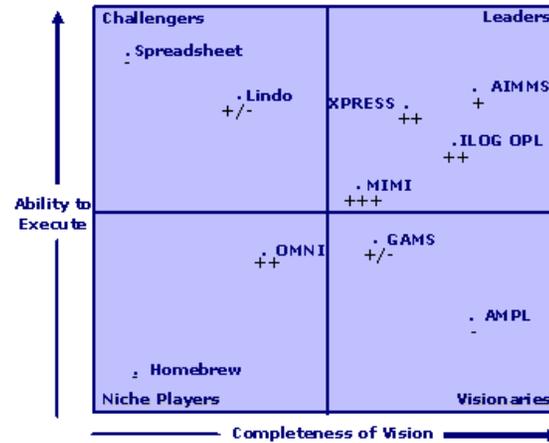
# Multi-Tier Resource Optimization



## Solution Technology



IT



Optimization

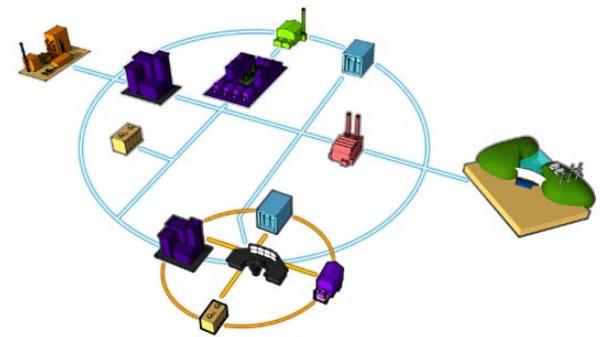


Visualization

- **Significant progress in OPF / Optimization usage**
  - Robust foundation in theory and practice
  - Scope of OPF expanded from classical base into new applications
  - Valuable experiences from users and developers
  - Critical feedback for continued progresses
  
- **Industry poised for critical next wave of optimization challenges**
  - Collaborative decisions with distributed intelligence
  - Sustainability management of shared scarce resources
  - Examples:
    - Eco-city micro-grid operation
    - Wholesale grid operation with significantly increased uncertainties
  - Increased problem complexity can easily overwhelm the users
    - Multi-disciplined approach: domain expertise and solution technologies

Clean Power Today !

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**Welcome within Alstom Clean & Smart  
Power initiatives !**

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