



# ATTEST project: Tools for Ancillary Service Procurement in Day Ahead Operation and Real-Time Activation in Distribution Grid

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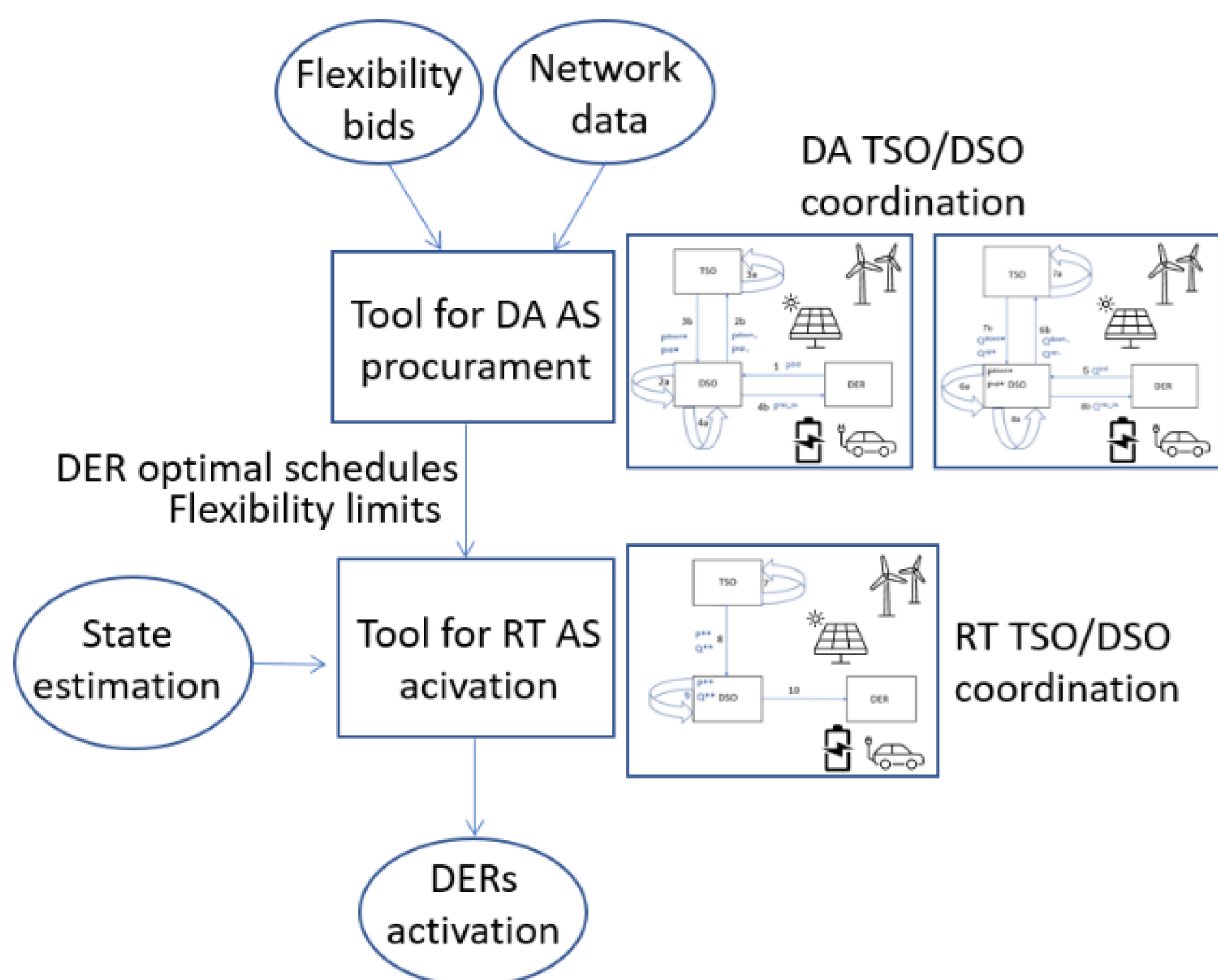
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## Introduction

Clean energy transition  
Distribution grids face challenges which require innovative approaches for planning and operation

## Two-stage ATTEST solution for ancillary service procurement and activation in distribution grids

- Day-ahead tool
- Real-time tool



## Day-ahead ancillary service procurement in distribution grids

### Inputs:

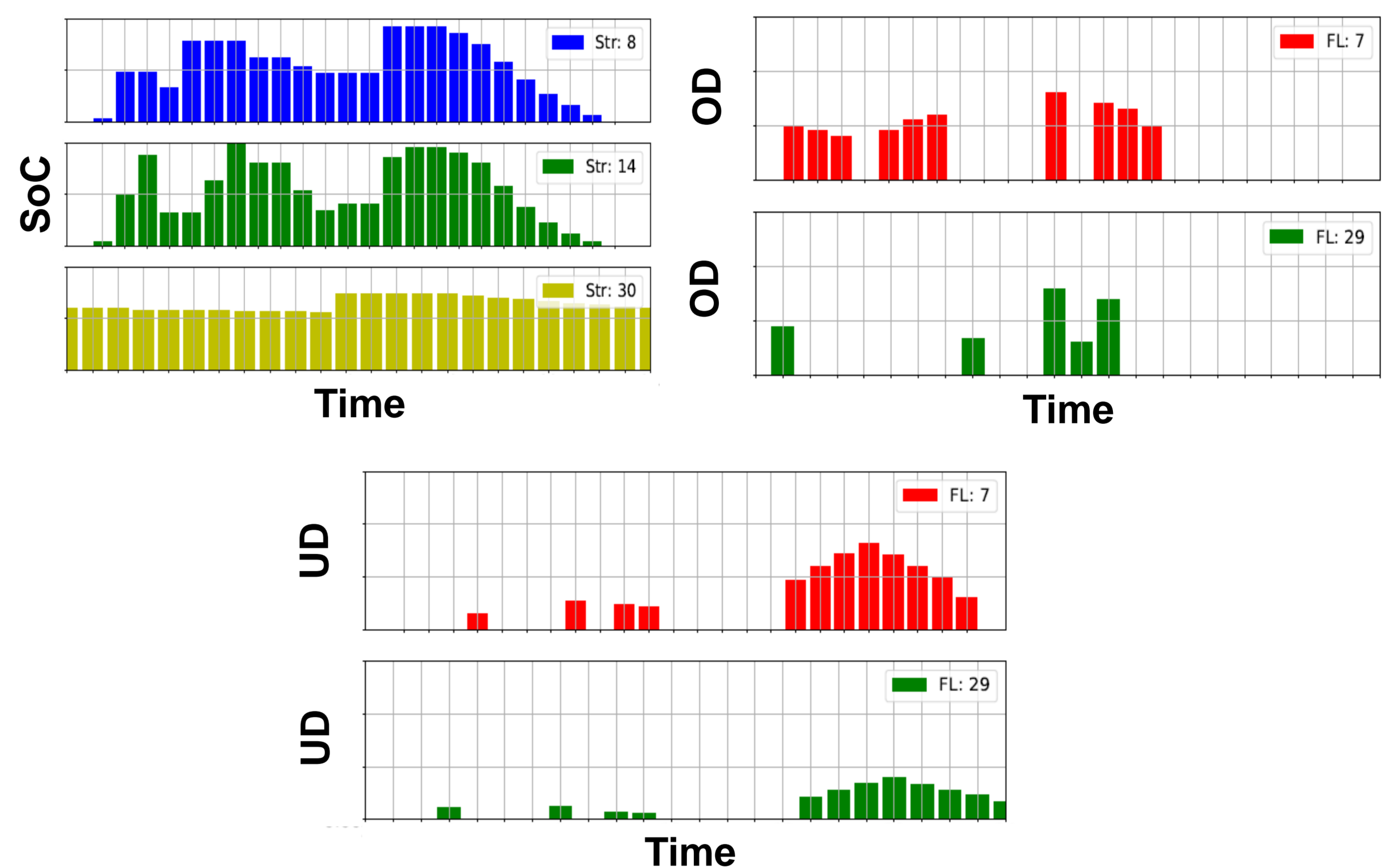
- Scenarios for RES through ARIMA model
- Flexible DER (loads, RES, storages & OLTC transformer) participation information
- Ancillary services (congestion management & voltage control) request from TSO

### Outputs:

- Flexible DER optimal set-points & associated cost to real-time activation tool

### Mathematical Model:

- Stochastic Multi-Period OPF framework based on mixed-integer non-linear programming (MINLP)



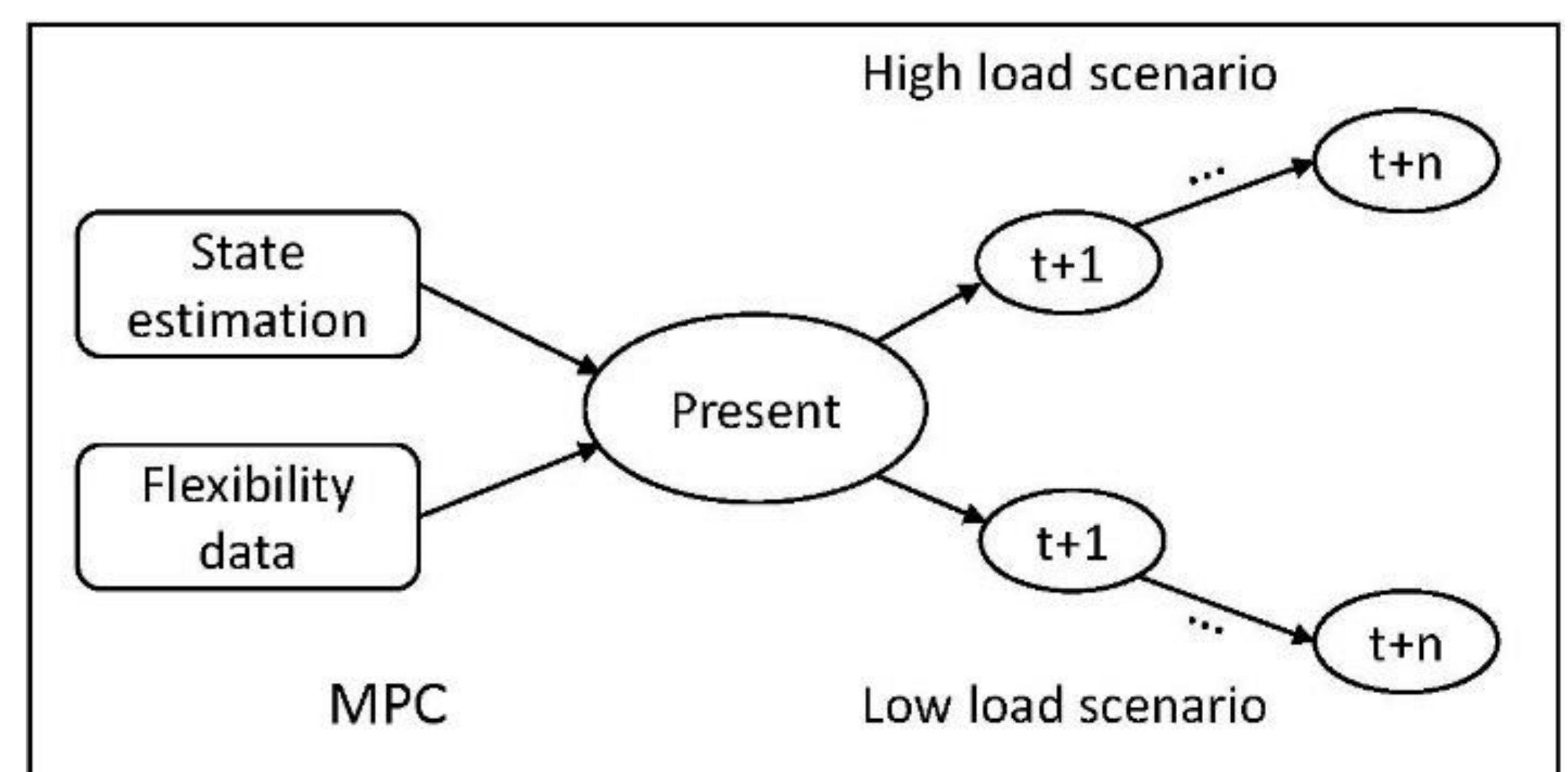
- Intractable due to binary variables, large problem size & non-convex AC power flow
- Sequential linearization of MINLP problem to achieve tractability

## Real-time ancillary service activation in the distribution network

### Inputs:

- Flexible source limits and costs from day-ahead procurement tool : loads, distributed generators and storage units
- Distribution network state from measurement data: voltage magnitudes and angles, power flows and bus injections from state estimation tool

### Uncertainty – model predictive control



## Acknowledgment

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