Master Thesis Defense

Mobile device power management for load flexibility: frequency dynamics and introduction to software aspects

Author
Grégory Foré

Date
25th June 2012

Supervisor
Prof. Dr. Ig. Damien Ernst
Introduction

- **Context**
  - smart grid approach
  - renewable energy increasing
  - energy and climate policy

- **Purpose**
  - frequency dynamics
  - primary reserve for frequency regulation
  - MODEPOMA concept: load flexibility
Uncontrolled power system

- Power imbalance $\Rightarrow$ frequency deviation
Uncontrolled power system

- Need a frequency regulation
Primary frequency control

- Aims to stabilize the frequency with a reduced frequency deviation
- P-controller usually used
Primary frequency control

- Reaches the objective
- Always asymptotically stable
Primary frequency control

- Controller’s parameters:
  - the time constant of the turbine $T_t$
    $\rightarrow$ the activation speed of the primary reserve
  - the speed droop characteristic $S$
    $\rightarrow$ the available primary reserve

$\Rightarrow$ Intrinsic features

$\Rightarrow$ Performance limited by its own implementation
Power management of loads

- Aims to stop the frequency drop
- Consider a P-controller
Power management of loads

- Reaches the objective
- Not always asymptotically stable: possibility to prevent oscillations
Power management of loads

- Controller’s parameters:
  - the frequency deviation for full activation $\Delta f_{\text{min}}$
  - the number of available quantized loads $N_0$
  - the quantized load $q$
    $\rightarrow$ the available primary reserve
  - the time-delay $\tau$
    $\rightarrow$ the lag introduced in the power system

$\Rightarrow$ Correlation with the primary frequency control

$\Rightarrow$ Relatively adjustable parameters
Transmission System Operator’s perspective

- Limitation of current standards
- Integrations:
  - the mixed integration: respect current standards
  - the piecewise integration: take advantage of the power management of loads
• Compared to the primary frequency control:
  - the mixed integration: less efficient
  - the piecewise integration: more efficient even with a smaller size
    global primary reserve
Introduction to software aspects

- Requirements to a software support: an IT platform
  - Assumptions and purpose
  - Constraints
  - Actors
  - Use cases
Conclusion

- Overview on what already exists
- Introduction of the MODEPOMA concept
  - model the power management of loads
- Integration of our idea in the current context
  - the piecewise integration efficiently works
- Next step: the implementation
Thank you for your attention