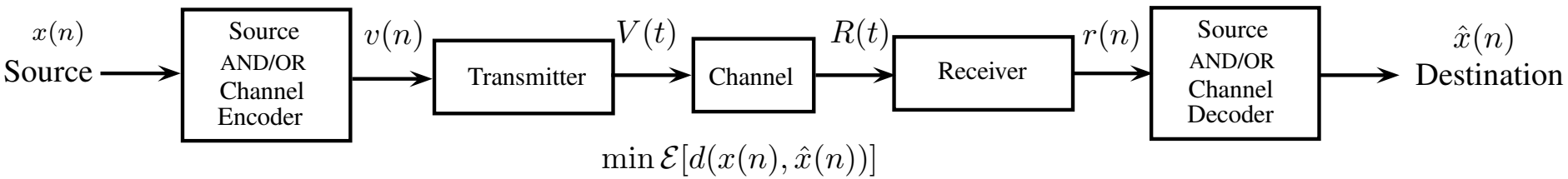
Communication for Control in Smart Grid (in a nutshell)

PhD Candidate: Reza Parseh[†]
Main supervisor: Prof. Kimmo J. Kansanen[†]
Co-supervisors: Prof. Tor A. Ramstad[†], Prof. Tor Arne Johansen[*]

[†]Department of Electronics and Telecommunications
[*]Department of Engineering Cybernetics
Norwegian University of Science and Technology
7034 Trondheim, Norway

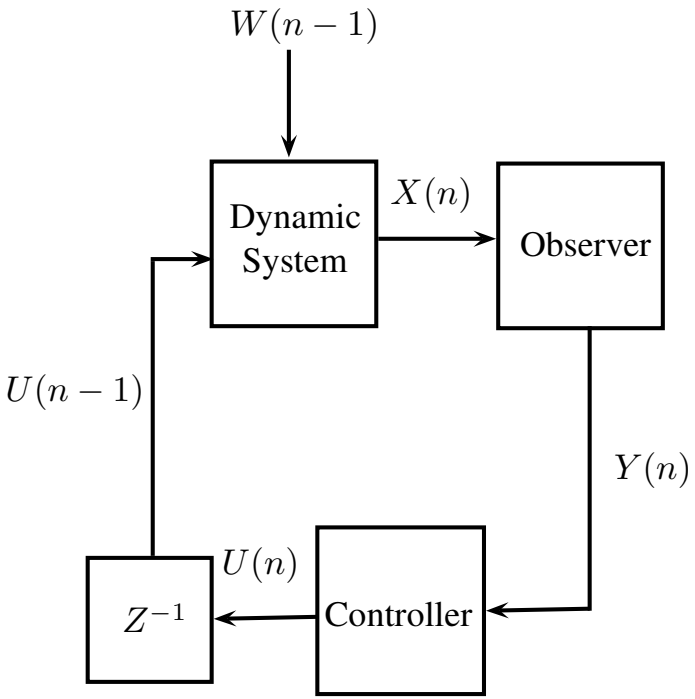
September 10, 2013

Telecommunication



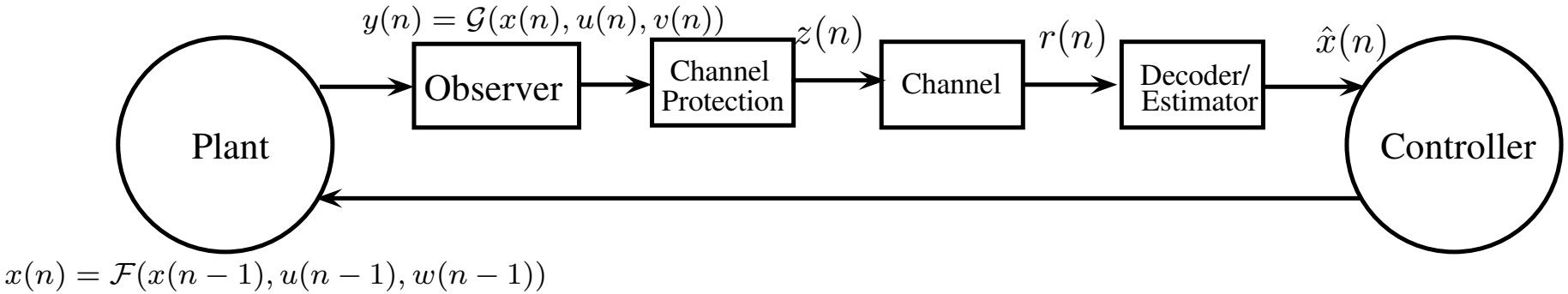
- Objective: Transmission of signal(s) $\mathbf{x}(n)$ from source point(s) to destination(s) via a communication channel.
- Result: Receiving a distorted version of the signal $\hat{\mathbf{x}}(n)$
- Main Issue: Resource usage vs. distortion trade-off
  - Resources: Power, time, frequency, etc.
  - Distortion: $\mathcal{E}[d(\mathbf{x}(n), \hat{\mathbf{x}}(n))]$
- Known Fact: "Allowing for long delays makes it possible to transmit at maximum rate..."

Control



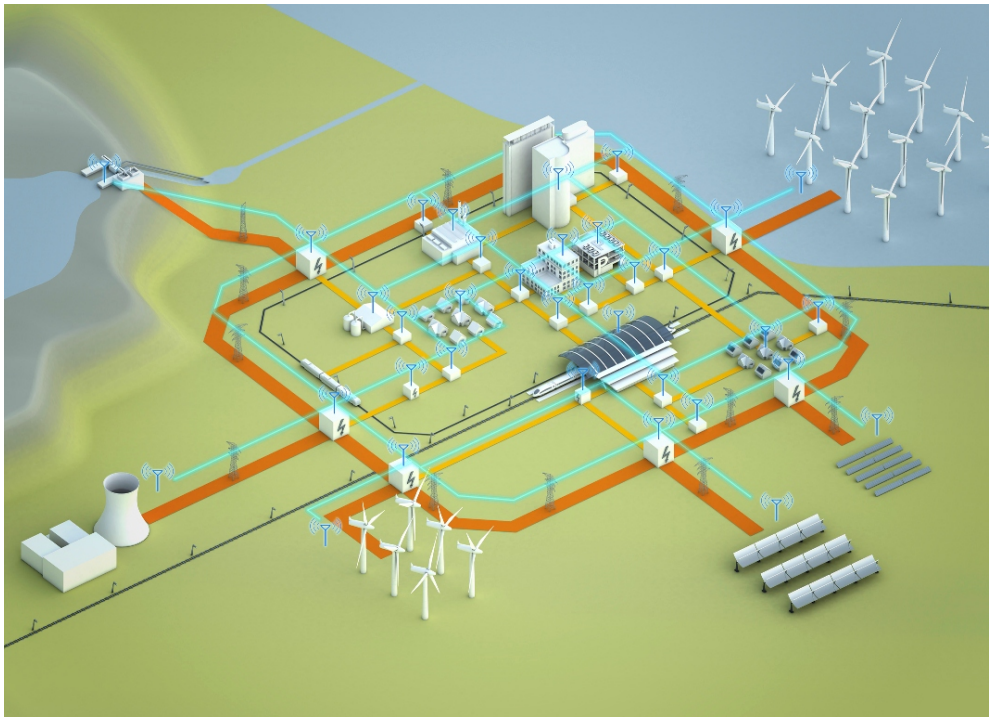
- Objective: Stabilize a dynamical system with control actions through a controller device
- known Fact: "Distortions, delay, etc in observing $\mathbf{y}(t)$ in general degrades the controller performance"

Integrated Communication and Control Problem



- Practical Schemes
- Analyzing Trade-offs
- Performance Limits

Smart Grid as a Communication/Control Framework



- Distributed generators as plants
- Wireless communication channels
- Particular signal models
- Tight delay requirements

Real-time compression scheme for grid signals

- Sum-of-harmonics source model
- Use of cyclostationary signal characteristics
- Use of adaptive predictors and differential coders
- Controllability achievable with very small bitrates (40 kbps)
- Application in a future communication control standard for smart grid

R. Parseh, S. S. Acevedo, K. Kansanen, M. Molinas, T. A. Ramstad, "Real-time compression of measurements in distribution grids," Proceedings of IEEE SmartGridComm 2012 Symposium -Network, November 2012, pp 223-228.(Best paper award for communication networks symposium)

More work...

- Wireless channel resistance improvement
- Implementation of the communication system on hardware
- Implementation within the smart grid setting in smart grid lab at NTNU/IME

Thank you for your attention!

{email: reza.parseh@iet.ntnu.no}