

# **Next Generation Heterogeneous Wireless CyberSystems to Support the Emerging SmartGrid**

**project update: 12/1/2011**

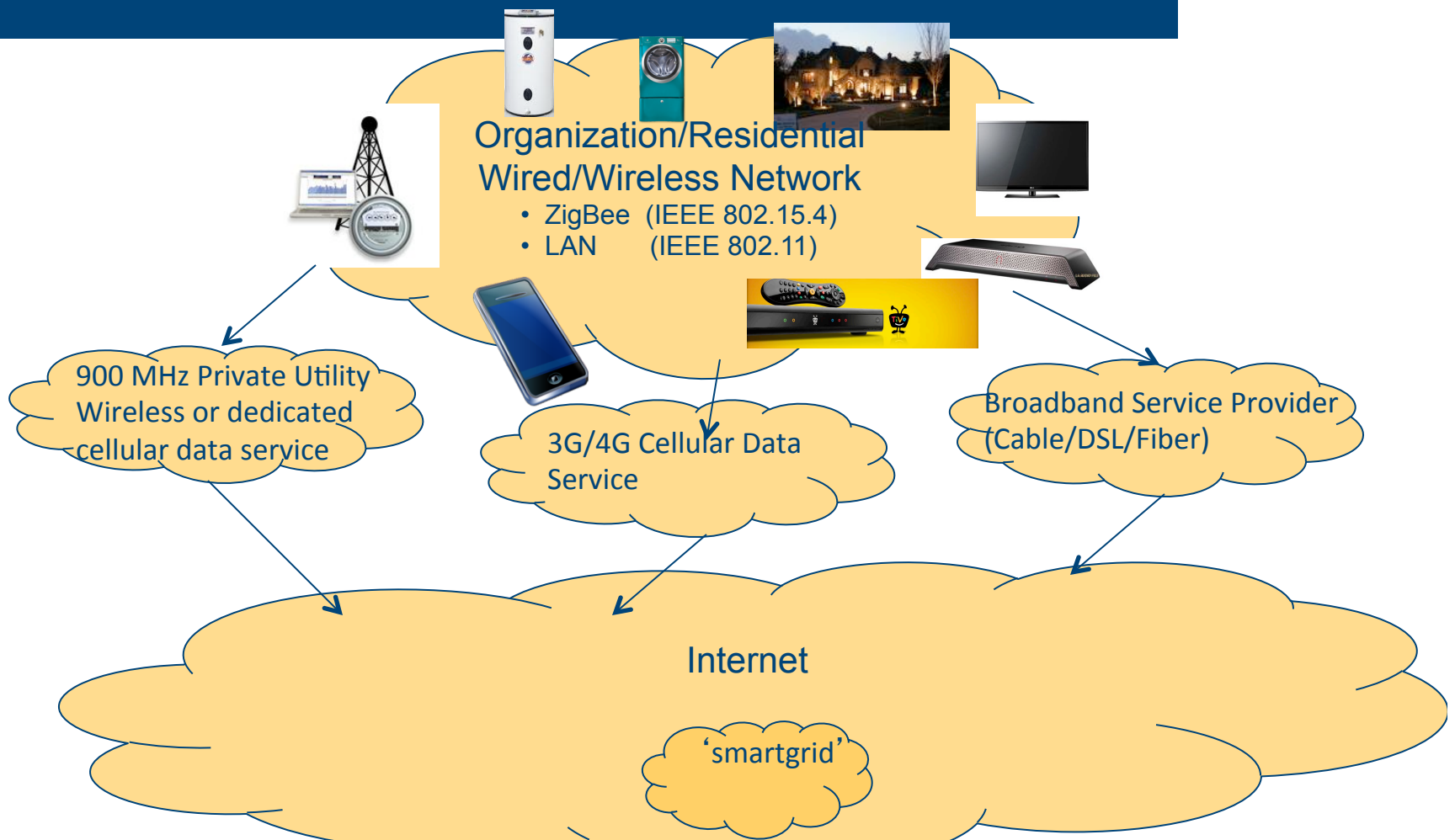
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# Overview

- Background
- Introduce the Smartgrid
- Problems of Interest
- Extensions of our current research projects
- Defining the idea

# The Smartgrid



# Smartgrid Complicates the CyberInfrastructure

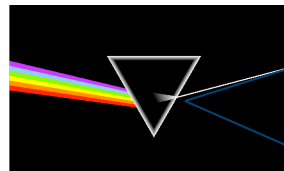
- Organizations/Residential homes will have a cyberinfrastructure.....
  - Computing platforms
  - Entertainment devices
  - Communications devices
  - Security devices
  - Devices that can be monitored and controlled via the network
  - Sensing devices
- There has been tremendous debate over the architecture of the emerging smartgrid. A crucial issue is the debate on the best choice of connectivity from the organization/home to the smartgrid cloud
  - Zigbee versus 802.11 devices
  - 900 Mhz licensed spectrum dedicated for private utility wireless networks, 2G/3G/4G cellular data service, broadband Internet access service
- As the Smartgrid evolves we anticipate the following:
  - There will likely not be a universal set of standards (at all layers from the PHY to the application) for many years. The resulting cyberinfrastructure will likely be a diverse set of networks that must work together
  - The complexity of the heterogeneous network will be high – beyond the home user. We fear this is yet another technology that will increase the digital divide.
  - The bandwidth requirements of the smartgrid end point will increase much faster than expected.

# Problem Definition

- **The areas of concern**
  - Cybersecurity
  - Managing resources for critical applications with products and networking technology that is “consumer grade”.
  - Complexity management
- **This set of problems exists in every business/organization that plans to join the ‘smartgrid’. To focus the project we consider the home environment**

# Problem Definition and Scope

- The areas of concern
  - Managing resources for critical applications with products and networking technology that is “consumer grade”
  - Complexity management
  - Cybersecurity
- This set of problems exists in every business/organization that plans to join the ‘smartgrid’. However, to help provide focus, we limit the scope of the project to focus just on the home (residential/small/home office) environment.



Focus on Residential, small business, home office environment

Focus on methods to manage resources in these future heterogeneous wireless network

# Project Idea

- Trends clearly show wireless devices are becoming more capable, more power efficient. Our device model is described as follows:
  - Some devices will have static radio communications capability- there is no way to change or vary the access technology. We anticipate the number of this type of device will drop over the next decade
  - Emerging devices will be multi-modal. They can be configured (dynamically) to support different types of radio access technologies.
  - While battery technology will improve, the requirements imposed on the devices will continue to make battery power a limiting factor in the capabilities of the home smartgrid
- Rather than have devices communicate over different wireless networks, we propose a system that allows the multiple, independent wireless systems to work together to form a single unified wireless network.

# Project Idea

- With this idea and motivation, the research problems addressed by the proposal are :
  - Defining an appropriate wireless architecture that supports a heterogeneous wireless system
  - Develop methods by which the system manages the wireless spectrum that is available in a manner that blends policy, fairness, and system efficiency while taking into account power management and application performance requirements.



# Project Description

- Develop the foundations to study the problem through a combination of lab benchmarking studies and simulation modeling.
- Research objectives:
  - Provide guidelines for the amount of broadband access (wired and wireless) bandwidth might be required.
  - Explore the sensitivity of the home network to intrusions caused by intentional and unintentional denial-of-service.
    - Intentional DoS occurs when an ‘infected’ computer within the network can cause portions of the home network to not work
    - Unintentional DoS occurs when a device (such as a netflix-enabled wireless device) consumes 100% of the bandwidth.

# Project Milestones

- **Task 1: Literature survey:** the starting point is to do a thorough academic literature survey to determine where the issues and possible future paths for the smartgrid.
- **Task 2: Industry/deployment survey:** We need an understanding of what the capabilities are of smartgrid systems being deployed now as well as what we can expect to see deployed over the next 5 years. This task includes connecting this project with smartgrid activities within IBM.
- **Task 3:** We will develop a system architecture and design a simulation model that captures the basic components of the system. We will use the open source ns2 simulation tool.
- **Task 4:** Baseline the basic system
- **Task 5:** Resource allocation algorithm design and evaluation
- **Task 6:** Document the project, deliver all code and data to our IBM sponsors, develop one or more academic papers and submit for publication at top level conferences and journals.

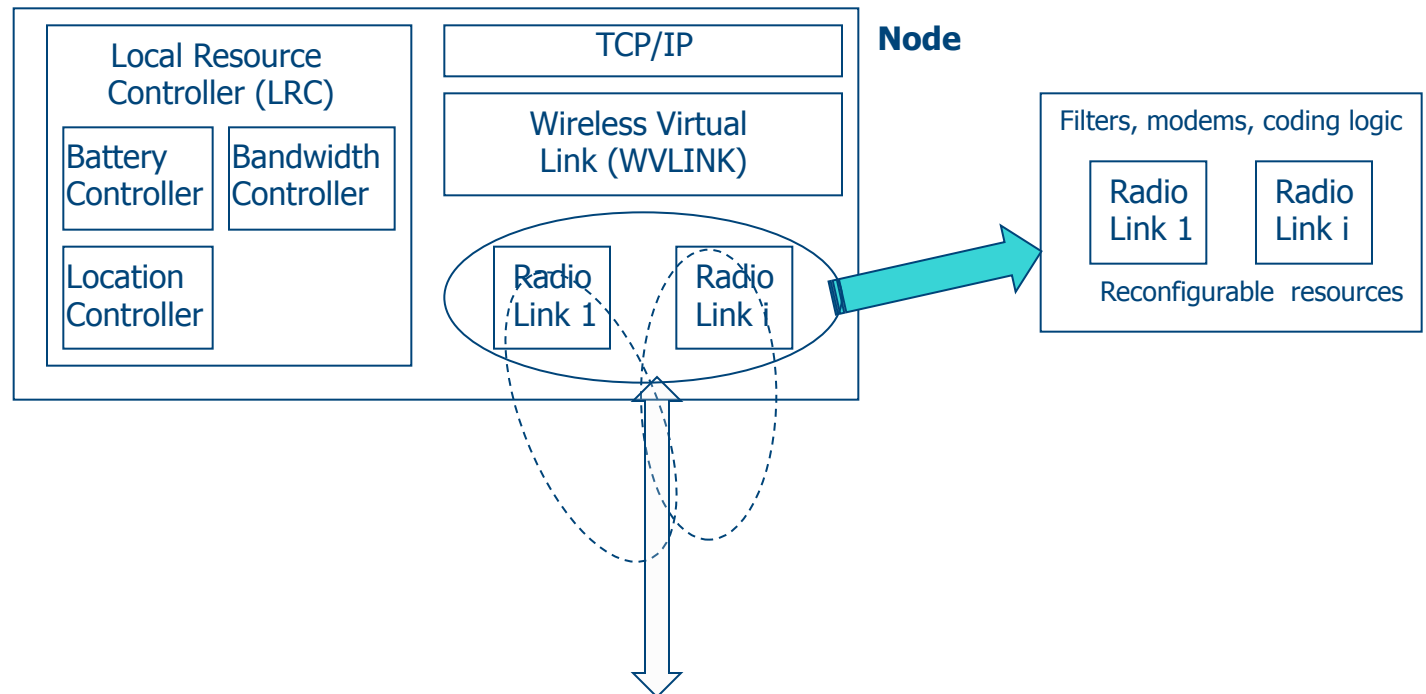
# Project Outcomes and Deliverables

- **Outcome 1:** For a residential/home office environment, we will demonstrate issues and limitations of the current approach used to build smartgrid capabilities – that involve separate underlying networks.
- **Outcome 2:** We will propose an innovative new approach for building the ‘cyberinfrastructure’ required to support current and anticipated requirements of the smartgrid.
- **Outcome 3:** We will demonstrate the benefits of the ideas using realistic applications and use cases
- **Deliverables:** Our IBM sponsors will have access to any/all simulation code, all data that is generated, and immediate access to any of the ideas/technology developed through the project (as it will be in the public domain through publications).

# Defining/Modeling the 'Smartgrid'

- Literature Survey
  - Lots of research in smartgrids
  - Internet of Things relationship
  - IEEE SmartGrid2010, 2011 (deadline May 6 2012)
- System Model :
  - Requirements of the system
  - Device model
  - Application oriented usage model
  - Wireless system model

# Device Model



# Possible System Model

