Critical Infrastructure Security: The Smart Grid (4.6)

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Education Need and Target Audience

• Need: The increasing convergence of power, communications, and information network is creating a need for new multi-disciplinary skill sets for the power industry employee. Furthermore, an aging and retiring workforce adds to this challenging problem.

• Audience: Students and university-level instructors
Description of the Offering

• Design a course with multi-disciplinary content integrating topics from data communication, computing, control, cyber-security and power systems that are relevant to secure operations of smart grids.

• Design a course to target audience of senior undergraduate and graduate engineering and computer science students (CS/EE, UG/G).

• Design a course that could be offered to online distance engineering students or engineers from industry as well as in the conventional classroom setting.
Description of the Offering

• Design course materials to be easily adopted by instructors at other schools.

• Design course evaluations that allow us to assess course outcomes and improve the content

• Team Taught by:
  • Anurag Srivastava – power systems aspects (6 lectures),
  • Carl Hauser – computer networking (6),
  • Dave Bakken – computation and distributed systems (6),
  • Carl Hauser/ Min Sik Kim – cyber security basics (6),
  • Joint: cases (4)

• Take-home group mid-term, final exam, and final project, 2 individual quizzes, 4 homeworks

• Text book: Book chapters and online references
Learning Objectives

• At the end of this course, student will,

1) Understand the basic principles of smart grid components and operation

2) Understand the principles of communication networks, data management, distributed computing and cyber security

3) Be able to critically analyze the interdependencies of related infrastructure in the smart grid needed to sense, communicate, compute and control in secure way

4) Be able to apply the interdisciplinary principles that you have learned in building secure smart grid infrastructure
Student Feedback to Date

Offered as ‘Critical infrastructure security: the emerging smart grid’

Spring 2012 (29+24=53)
• Pullman Campus: - CptS: UG 7 G 1, EE: UG 4 G 11
• Tri-Cities Campus: - CptS: UG 4 G 2, EE: U 0 G 0
• Online: 24

Spring 2013 (27)
• Pullman Campus: - CptS: UG 2 G 3, EE: UG 3 G 15
• Tri-Cities Campus: - CptS: UG 0 G 0, EE: U 0 G 4
Student Feedback to Date (2012)

- Evaluations from 15/29 students

- Overall rating
  - 33% excellent
  - 40% good
  - 13% neutral
  - 13% poor or very poor

- Course was well organized
  - 47% strongly agree
  - 47% agree
  - 7% neutral

- I believe I learned in the class
  - 80% very often
  - 7% sometime
  - 13% few times
Student Feedback to Date (2013)

• Evaluations from 23/27 students

• Apply the interdisciplinary principles that I have learned in building secure smart grid infrastructure

• Critically analyze the interdependencies of related infrastructure in the smart grid needed to sense, communicate, compute and control in secure way

• Understand the principles of communication networks, data management, distributed computing and cyber security in context of the smart grid

• Understand the basic principles of smart grid components and operation
Student Feedback to Date

Student Feedback

• Too much information per session; cut down and emphasize the basics
• Too many professors – hard to know what is expected
• Group work on exams (not project) was “unpleasant”
• Spend more time on real-world applications

Faculty Feedback

• It was a very challenging class to design and teach
• Many were bored and others terrified at any given time
• Lectures hard to design to reach both EE/CptS students
• Final projects were actually pretty good and interesting, except in a few cases
Plans for Future Use

• Try to integrate details about networking/power/computing/security topics around a few case studies that each involve at least two of the topics
  • E.g. Talk about AMI and its smart grid role and couple it with a detailed discussion of IP/UDP, symm. key encryption
  • E.g. Talk about monitoring and control, discuss SCADA, DNP3, and its encapsulation in IP/TCP

• We need our own notes rather than selecting chapters from topic-specific textbooks

• Background reading list – “you should be familiar with this”
Accessing the Materials

• Course Material will be available in late Summer 2013 (improved one in 2014)

• More Information Available at:

• Online offering for certificate (this may change to online degree program in long term). This will be available through WSU global campus in 2014.