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# Applied Computational Mechanism Design

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March 06, 2008



#### **Credits**

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## **Recall from Mark Klein's Talk...**

"Theories and constructs from the field of economics can endow the notion of architecture with new meaning and consequently offer structuring principles for Ultra-Large-Scale Systems."\*



We put this idea to the test to allocate scarce bandwidth in an emulated tactical data network based on the US Navy's LINK-11.

ULS Research Area 6.2 Computational Emergence 6.2.1 Algorithmic Mechanism Design Computational

Mark Klein, Panel slides, SMART Ultra-Large-Scale Systems Forum

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# Did you know that...

- 98%+ of Google's \$6.7B revenue in 2006 has been attributed to an auction mechanism?
- the FCC has conducted auctions of licenses for electromagnetic spectrum since 1994?
- in 2007 three Nobel prizes in economics were awarded for work in mechanism design?



# What is Computational Mechanism Design?

- A mechanism is an institution, such as a market or an auction, that defines the rules for how humans are allowed to interact, and governs the procedures for how collective decisions are made.
- A computational mechanism uses computational processes to act on behalf of humans, and/or uses computers to determine decision outcomes.
- Computational mechanism design is the art of designing computational mechanisms
- Computational mechanism design straddles microeconomics, game theory, and computer science



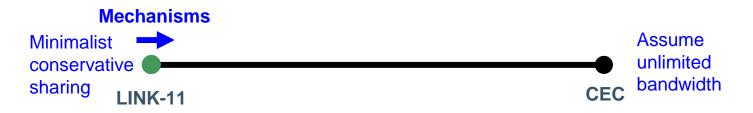
## Why Study Tactical Data Networks?

A tactical data network will serve diverse needs of diverse users in a highly dynamic, performance-critical environment

Many systems communicate only minimal information to conserve bandwidth and to minimize latency

Mechanisms may provide a principled way to trade scarce bandwidth for value-driven improvements in data quality

We will regard the system as a virtual economy, where bandwidth is *scarce* and information has *value* 



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## Our approach to studying mechanism design

Develop an environment to study mechanisms at scale

• tactical data network (LINK-11)

Study one mechanism in-depth in this environment

• Vickrey-Clarke-Groves auction

Evaluate engineering potential

 mechanism engineering as a peer of, for example, performance engineering?







#### demonstration...

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#### **Takeaway Point**

"Since computation has moved over the past twenty years decisively closer to people, interfaces with social sciences such as Psychology and Sociology, besides Economics, have become increasingly important"

> Christos H. Padadimitriou, in "Algorithms, Games, and the Internet"