

M&S Research Directions in the Era of Big Data and IoT

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Main Thesis

- The emergence of big data and IoT highlight the increasing importance of *on-line decision making*, an area where M&S has much to contribute.
- The *power and energy consumed by simulations* is a critically important area meriting greater consideration by the M&S research community.

Online Decision Making

Smart-X is here: Smart sensors, smart phones, smart appliances, smart cars, smart buildings, smart power grids, smart transportation systems ... smart cities



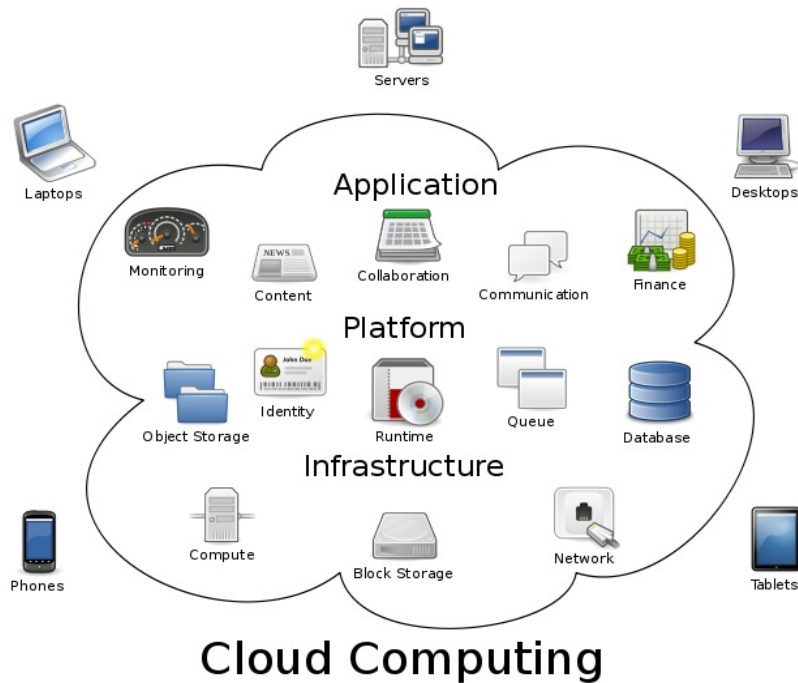
Technologies

- Dynamic Data Driven Application Systems (DDDAS)
- Cyber-Physical Systems

Computational models and simulations play a critical role in smart devices and systems

Computing Platforms for Online Decision Making

Cloud Computing

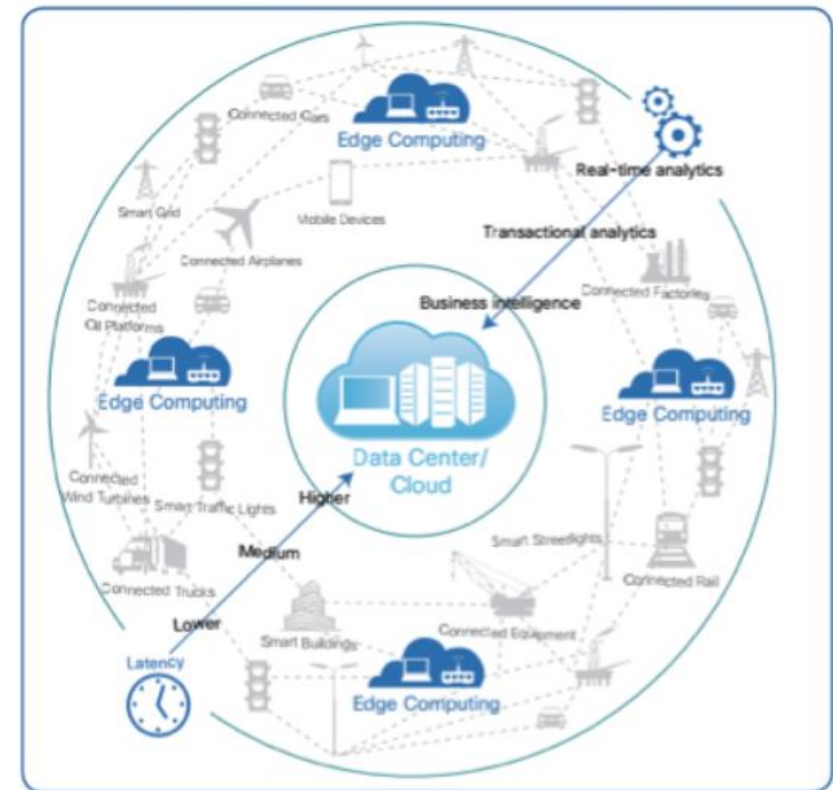


source: wikipedia

- Remote sensing
- Analytics in the cloud
- Applications tolerant of high latency

Edge Computing

Edge computing helps ensure that the right processing takes place at the right time and place.



source: Cisco

- Computing near or within sensors, e.g., embedded simulations
- Low latency feedback loops
- Reduced network, privacy constraints

Power & Energy in Cloud Computing

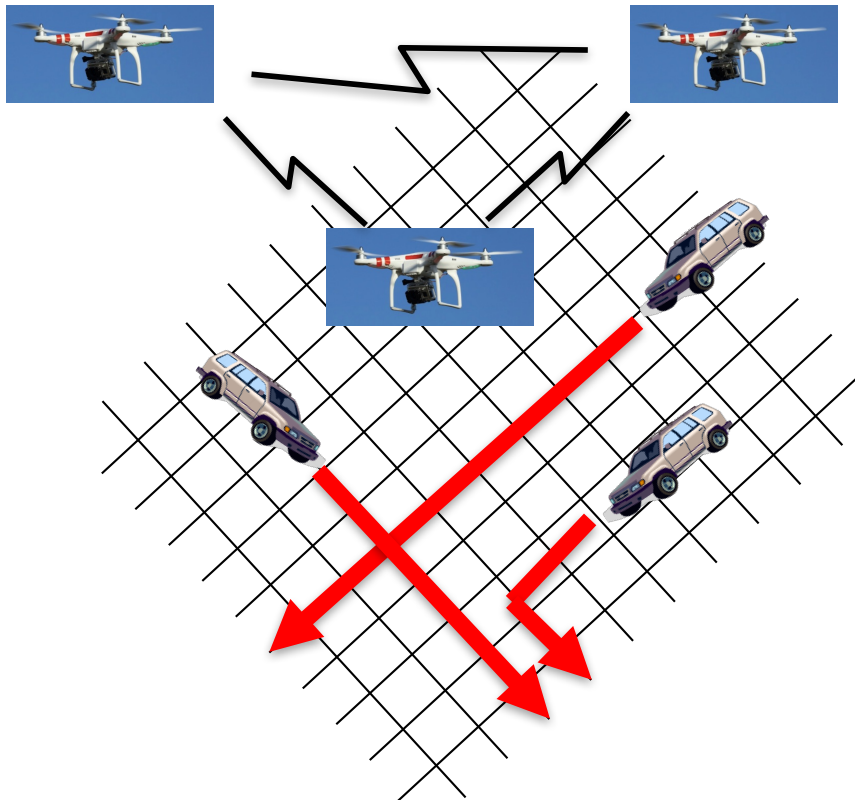


- Electric power in data centers a major operating expense
 - 70 billion kW-hours in 2014 (1.8% electricity consumption in the U.S.)
- Heat dissipation a major hurdle to reaching exascale supercomputer performance
- Power management now a major concern
 - Power cap constraints

Power & Energy in Edge Computing

Adaptive Sensor Networks

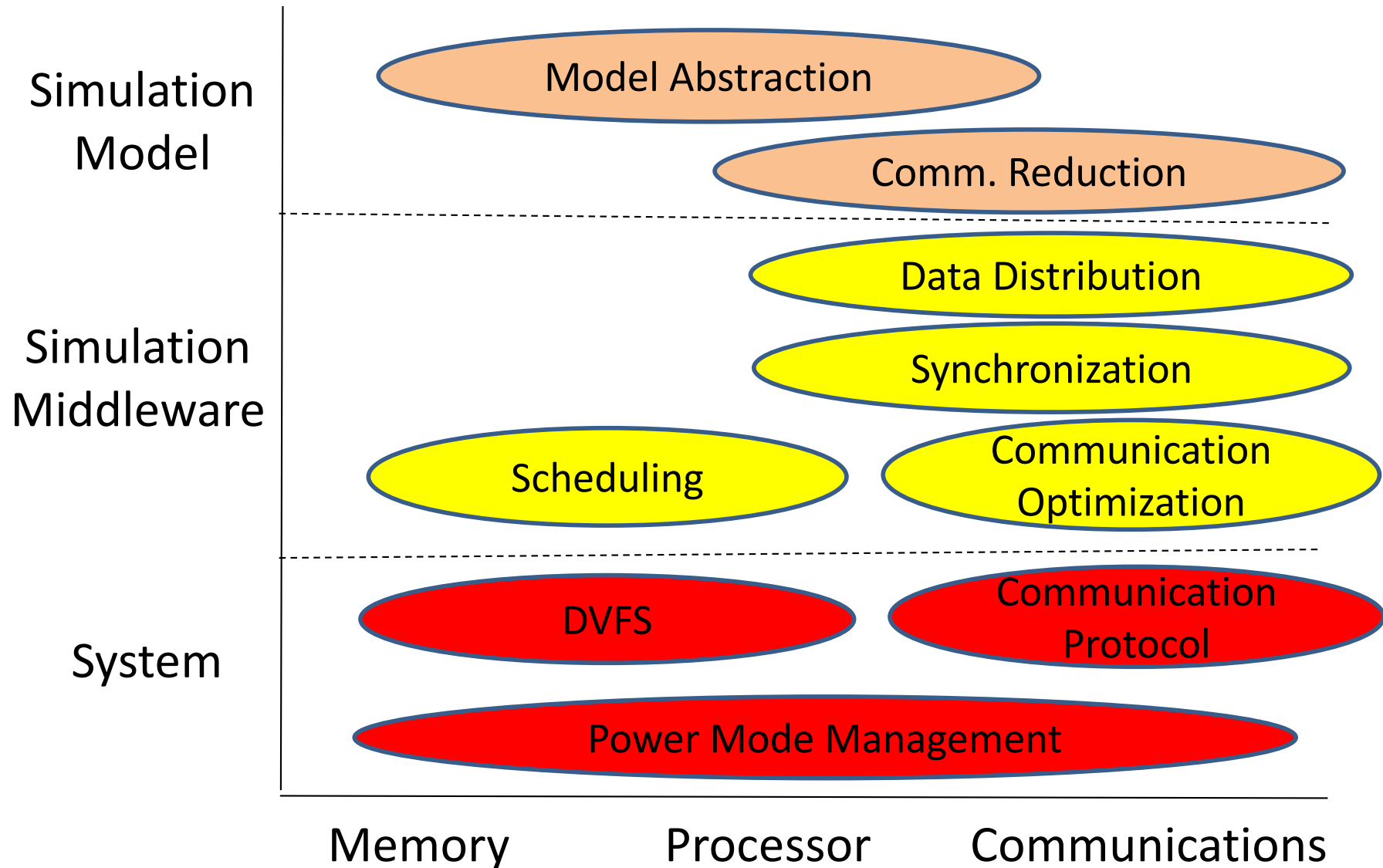
- Mobile sensors monitoring a physical system (forest fire, cloud plume, traffic)
- Simulations guide adaptation of the sensor network



Energy Consumption a Major Concern

- Longer time between recharging battery
- Smaller, lighter weight batteries

Energy in Distributed Simulation: Research Roadmap



Big Data: M&S Partner or Competitor?

CHRIS ANDERSON SCIENCE 06.23.08 12:00 PM

THE END OF THEORY: THE DATA DELUGE MAKES THE SCIENTIFIC METHOD OBSOLETE



* Illustration: Marian Bantjes * **"All models are wrong, but some are useful."**

We no longer need models [or simulations]!

Chris Anderson, Wired Magazine, June 23, 2008

"Petabytes allow us to say: 'Correlation is enough.' We can stop looking for models."