Performance Analysis Of Cluster-based Data Center

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Outline

- Synchromedia Consortium
- Green ICT & GreenStar Network
- Green Telco Cloud project
- Tracing in Cloud Environment
- Team & Tasks

Synchromedia
Overview

- Founded in 1998 by 4 universities of Quebec
- Awarded a $4 million CFI grant to build a Pan-Canadian Consortium.
- Research areas
  - Network virtualization
  - Telepresence
  - Intelligent interfaces
  - Biomedical image processing
  - Document processing
  - Machine Learning & classification
  - Green ICT
  - Environmental assessment

Synchromedia
Sample Projects

- Green Sustainable Telco Cloud (2012)
  - $1.5 million funded by NSERC, Ericsson, Inocybe Technologies
- The Indian Ocean World (2010-2017)
  - $2.5 million funded by SSHRC
- GreenStar Network (2010-2012)
  - $2.1 million funded by CANARIE
- Multimedia communication in telepresence (2005-2010)
  - $4 million funded by CFI
- EU's FP7 Panlab II (2008-2011)
  - $500k funded by MDEIE's PSIIRI
- EU's FP6 Panlab I (2006-2008)
  - $100k funded by MDEIE's PSIIRI

Green ICT & GreenStar Network

Green ICT

- Climate Change is not reversible
- There will be an urgent need to develop low carbon solutions.
- Increasingly such solutions will be a major component of all future innovation in every aspect of our lives.
- ICT are a major consumer of power (8% in the US) and CO2 production which is growing at 6% per year. As such ICT sector is one of the primary areas in which we can develop low carbon solutions

Green ICT & GreenStar Network

Premises

Current research focuses on energy efficiency

- Renewable energy sources are hard to connect to the grid
- Energy loss in transmitting power is higher than when data is moved over networks

Khazzoom–Brookes postulate:

"Energy efficiency improvements, on the broadest considerations, are economically justified at the micro level, lead to higher levels of energy consumption at the macro level"

Bill St. Arnaud:

"Energy efficiency is an irrelevant network design approach and the objective should be to make networks carbon neutral"

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Green ICT & GreenStar Network

Goals of the GSN

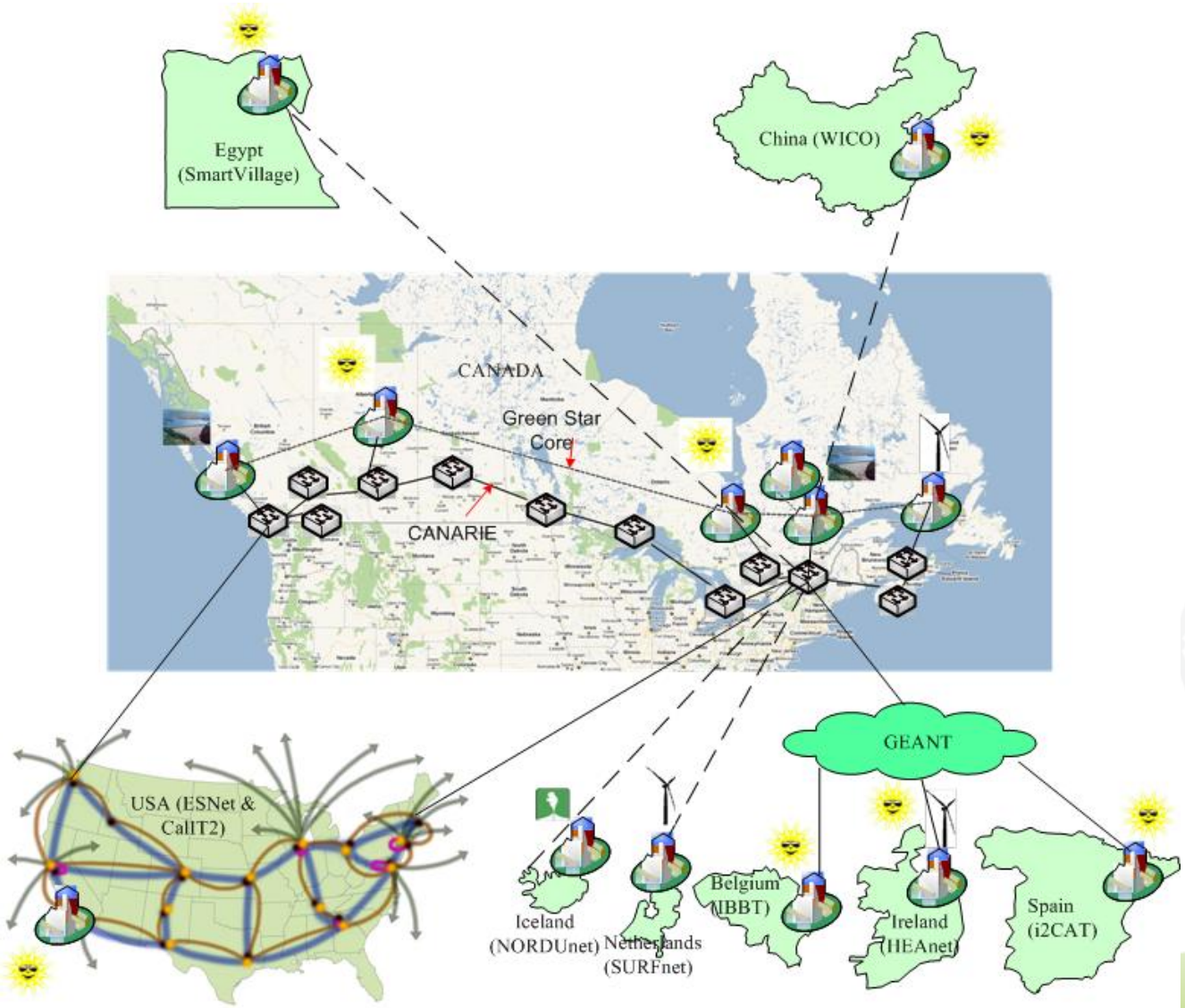
GreenStar
World's First Zero Carbon Internet & Cloud

- To develop ***low-carbon technologies***, including:
  - renewal energy like wind- and solar-powered networks,
  - *virtualization*,
  - *carbon quantification procedures*, and *tools*,

- **To ensure ICT's carbon footprint remains under control** and does not increase as the world becomes more and more reliant on information and communication technologies.

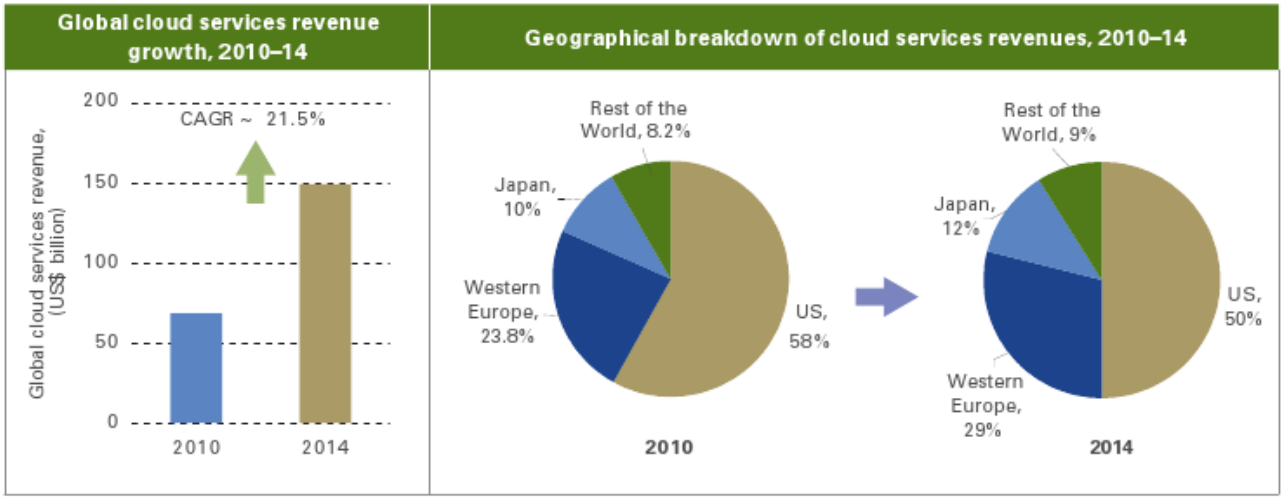
Green ICT & GreenStar Network

Network Plan



Green Telco Cloud

The need of Telco cloud



Source: Gartner

Cloud market

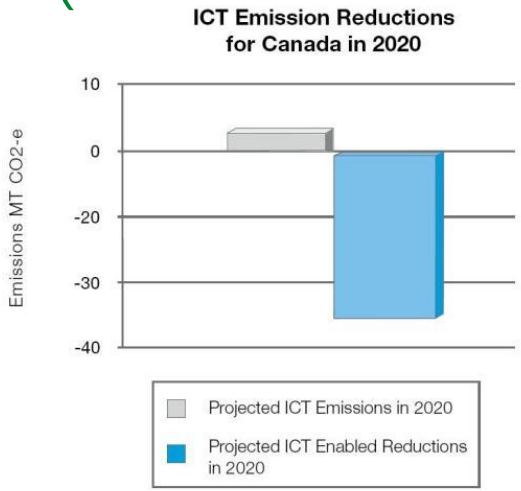
Telco	SaaS	IaaS	PaaS
AT&T	✓	✓	✓ (Planned)
BT	✓	✓	×
Deutsche Telekom / T-Systems	✓	✓	✓
France Telecom / Orange Business Services	✓	✓	✓ (Plan to launch by second half of 2012)
NTT	✓	✓	×
Telefónica	✓	✓	×
Telstra	✓	✓	✓ (Planned)
Verizon	✓	✓	×

Global operators

Green Telco Cloud

But… there is environmental concerns

- Estimates of data center electricity demand are at 31GW globally, with an increase of 19% in 2012 alone (global electricity demand essentially flat for the past three years)
- It is estimated that global mobile data traffic grew 133% in 2011, with 597 petabytes of data sent by mobiles every month.
- Electronic devices account for 15% of home electricity use, and are predicted to triple by 2030. (SMART 2020, 2008)
- The combined electricity demand of the internet/cloud (data centres and telecommunications network) globally is 623bn kWh (and would rank 5th among countries). (Make IT Green, 2010)



Tracing & Monitoring in Telco Cloud

The Need

- Heterogenous environment
  - Server, Network, Storage, Application, Middleware
- Specific behaviours & actions
  - Virtualization, migration
  - High Performance Computing
- Various data models
  - CPU, memory, I/O of servers
  - Hypervisor, virtual machines, hardware accelerators
- Requirements for optimization
  - Resource usage
  - System throughput
  - Response time

Tracing & Monitoring in Telco Cloud

Challenges

- Type of jobs in cloud
  - Parallel (jobs in clusters & grids are basically bags-of-tasks, mostly sequential)
  - Application-specifics (e.g. Telco apps)
- Resource provisioning
  - On-demand (no preperation time)
  - Resources can flexibly be allocated/relocated/released
- Scale
  - Very large / Various layers (IaaS, PaaS, SaaS)
  - Unknown geographical localtions
- Performance metrics
  - Various / No standard
  - High variability (Average vs. Peak)

Tracing & Monitoring in Telco Cloud

Requirements for Tracing Tools

- Virtualization
  - Support many types of hypervisors (VMWare, KVM, XEN)
  - Tracing servers and VMs performance in the same time
  - Easily integrated into cloud middleware
- Real-time tracing
  - Resource acquision and release are substantial
  - Tracing performance during migration (high variation)
- Distribution/Scalability
  - Capable of working in various distributed nodes
  - Working in parallel
- Robustness
  - More intelligent
  - Context-aware

ETS Team & Tasks
The Team

- Team
  - Professor Mohamed Cheriet: data analysis, pattern recognition, artificial intelligence, cloud computing, green ICT
  - Research Associate Kim Nguyen: high performance networking, cloud computing, data processing, optimization, green ICT
  - PhD 1 (working in Green Telco project): cloud middleware, performance analysis
  - MSc 1: Telco cloud monitoring and tracing, data visualization
  - MSc 2: Remote client monitoring, data visualization
- Collaboration / Follow-up
  - Monthly meeting via Video Conference system
  - Monthly website update
  - Follow-up by Geniève Bastien & Kim Nguyen
  - Quarterly report

ETS Team & Tasks

Tasks (to be revised)

- Tasks in CTPD
  - T4M1.1 Telecom cluster monitoring state of the art
  - T4M1.2 Algorithms for Telecom Cluster tracing and debugging
  - T4M1.3 Optimization of Telecom cluster tracing and debugging
  - T4M1.4 Technology transfer and results dissemination
  - T4M2.1 Telecom cluster visualization and control survey
  - T4M2.2 Algorithms for Telecom Cluster monitoring and control
  - T4M2.3 Optimization of the Telecom cluster monitoring
  - T4M2.4 Technology transfer and results dissemination
  - T4M3.1 remote client monitoring state of the art
  - T4M3.2 Algorithms for remote client servers tracing
  - T4M3.3 Optimization of the remote client servers tracing
  - T4M3.4 Technology transfer and results dissemination
  - T4M4.1 remote client servers visualization/control survey
  - T4M4.2 Algorithms for remote client servers visualization
  - T4M4.3 Optimization of the remote client servers tracing
  - T4M4.4 Technology transfer and results dissemination

ΣQUATION
A MAJOR GREEN ICT INITIATIVE
Technology + Ecology = Economy

Thank you!

Discussion

Greenstar NETWORK