Green Cloud Computing and Sensor Cloud Computing – Revision Notes

Green Cloud Computing - Quick Revision Notes

Definition

- **Green Cloud Computing**: Aims at efficient computing infrastructure utilization **while minimizing energy consumption**.

Importance of Energy Efficiency

- **Rising Demand**: Rapid growth in data centers.
- **Energy Intensity**: Data centers consume **10–100x more energy/sq. ft.** than typical office buildings.
- **Cost Impact**:
  - Energy = **10% of OPEX**, expected to **rise to 50%**.
  - Cooling costs: **$2–$5 million/year**.

Typical Data Center (DC) Energy Consumption

- **Cooling Systems**: 45%
- **Power Distribution**: 15%
- **IT Equipment**: 40%

Data Center Architectures

Past - Two-tier Architecture

- Layers: **Access + Core**
- Network: **Full mesh**
- Technologies: **1 GE, 10 GE**
- Load Balancing: **ICMP**

Present - Three-tier Architecture

- Layers: **Access + Aggregation + Core**
- **Scales to 10,000+ servers**
- Enhanced performance:
  - **100 GE (IEEE 802.3ba)**
  - **2-way ECMP** load balancing

Cloud Service Providers (CSP) Initiatives

- CSPs need to reduce energy costs to maintain profitability.
- **Amazon**: Energy costs = **42% of data center budget**
- **Google, Microsoft, Yahoo**:
  - Building data centers near Columbia River (USA)
  - Use **cheap hydroelectric power**

Green Broker - Energy-aware Scheduling

- **Cloud Broker**: Leases cloud services, schedules apps.
- **Green Broker**:
  1. Analyzes user requirements
  2. Calculates **cost + carbon footprint**
  3. Performs **carbon-aware scheduling**

Sensor Cloud Computing

Limitations of Traditional Sensor Networks

- Poor scalability
- Vendor lock-in; lack of interoperability
- Low resource capability
- Application rigidity
- Slow adoption in large-scale usage

What is Sensor Cloud Computing?

- Infrastructure connecting **sensors + cloud + internet**
- Interfaces physical & cyber worlds
- Enables **large-scale data sharing** and **cross-disciplinary applications**
- Provides cloud services via **sensor-rich devices**

Virtual Sensor Configurations

1. **One-to-Many**:
   - 1 physical sensor → many virtual sensors.
   - Middleware manages **frequency & duration** for all users.
2. **Many-to-One**:
   - Many physical sensors (in a region) → 1 virtual sensor (aggregated data).
   - WSNs activated based on user's **phenomenon request**.
3. **Many-to-Many**:

- Combination of above.
- Physical sensor ↔ many virtual sensors.
- Also participates in **aggregate data** for virtual sensors.

🎯 **Exam-Focused Points to Remember**

Topic	Key Fact
Green Cloud	Efficient + energy-aware computing
DC Cooling Cost	45% of total energy
2-tier DC	Access & Core
3-tier DC	Access, Aggregation, Core
Energy in OPEX	10% now, may rise to 50%
Amazon Energy Budget	42% total DC budget
Green Broker	Carbon-aware scheduling
Sensor Cloud	Sensor + Cloud + Internet
1→Many Config	Shared physical sensor, multiple users
Many→1 Config	Aggregated regional sensor data
Many↔Many	Flexible, bidirectional sensor mapping