
بسم الله الرحمن الرحیم

National Cloud Computing Adoption Framework and its Implementation Strategies

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Profile

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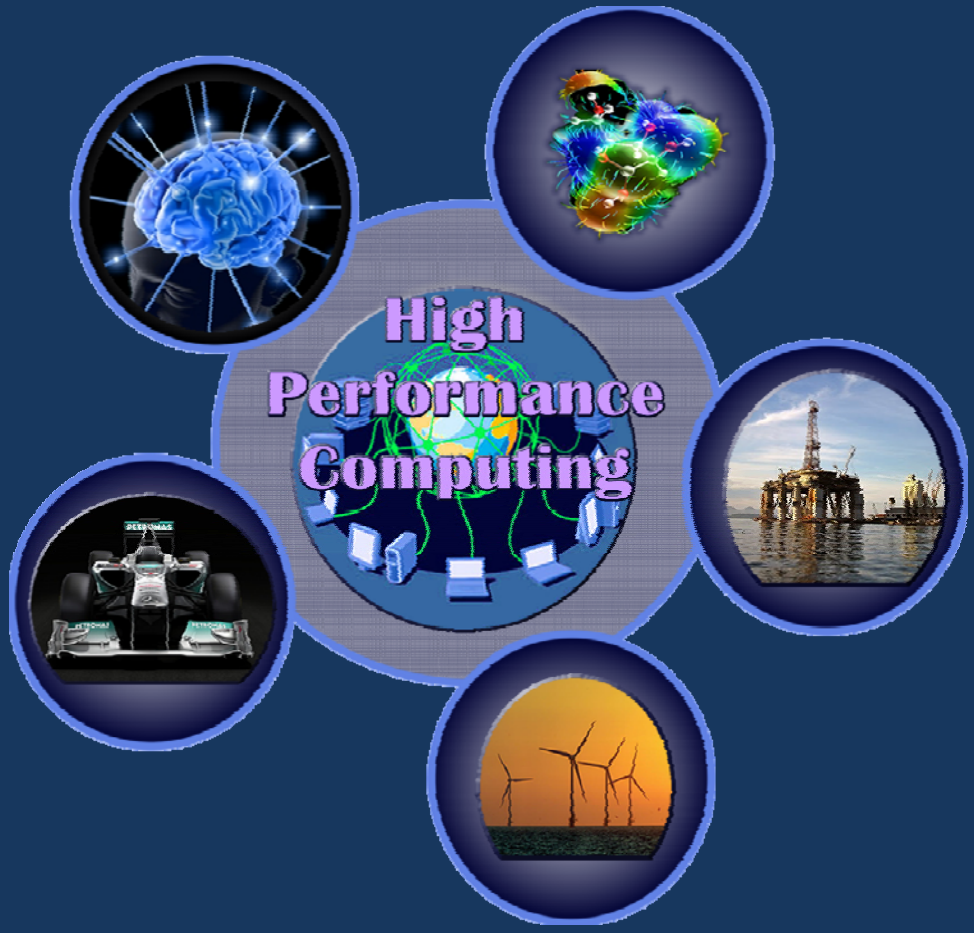
Goal of the Talk:

- What is high performance computing and its present and future
- Worldwide Cloud adoption and application strategies
- NCP Grid @ CERN Cloud
- Cloud Adoption in Pakistan
- National Cloud Computing Framework and its Implementation Strategy

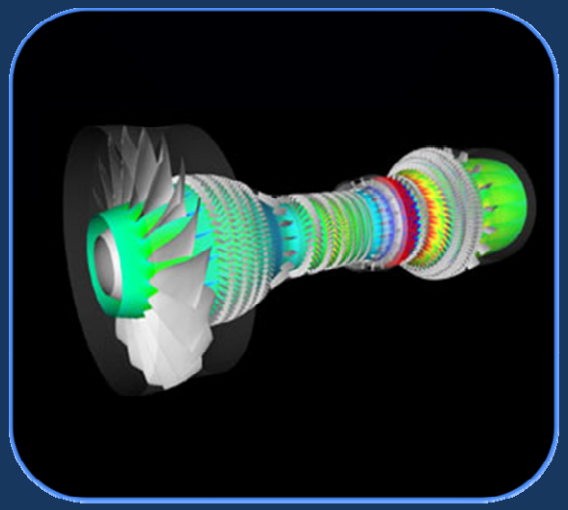
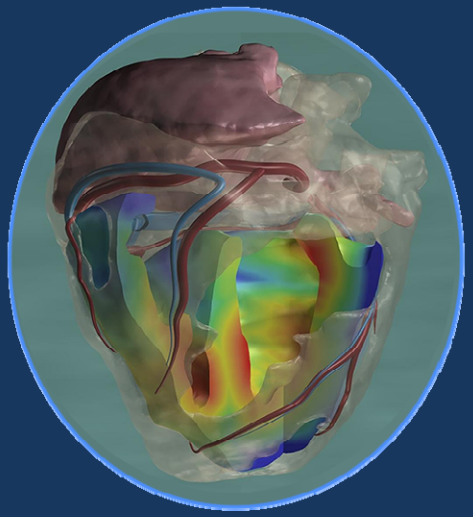

High Performance Computing

What is High Performance Computing?

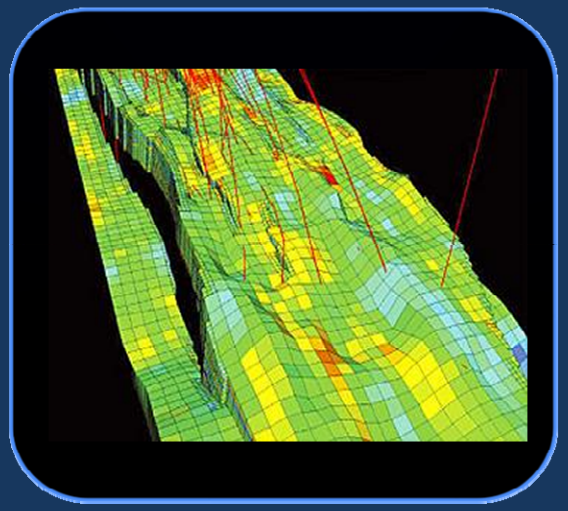
High-performance computing (HPC) uses super computers and compute clusters to solve advanced computational problems.



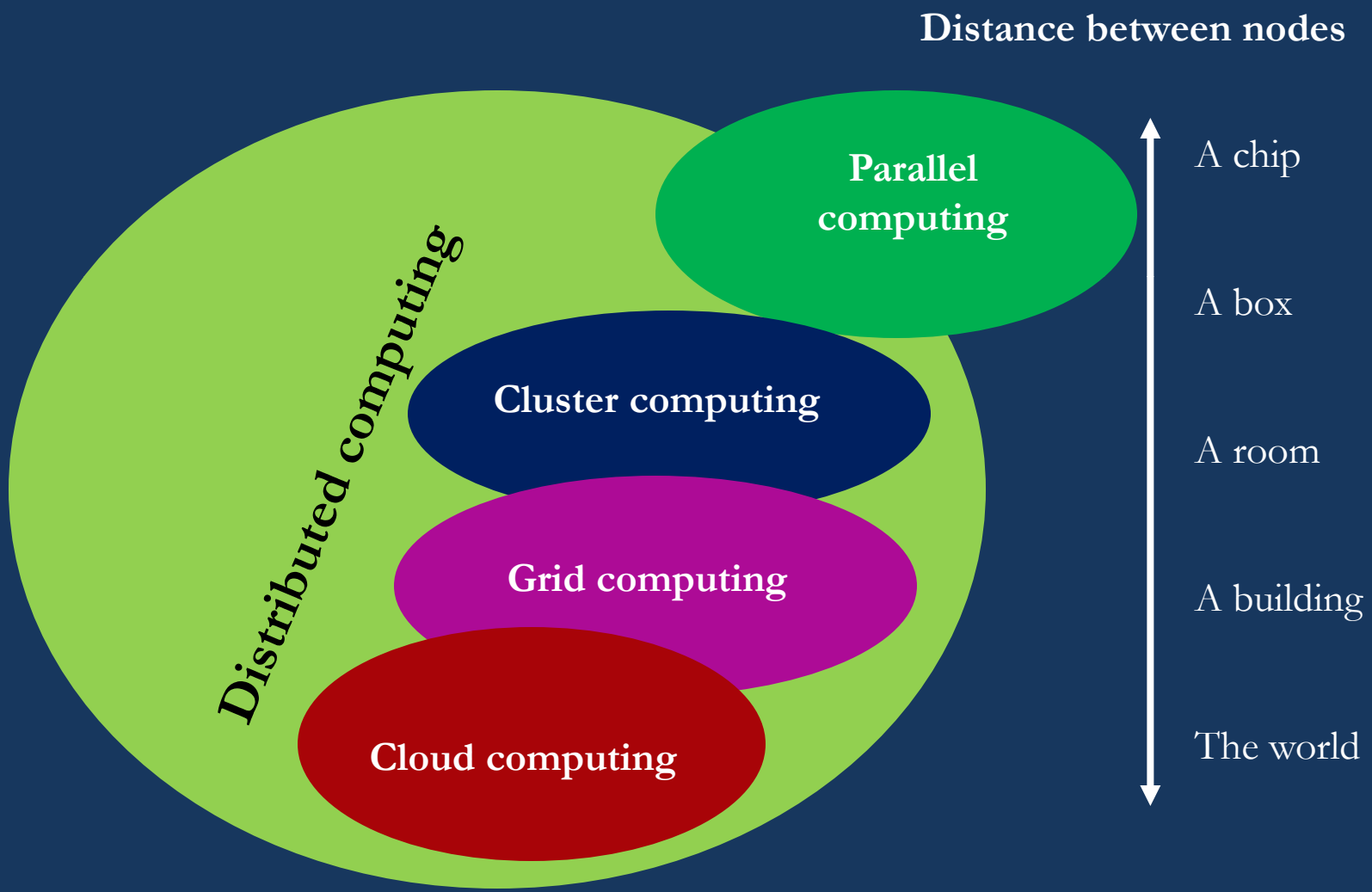
Scientific World : Uses for HPC





Place for Clusters in HPC world ?



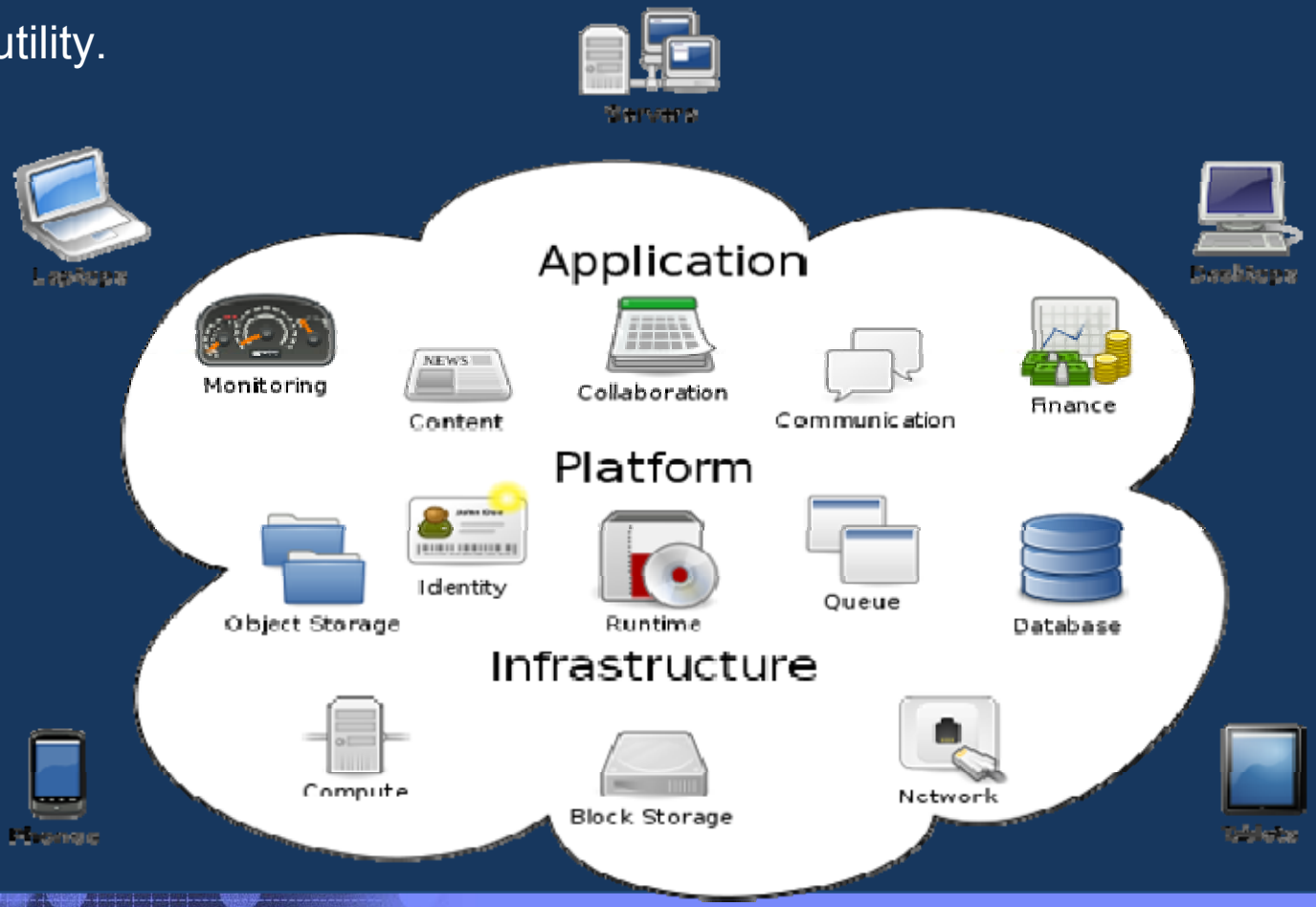
Grid Computing

- Grid computing enables the sharing, selection, and aggregation of geographically distributed heterogeneous resources for solving large-scale problems in science, engineering, and commerce

- Grid computing is the back bone of the cloud computing.

Cloud Computing

- Cloud computing is internet based computing, whereby shared resources, software and information are provided on-demand, like a public utility.

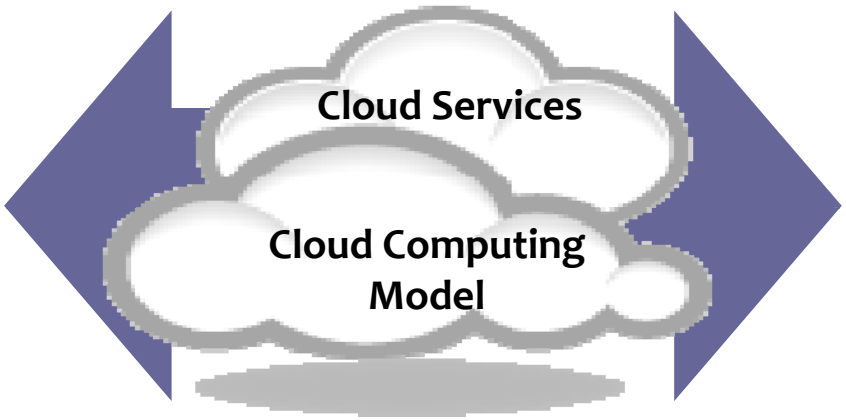


Cloud Computing Delivery Models

Flexible Delivery Models

Public …

- Service provider owned and managed.
- Access by Subscription.
- Delivers select set of standardized business process, application and/or infrastructure services on a flexible price per use basis.
- E.g. **Amazon, Google**



Private …

- Privately owned and managed.
- Access limited to client and its partner network.
- Drives efficiency, standardization and best practices while retaining greater customization and control
- e.g. **Mobilink, Banking Network**

Hybrid …

- Access to client, partner network, and third party resources

…. Standardization, capital preservation, flexibility and time to deploy

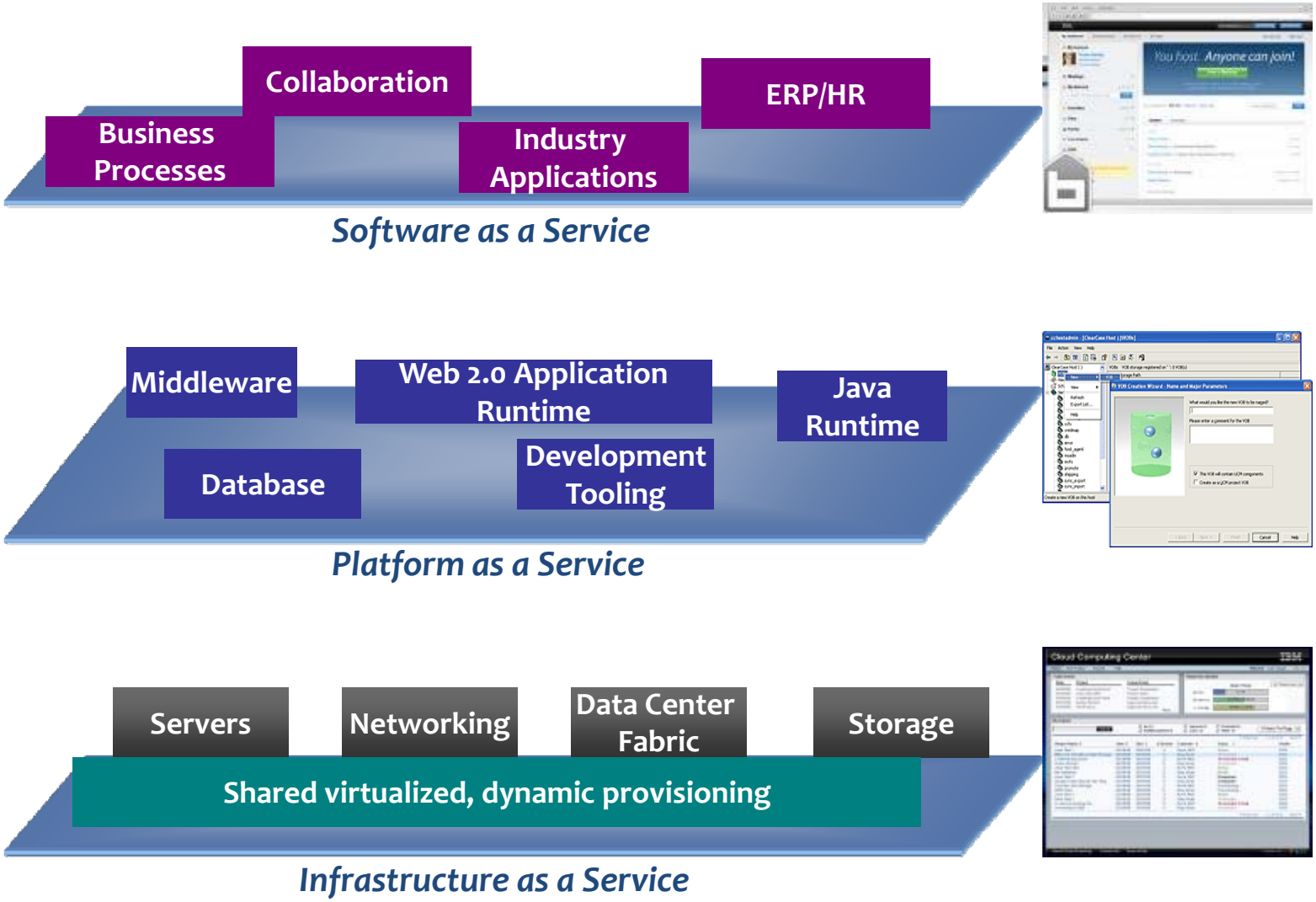
…. Customization, efficiency, availability, security and privacy

…service sourcing and service value

Why the crazy interest in cloud computing today?

- IT needs to deliver service, to meet the needs of the business
- IT has not been doing a good job for this because of QoS. Users are not satisfied
- A private cloud is a model for IT to do a better job of delivering services to end users
- IT needs to operate as a value center. When IT is a cost center, the only thing they ask you to do is cut costs!

The layers of IT-as-a-Service



What do We Want to Achieve ?

- Develop High Performance Computing (HPC) Infrastructure which is
  - Scalable (Parallel → MPP → Grid → Cloud)
  - User Friendly
  - Based on Open Source
  - Efficient in Problem Solving
  - Able to Achieve High Performance
  - Able to Handle Large Data Volumes
  - Cost Effective
- Develop HPC Applications which are
  - Portable (Desktop → Supercomputers → Grid → Cloud)

Programming Languages for HPC

Java

- mpiJava, Java-MPI, JOPI, Expresso, MPJ Express

C/C++

- MPI, OpenMP

Fortran

- MPI, OpenMP

World-wide Cloud Computing Adoption

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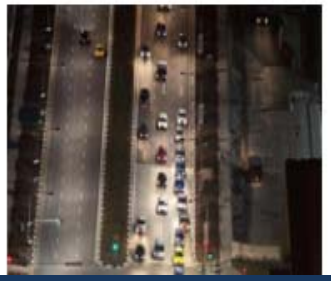
National Cloud: Creating real impact for efficient government

Delivering more with less for the Government of Hong Kong



World wide Cloud Adoption

Japan

- Cloud market was worth 4.5 billion U.S. dollars (363 billion Yen) in 2010
- Smart Cloud Strategy (May 2010)
- Increased approximately seven times; 27.9 billion US $ by end 2015

Europe

- Every European Digital”
- 370 000 new businesses, over 5 years and over 450 000 over 10 years.
- Europe: Cloud Computing in Horizon 2020
- G-Cloud: Digital Market Place

US

- Estimated total of $20 billion of the Federal Government’s $80 billion budget of ICT for cloud computing
- Decision Framework for Cloud Migration: Select, Provision & Manage

Australia

- Three work directions known as “streams”
- Stream 1: provides agencies with guidance and documentation.
- Stream 2: Encourage agencies towards cloud.
- Stream 3: Strategic approach to Cloud

Microsoft Word Document

World wide Cloud Adoption

Brazil

- Brazil Internet Bill of Rights (2012)
- Cloud computing market growth from US $ 64 million in 2010 to 491 million US $

Asia & Asia Pacific

- Asia Cloud Computing Association(ACCA) and Asia Cloud Readiness Index
- Ever-ready leaders such as Japan, New Zealand, Australia, Singapore, Hong Kong and South Korea.
- The dedicated improvers such as Taiwan, Malaysia, Thailand and the Philippines.
- The steady developing countries including China, Indonesia, India and Vietnam.

India

- Architectural Vision and the GI Cloud Environment
- Adoption Approach of GI Cloud
- Phase I: Strategy, policy and guidelines establishment
- Phase II: Implementation
- Phase III: Monitoring, management and ongoing improvement

Africa

- Almost 50% of ICT Organizations have moved to Cloud.
- Specific data centers in Tanzania and Rwanda
- Strategies being set up in Benin and Burundi
- 58 % of the ICT organizations in Namibia support cloud adoption
- Strategic plan formulated by Government for launching of data centers in Africa

ASIA Cloud Computing Market

SME Cloud Computing Market Attractiveness Index 2015

Overall Ranking

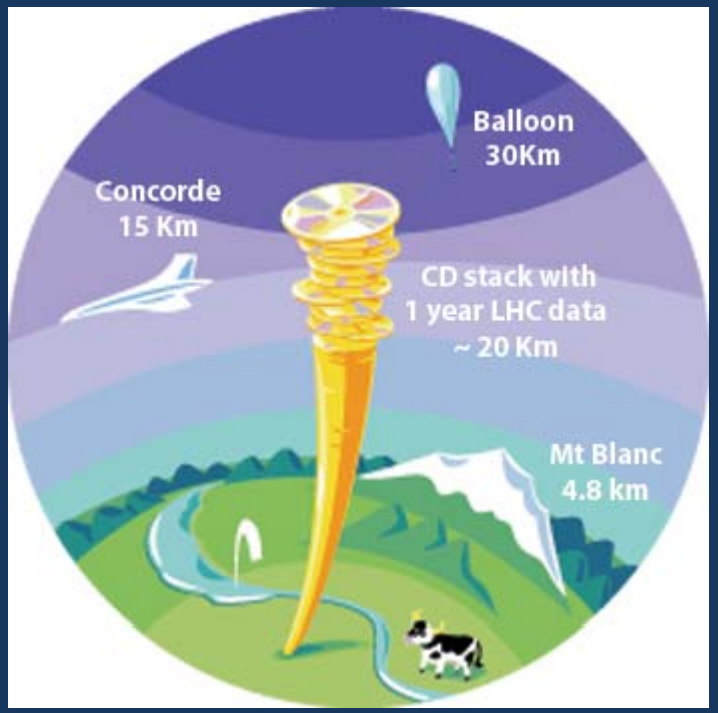
RANK	ECONOMY	Addressable Market	Early Adoption	Demand Drivers	Affordability	Support	OVERALL SCORE
1.	Japan	101.4	57.7	71.0	64.7	56.6	70.2
2.	Singapore	25.7	78.0	68.7	73.0	73.8	63.8
2.	Hong Kong	29.3	75.7	66.7	75.3	72.3	63.8
4.	South Korea	40.3	67.7	78.0	70.7	58.8	63.1
5.	China	141.9	37.3	36.3	29.3	59.0	60.8
6.	Taiwan	27.6	73.3	62.7	66.7	73.0	60.6
7.	Australia	44.3	56.7	72.0	80.3	46.0	59.9
8.	New Zealand	28.3	72.3	71.3	77.7	48.8	59.7
9.	Philippines	17.8	66.0	52.7	54.3	52.8	48.7
10.	Indonesia	76.8	39.7	39.3	31.3	52.0	47.8
11.	Malaysia	20.6	57.3	41.0	53.0	60.8	46.5
12.	Thailand	22.4	50.0	47.0	48.7	56.8	45.0
13.	India	39.3	39.3	24.3	43.7	42.0	37.7
14.	Vietnam	6.2	41.0	26.0	34.7	35.5	28.7

Source: Asia Cloud Computing Association 2015 http://www.asiacloudcomputing.org/research/smecloud2015

NCP Grid, Pakistan @ CERN

The LHC Data Challenge

- Once the accelerator is completed it will run for 10-15 years
- Experiments will produce about **15 Million Gigabytes** of data each year (about 20 million CDs!)
- LHC data analysis requires a computing power equivalent to **~100,000 of today's fastest PC processors**
- Requires many cooperating computer centres, as CERN can only provide ~20% of the capacity



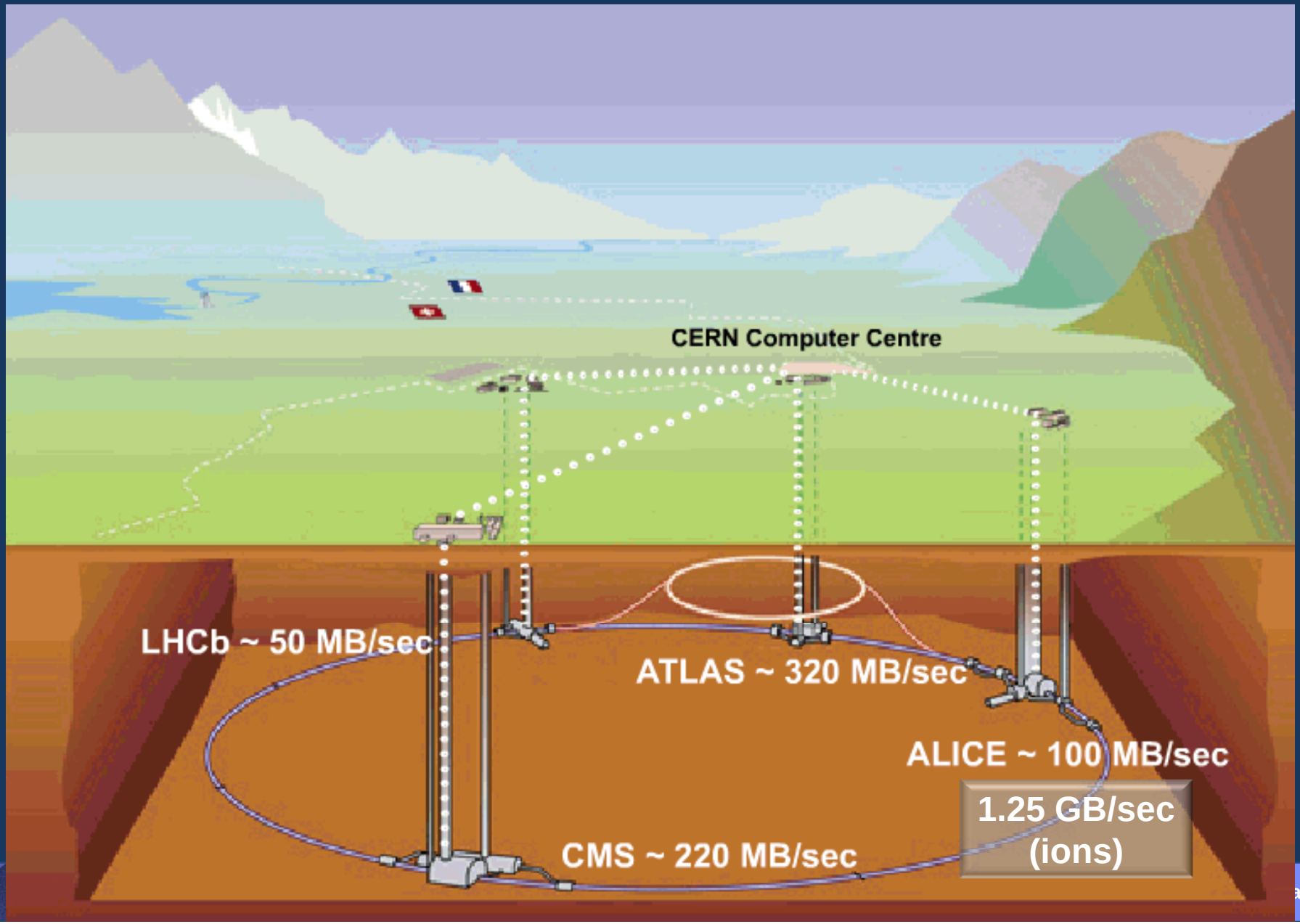
Solution: the Grid

- Use the Grid to unite computing resources of particle physics institutions around the world

The **World Wide Web** provides seamless access to information that is stored in many millions of different geographical locations

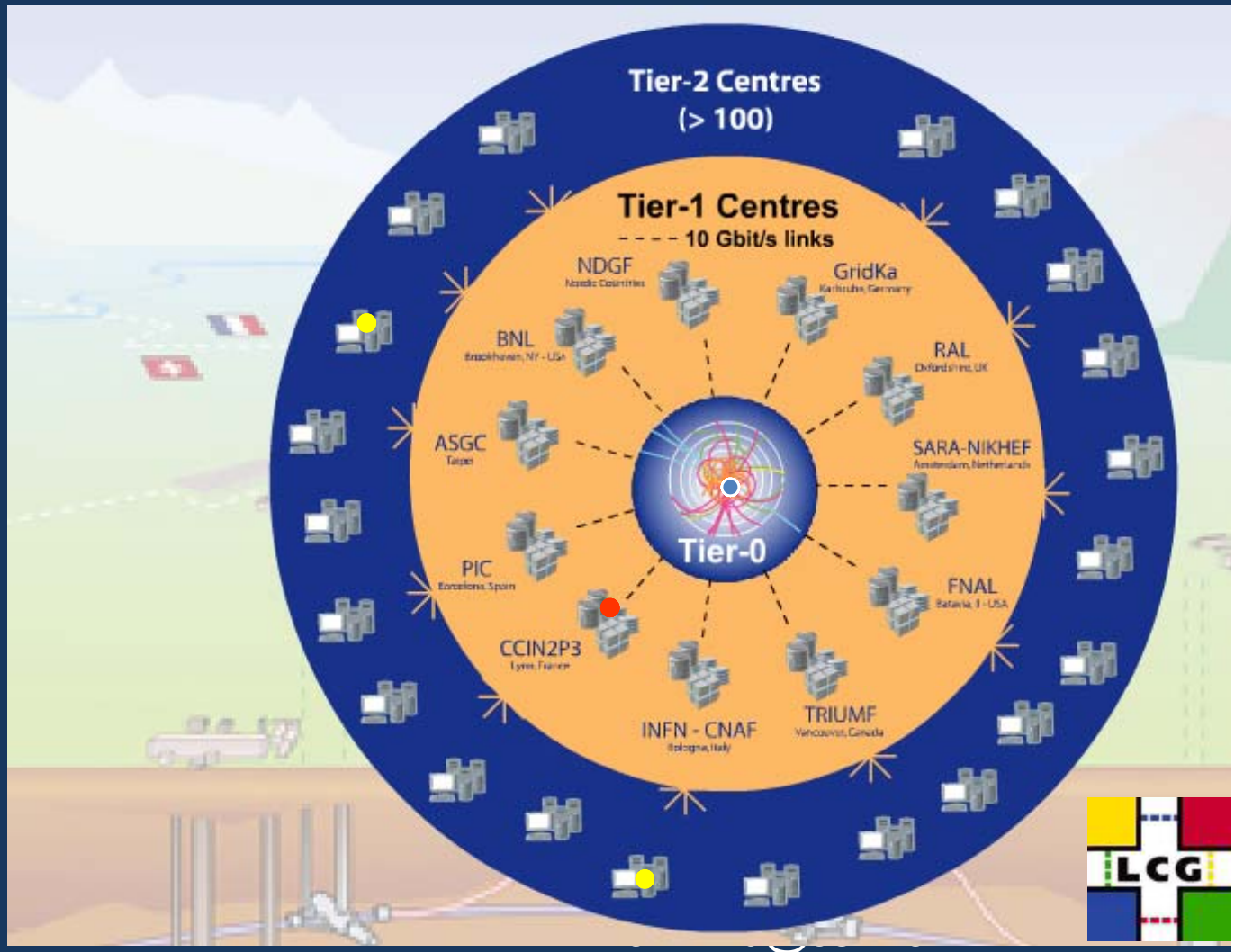
The **Grid** is an infrastructure that provides seamless access to computing power and data storage capacity distributed over the globe

Tier 0 at CERN: Acquisition, First pass reconstruction, Storage & Distribution



LHC Computing Grid project (LCG)

- More than 140 computing centres
- 12 large centres for primary data management: CERN (Tier-0) and eleven Tier-1s
- 38 federations of smaller Tier-2 centres
  - 7 Tier 2 in Spain: supporting ATLAS, CMS, LHCb
- 35 countries involved



Cloud Adoption in Pakistan

Background Characteristics	Virtualization	Cloud Computing
Types	• Full • Partial	• Public • Private • Community • Hybrid • Public versus Private
Key Aspects	• Act of Abstraction • Hypervisor	Convenient, on-demand network access

Benefits	• Scalability
	• Availability
	• Reduced Cost
	• Security Benefits:
	  o External Monitoring
	  o Transience
	  o Isolation
	  o State Restore
		• Resource Pooling
		• Rapid Elasticity
		• Broad Network Access
		• Availability
		• On Demand Self Service
		• Services:
		  o SaaS
		  o PaaS
		  o IaaS

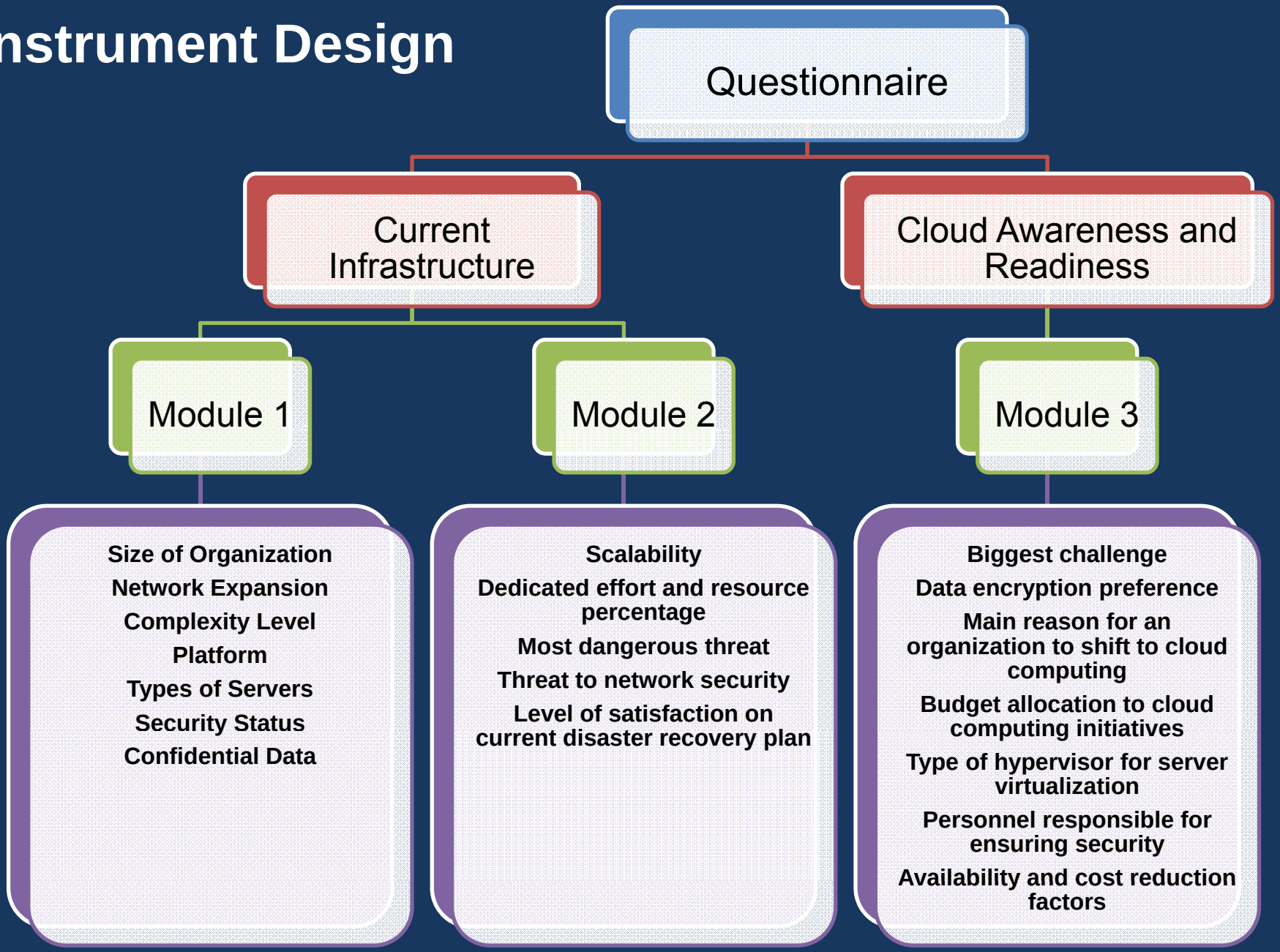
Issues	• Information Leakage • Migration Attack	• Data Theft • Privacy Issues • Infected Applications • Data Ownership • Identity and Access Management

Common Challenges Faced	Mitigation Strategies
Lack of Awareness	Launch of Training Programs
Legacy Systems	Establishment of Data Centers
Loss of Control	Careful Cloud Computing Outsourcing
Governance Issues	Effective Regulatory Process Cross-border Standardization and Regulation
Data Privacy and Confidentiality	Firewalls Secure Email Groups Private Clouds

Mapping of Questionnaire to Background Study

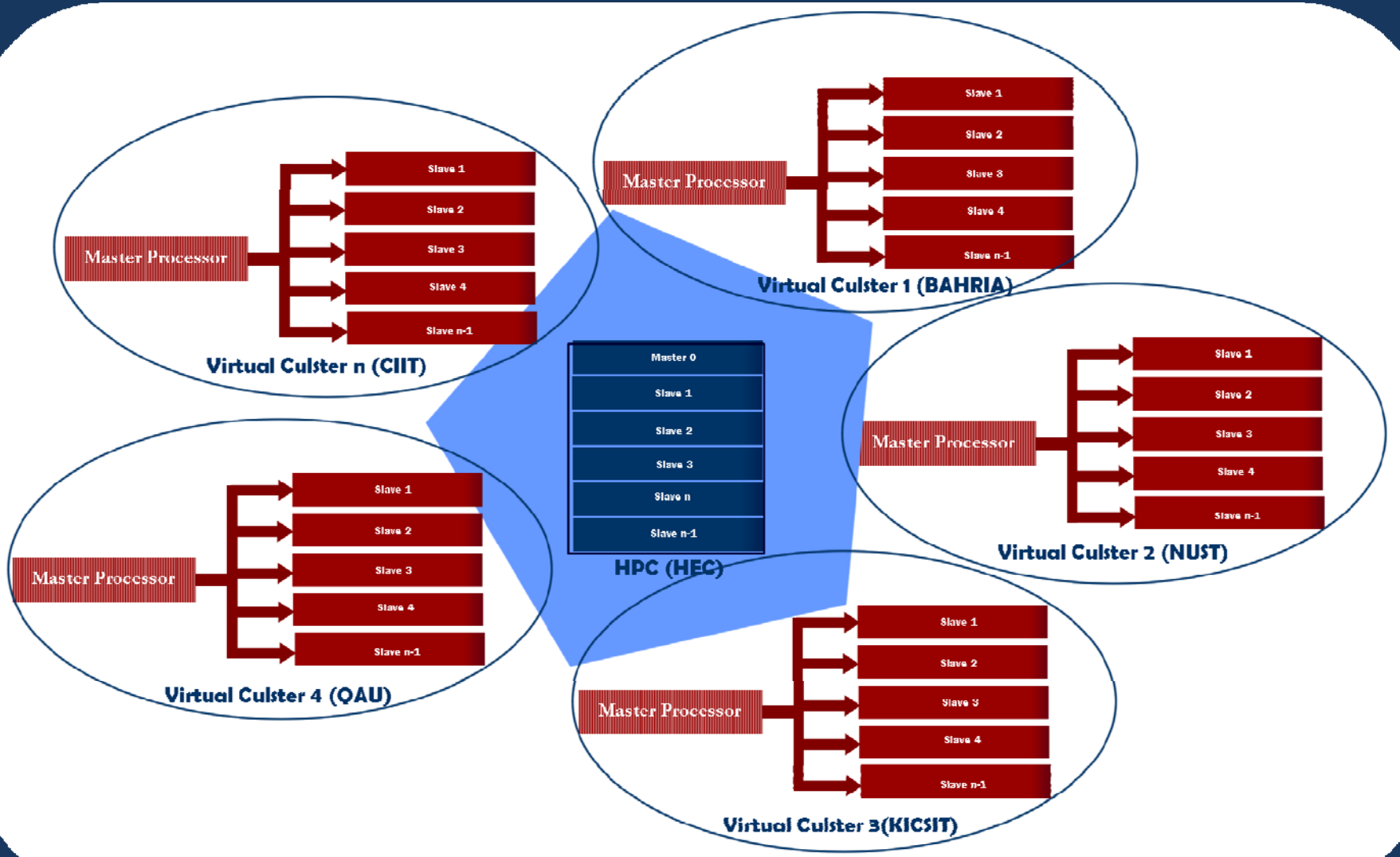
Characteristics of Cloud (Literature Review)	Questions
Improved Scalability	Q1 (Size of Organization) & Q10 (Need for Scalability)
Shared Resources & Centralized management	Q2 (Delay in Network Expansion due to Non-Provisioning of Resources) Q11 (Dedicated Effort and Resource Percentage)
Simplicity	Q3 (Complexity Level) & Q4 (Complex Service Management)
Platform	Q5 (Platform for Servers) & Q6 (Platform for Clients)
Server Virtualization	Q7 (Types of Servers)
Improved Security	Q8 (Security Status) Q12 (Most Dangerous Threat) Q13 (Threat to Network Security) Q15 (Sharing of Classified Information via Secure Mail Group) Q17 (Data Encryption) Q20 (Personnel Responsible for Ensuring Security)
Lesser data confidentiality in public cloud	Q9 (Confidential Data)
Redundancy	Q14 (Level of Satisfaction on Current Disaster Recovery Plan)
Challenges faced by different countries of the world	Q16 (Biggest Challenge)
Reduced Cost	Q18 (Main Reason for an Organization to Shift to Cloud Computing) Q19 (Budget Allocation for Cloud Computing Initiatives)
Virtualization	Q21 (Type of Hypervisor for Server Virtualization)
Availability	Q22 (Effect of cloud on Service Availability)

Instrument Design



National Educational Cloud for Pakistani Scientific Society

National Educational Cloud



Objectives of National Cloud

- Promote the culture of collaboration among universities and R&D organization
- Promote the spirit of academic research in the field of computational sciences including computer science, computational biology, computational physics, computational chemistry and mathematics
- Provide an experimental and discussion forum for collaborative research among computational science students and industry people
- Promote the publication and presentation of scholarly works by students and young faculty members at conferences
- Assist each other academically in our individual and collective research
- Train our young scientific community with state of the art computational tools that they can apply in their research activities.

National Cloud Computing Framework

Pakistan Government Involvement

- Pakistan: Vision 2025: E-Governance
- Develop Legislative Frameworks
- Develop Public Private Model
- Overcome Geographical Barriers

Framework Formulation:

1. Step 1: To Increase Awareness Among ICT Personnel
2. Step 2: Selection of Cloud and Identification of Data to be Migrated
3. Step 3: Virtualization
4. Step 4: Provision of Cloud Services
5. Step 5: Ensuring Cloud Security

Recommended Framework

Step 1: To Increase Awareness

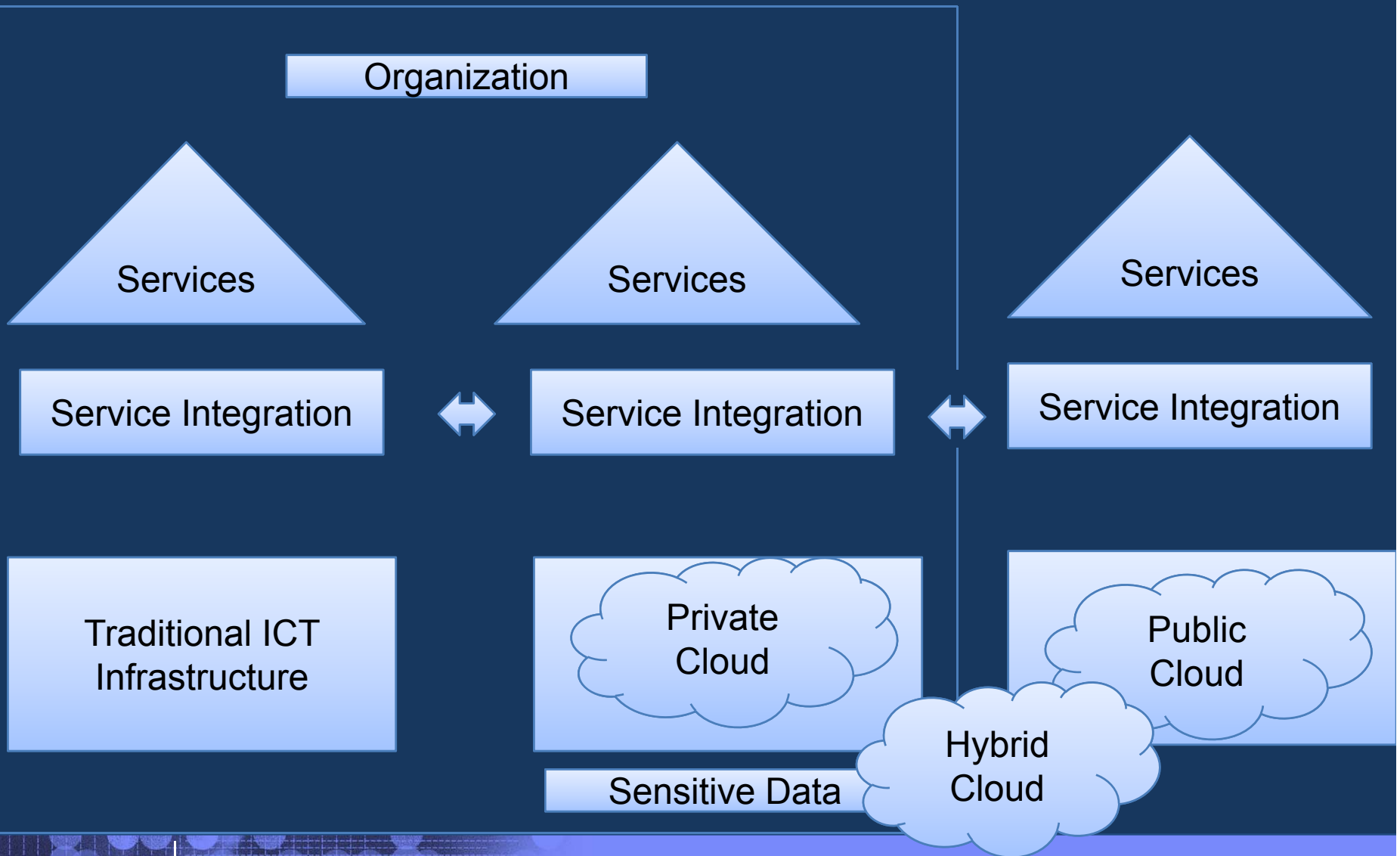
Proposed training modules for standardization and regulatory Process:

- Module 1: Cloud Computing Concepts, Definitions and Standards
- Module 2: Cloud Computing − Legal and Operational Challenges
- Module 3: The Contract Establishment

Proposed training modules for technical stakeholders:

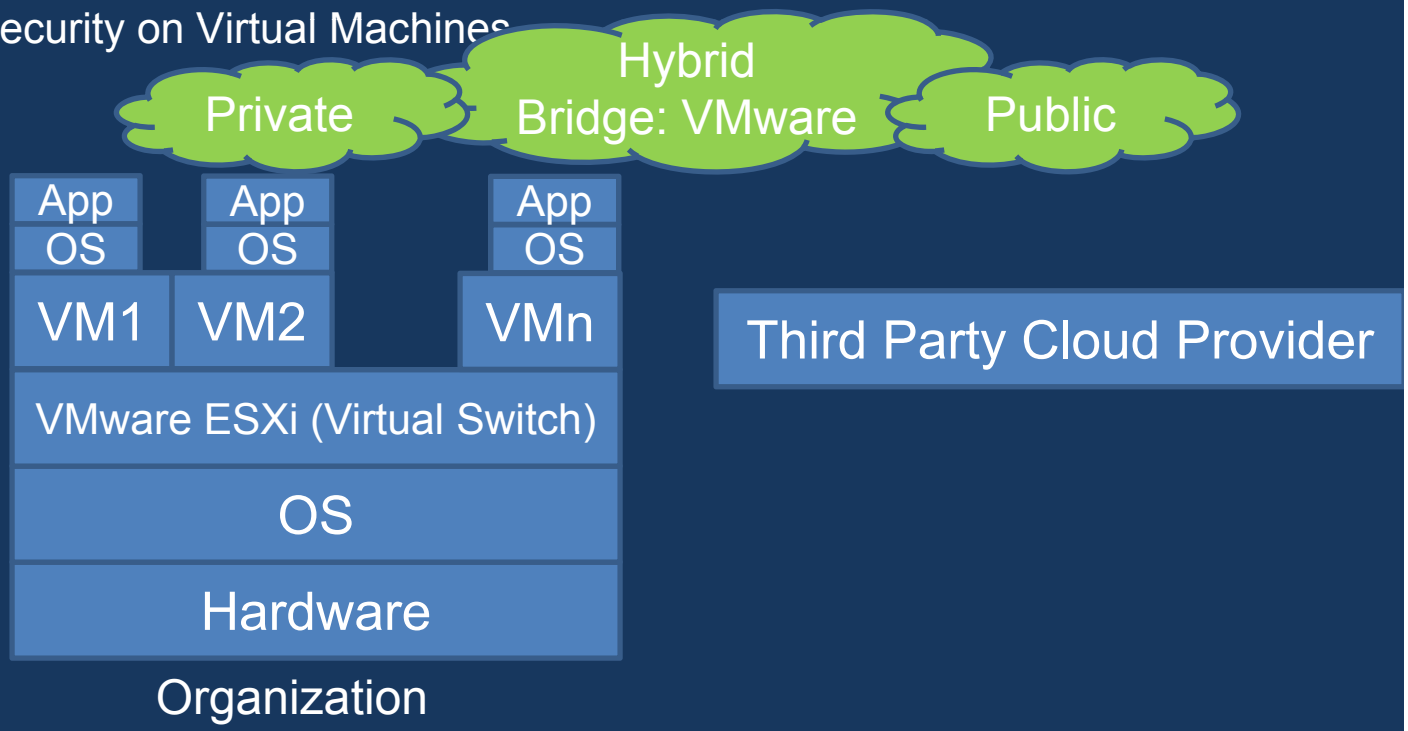
- Module 1: An introduction to Cloud Computing
- Module 2: Data centers & Networks for the Cloud
- Module 3: Hypervisor: Installing, Configuration and Management
- Module 4: Creation of Virtual Networks, Storage Devices
- Module 5: Management of Resource Allocation and Utilization

Step 2: Selection of Cloud & Identification of Data to be Migrated

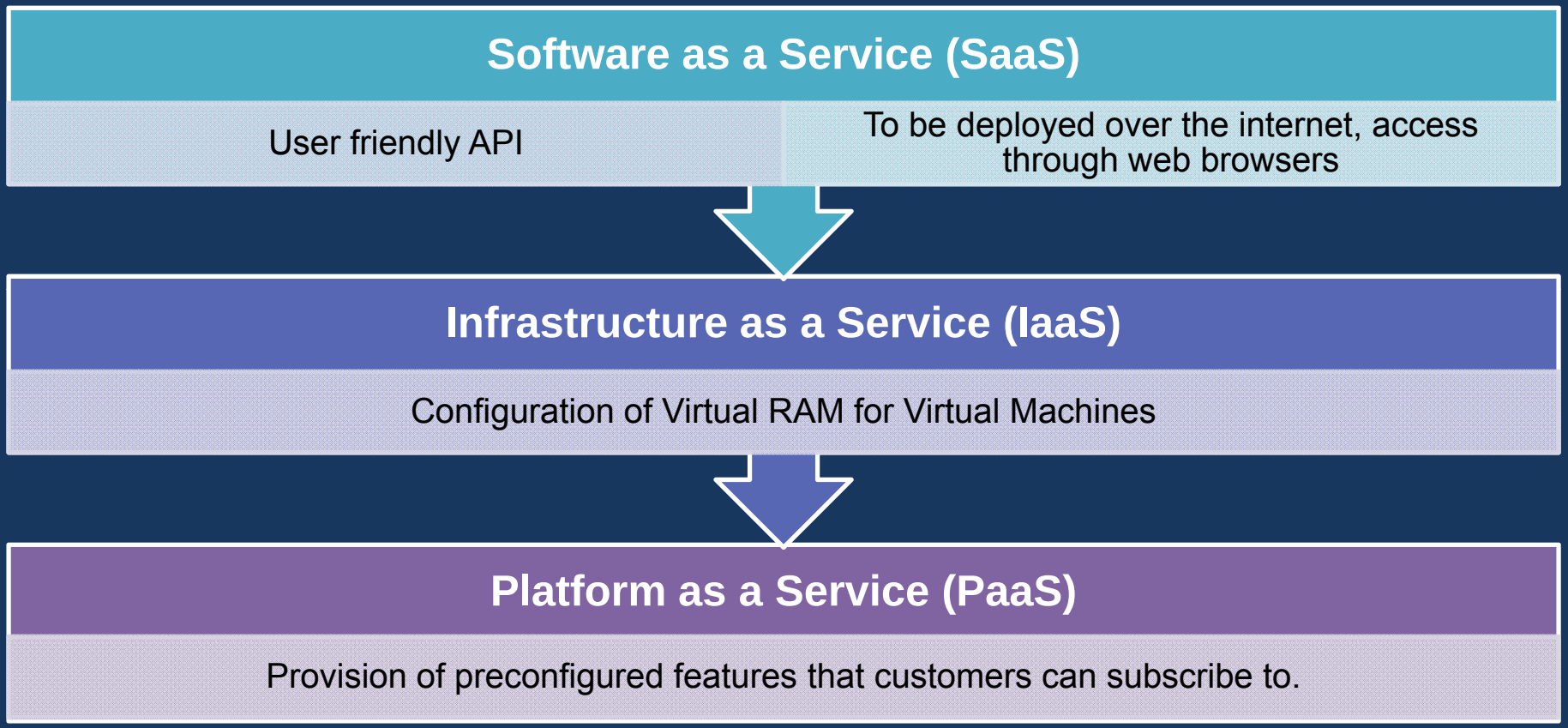


Step 3: Virtualization

- VMware (Preferred Hypervisor)
- Installation of VMware ESXi
- Creation and Management of Virtual Machines
- Data Center Virtualization using vCenter Server
- Configuration of Virtual Networks using Virtual Switches with Security
- Configuring Virtual Storage Devices
- Implementing Security on Virtual Machines



Step 4: Provision of Cloud Services



Step 5: Ensuring Cloud Security

Encourage Smart Passwords

Data Backup

Data Encryption

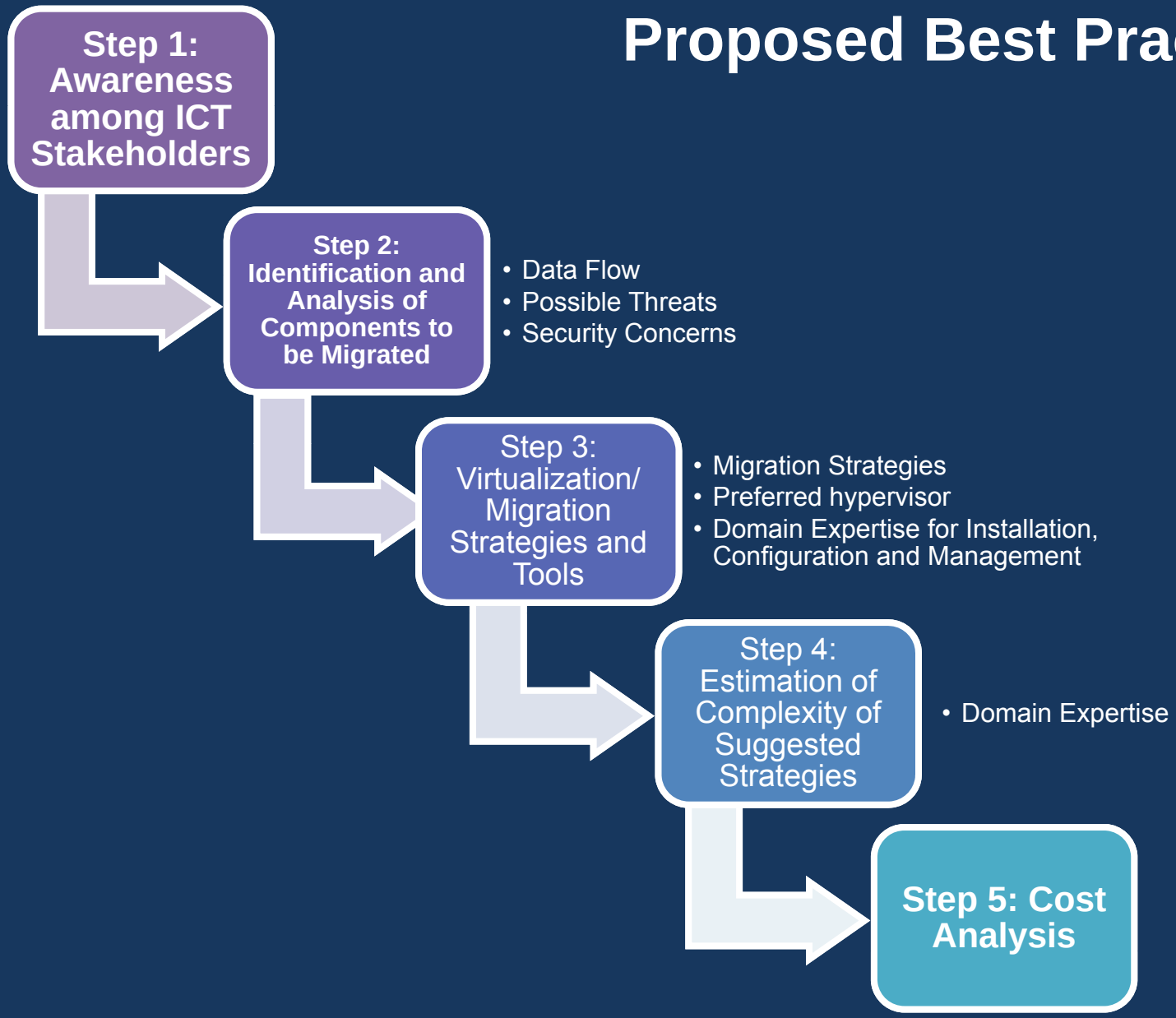
- Encryption Software
- Encryption techniques

Firewall Setup

- Application Control
- IDS/IPS
- Reporting and Visibility
- Network Anti Virus and Anti Spyware

Potential Benefits of Recommended Framework

Proposed Best Practices



Pakistan Society of Computational Science / Biology

www.pscb.org.pk

- First National Workshop/Conference on Computational Tools at National Centre for Physics, Islamabad from 8-12 April 2013
- 2nd Annual Computational Science Conference 2013 at International Islamic University, Islamabad from 20-25 October 2013
- 3rd Annual Computational Science Conference 2015 at Institute of Space Technologies, Islamabad from 13-15 May 2015
- **4th Annual Computational Science Conference 2016 will be organized at National Centre for Physics, Islamabad in Dec 2016**


First National Workshop/Conference
on Computational Tools
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3rd National Computational
Science Conference
Organized by:
Pakistan Society for Computational Biology
Institute of Space Technology, Islamabad
Government College University, Faislabad

Way Forward

- Information and knowledge are growing exponentially
- People need high computing power
- Public –Private Model for National Cloud Development
- eHealth Care, eEducational Clouds
- E-Governance
- Intelligent threat detection system in cloud computing

National Cloud is the demand of Today !

Questions / Comments !!!