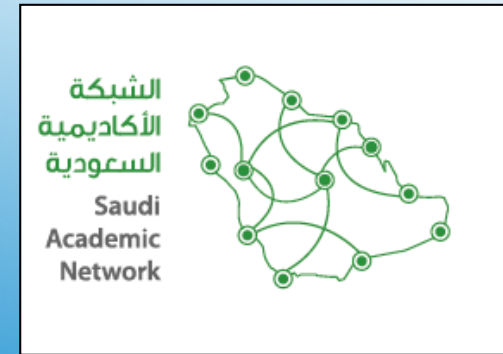


# Internet Services Unit

King Abdulaziz City for Science & Technology

**MENOG 6, RIYADH**

**10-14 APRIL 2010**



## Developing a National Research and Educational Network in Saudi Arabia



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**DIRECTOR OF INTERNET SERVICES UNIT**  
**KINGABDULAZIZ CITY FOR SCIENCE AND TECHNOLOG**



1

**What is a NREN?**

**Definition**

**NREN Components**

**NREN Evolution**

2

**Establishing a NREN**

**Drivers and Technical Benefits**

**Economical Benefits**

**Applications**

**Services**

**Constituents**

3

**Developing a Saudi NREN**

**Requirements**

**SA NREN Project Plan**

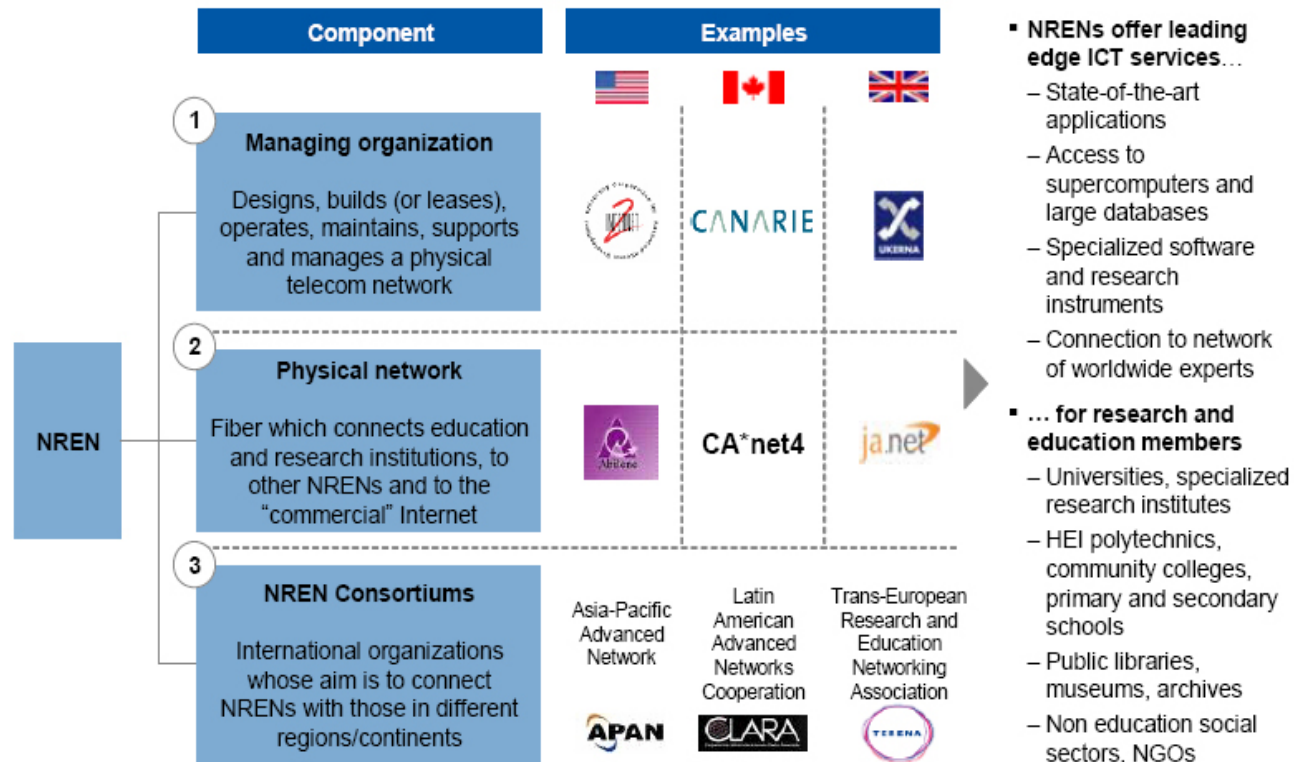
**Challenges/Success Factors**



DEFINITION

A **NREN** is a National Research and Educational Network designed to fulfill data communications networks, applications and e-services needs the research and education community. Commercial providers can only achieve by means of high levels of investments that are not commercially justified.

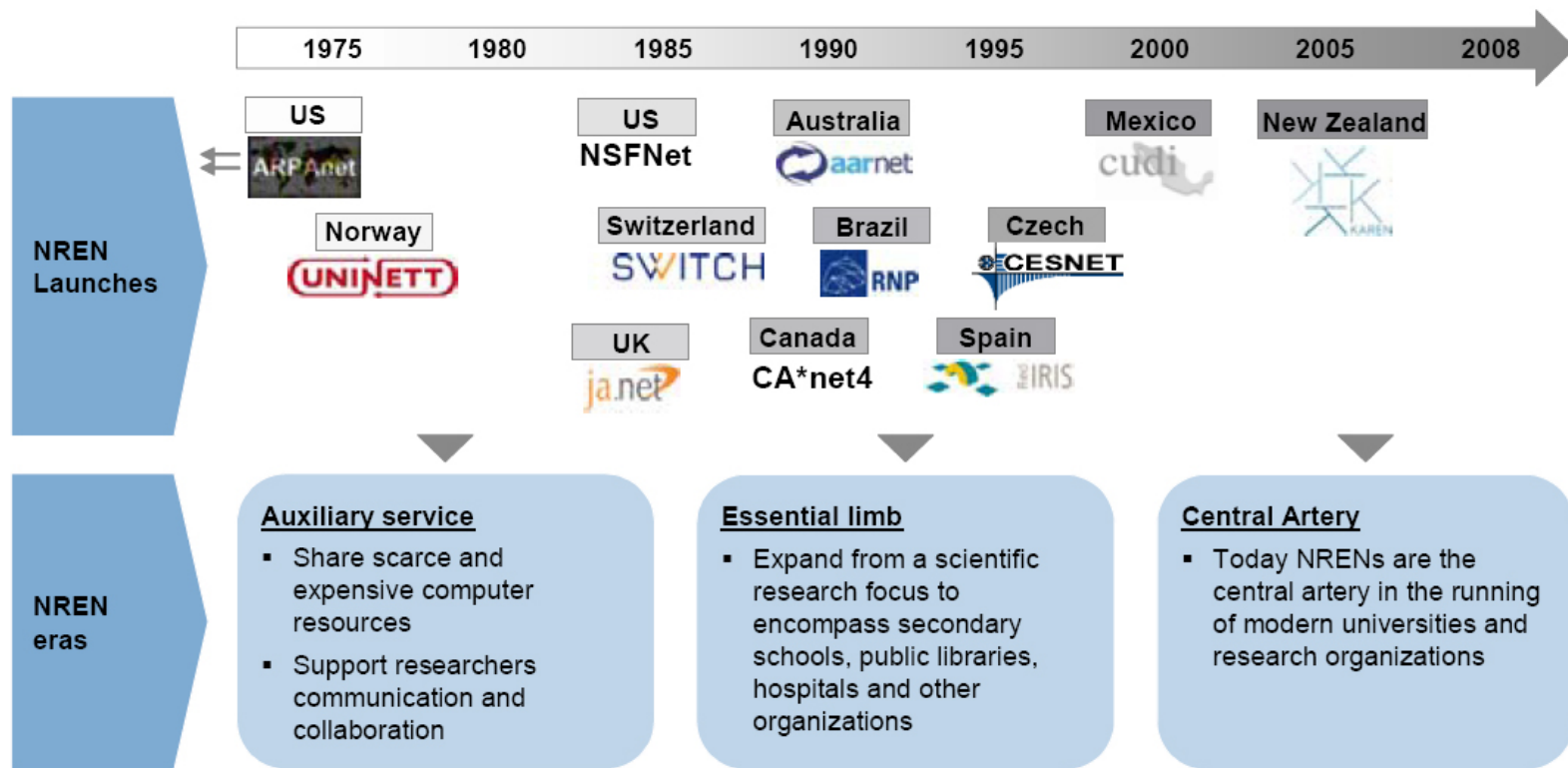
NREN COMPONENTS



Source: Oliver Wyman analysis



NREN EVOLUTION



► **Countries worldwide are now forming mega REN alliances of continental proportions with a vision of creating a world community of universities**

Source: Khan, Dr. Javed I., Worldwide Emergence of Research and Education Networks and a Proposal for Bangladesh, 21/02/2006; Twinomugisha, Alex, Understanding NRENs and key considerations for setting them up, Nov 2006



# Establishing a NREN

## - Drivers and Functional Benefits

1. Promotion of the cooperation and collaboration between the academic and research communities' constituents.
2. Better positioning of the country's academic and research communities in the international scene by connecting the NREN to other worldwide NRENs; and hence better exposure and easier access to the international accumulated research and knowledge base.
3. Provision of High Bandwidth (Gbps) connectivity required for particular types of research, such as large scale simulation, image data transfer, large scale and grid computing and others.
4. Joint approach opportunity to deal with the ICT challenges and opportunities brought by the common forum the NREN provides to its constituent members.
5. Cost sharing of research equipments, services, and applications as well as expenditure optimization such as shared access to supercomputing facilities, radio-telescopes and others.
6. Opportunity of economies of scale as one single network entity procures connectivity services and applications from service providers. This also offloads the administrative and operational burden from individual members to the NREN organization.



## ***1. Human capacity development***

- NREN can develop an appropriate human capacity to respond to the growing demand in the market of skilled individuals as many recruiting companies complain of the lack of “local” expertise.

## ***3. Research in appropriate technologies***

- Since the NRENs missions revolve around research, NRENs have a big role to play in helping to create relevant, innovative applications and content that is appropriate to local needs.

## ***5. Demand for local solutions***

- The NREN constituent members constitutes a big consumers of ICT goods and services from the private sector.



## ***4. Lobbying for better bargains***

- NRENs have a stronger negotiating position and can better lobby on behalf of the all academic institutions.

## ***5. Contributing in articulating the ICT policies***

- As ICT policy has a big influence on overall economy and sustainable development, NREN can effectively engage with governments, regulators and other stakeholders on issues related to the ICT in order to guide development of those policies and regulations to make more relevant to industry.

## ***8. Sharing the cost of expensive facilities.***

- NRENs provide an opportunity for the cost sharing of research equipments, services, and applications as well as expenditure optimization such as shared access to supercomputing facilities, radio-telescopes and others.



## ***7. Source of knowledge***

- NRENs provide the access to digital libraries and archived content that provide the necessary knowledge base to excel.
- NRENs create constant awareness of how businesses can leverage technology to become more efficient and productive.





## 1. Dedicated high-speed, reliable and highly available networks

- this is the most fundamental and important service provided by NRENs to its members that can facilitate the connectivity to some expensive equipment such as the supercomputers and radio-telescopes.

## 2. E-learning services

- By leveraging the NRENs platforms and services to stimulate new techniques for teaching and learning (such as videoconferencing for distance learning).

## 3. Integration of an access to digital libraries and archived content.

## 4. Technology transfer

- NRENs can enable the transfer of innovations between the research community and the industry to benefit the entire society

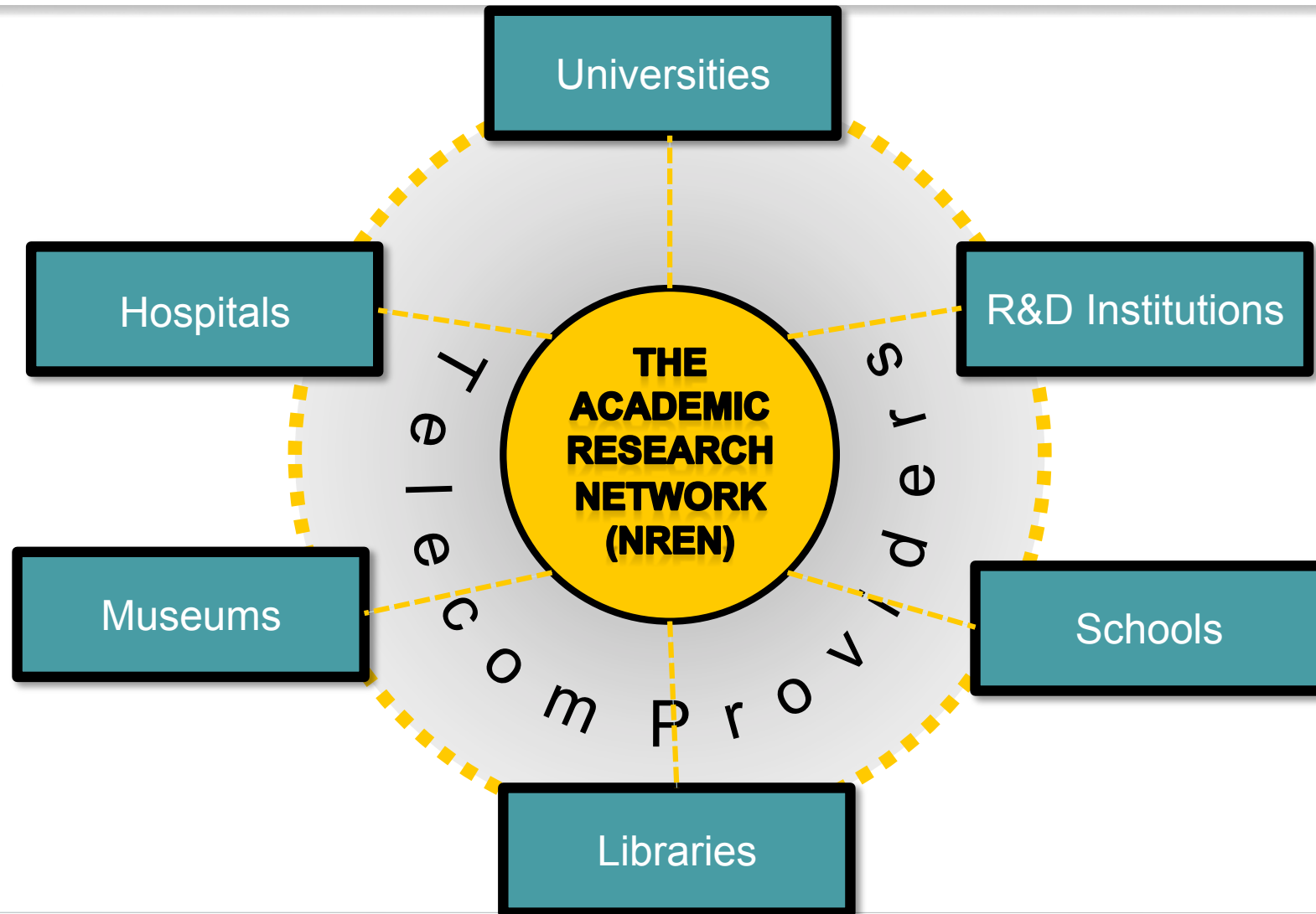
## 5. Consultancy services

- NRENs can offer centralized expertise and consulting services, such as advanced security services for intrusion detection and prevention that individual institutions would not be able to solely afford for financial and expertise reasons.



## 6) Network services and applications:

- Web hosting services
- Domain Name services
- Email services
- Network security services
- Bandwidth on Demand
- Bandwidth management (e.g. web caching and traffic shaping) services
- Network Operating Center (NOC)
- Storage services
- Collocation services
- IP telephony services (VoIP)
- Authentication, Authorization and Accounting (AAA) services
- Video services: Video Conferencing, Video on Demand

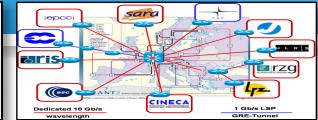
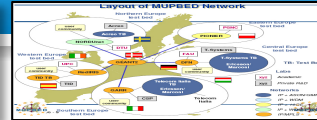
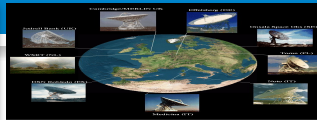




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# Establishing a NREN - Applications



### 1. Physics

The Large Hadron Collider (LHC) of CERN (the European Organization for Nuclear Research) - a collaboration between 10,000 scientists and engineers from 100 countries - will undertake colliding particles experiments that will produce 15 million Gigabytes of data annually. GEANT2, the pan-European communications network serving Europe's research and education community, will enable the distribution of this data to processing centers around the world for quick efficient analysis by thousands of scientists.

### 2. Astronomy

The European VLBI Network (EVN) is a collaboration of the major radio astronomical institutes in Europe, Asia and South Africa and performs high angular resolution observations of cosmic radio sources. GEANT is supporting the work of the EVN through the provision of network resources to allow rapid data transfer. GEANT and the national research and education networks in participating countries enable significantly faster processing and correlating of radio telescope data. Data can now be transferred almost instantaneously via the national research networks and GEANT. Therefore, it can be immediately correlated and processed, producing images in near-real time.

### 3. Life and Medical Sciences

The Biomedical Informatics Research Network (BIRN) in the USA promotes advances in biomedical and health care research through the development and support of a cyber infrastructure that facilitates data sharing and multi-institutional collaboration. Sponsored by the National Institute of Health, BIRN is creating an environment that encourages biomedical scientists and clinical researchers to make new discoveries by facilitating sharing, analysis, visualization, and data comparisons across laboratories. The growing BIRN consortium currently involves more than **forty** research groups from more than **twenty five universities** and **hospitals** interconnected by **Internet2's** Abilene Network. This network provides the backbone for all distributed data and computational resources within the BIRN.

### 4. Information and Communications Technology

One of the most notable network testbed projects using GEANT2 today is MUPBED (Multi-Partner European Testbeds for Research Networking). Network testbeds, such as those created by the MUPBED project, allow researchers to test new technologies and techniques on a pan-continental scale. MUPBED is a consortium of telecommunications equipment manufacturers, commercial and research network operators, and networking research centers from **eight European countries**. MUPBED intends to use large-scale testbeds to test new network technologies such as ASON (Architecture for Automatically Switched Optical Networks) and GMPLS (Generalized MPLS)

### 5. High Speed Super Computing

DEISA, the Distributed European Infrastructure for Supercomputing Applications, is a consortium of leading national Supercomputing centers that aims at fostering the pan-European world-leading computational science research. DEISA provides leading scientific researchers with access to a European cluster of state-of-the-art High Performance Computing (HPC) resources. GEANT2 deploys a "private network" of point-to-point links that enables researchers to gain faster and more efficient access to DEISA's shared file system, and thus supporting ground-breaking applications in computational sciences.

### 6. Environmental Sciences

EUMEDCONNECT, a regional high-capacity IP-based data-communications network connecting **seven countries** across the Southern Mediterranean, along with GEANT2, support the **Climate Change and Impact Research (CIRCE)** Project by providing advanced e-infrastructure tools which enable scientists in the southern Mediterranean countries to engage in world-class climate research and, ultimately, to respond to global challenges, whilst addressing local concerns. **Water shortages, poor harvests and relentless desertification** expose the acute vulnerability of the Mediterranean to climatic extremes.

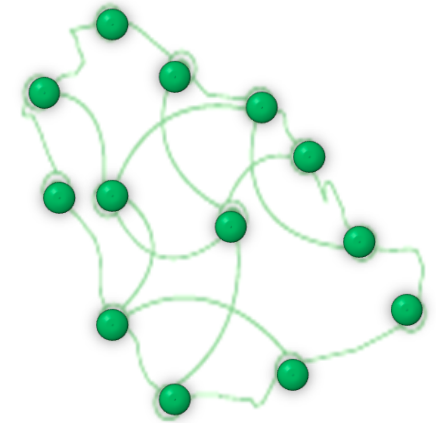
**SAUDI NREN**  
**SAUDI ACADEMIC RESEARCH AND INNOVATION  
NETWORK**

الشبكة  
الأكاديمية  
السعودية  
Saudi  
Academic  
Network



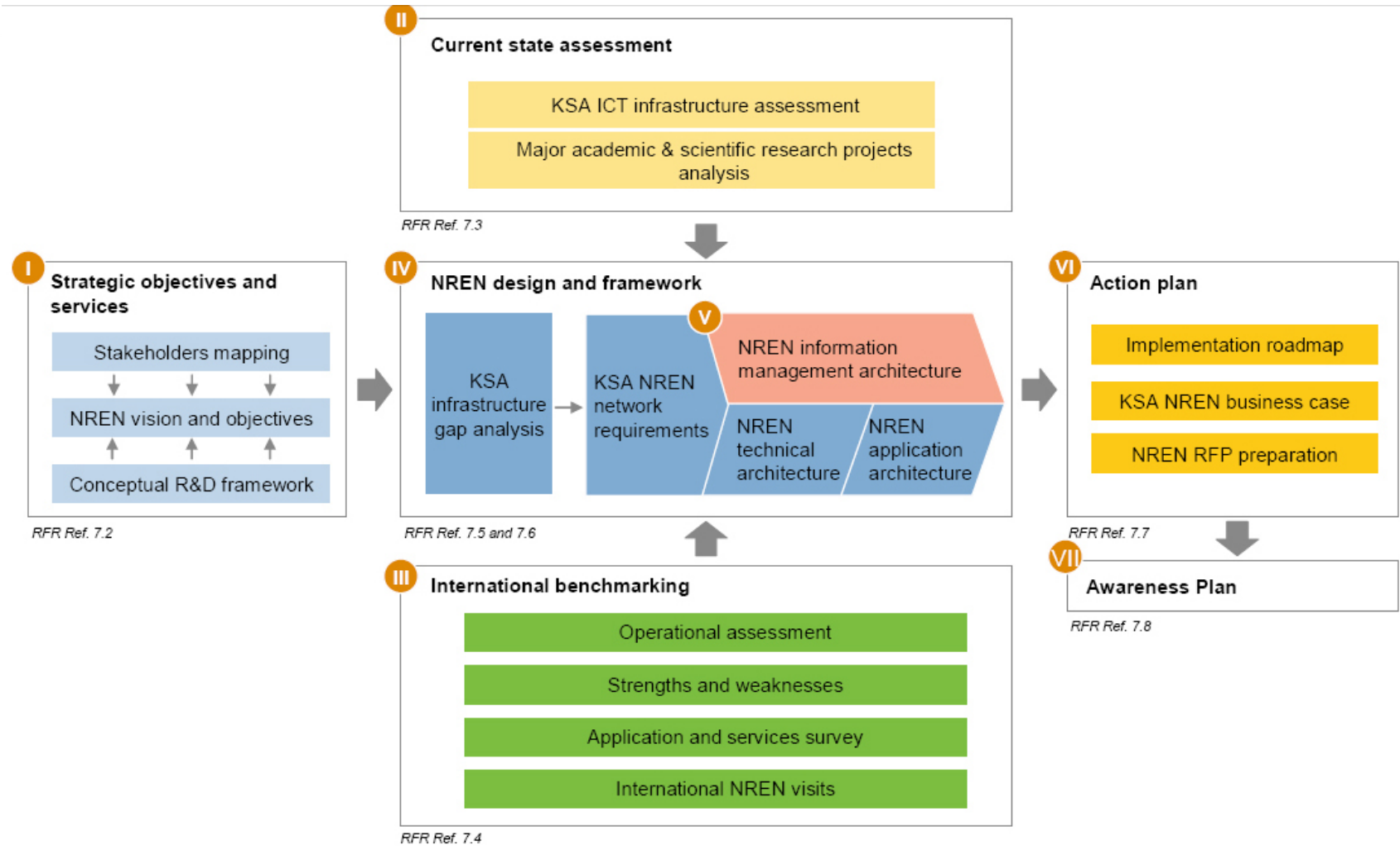


- 1. Defining Strategic Objectives and services**
- 2. Current state assessment**
- 3. International Benchmarking**
- 4. Application Architecture**
- 5. Technical Foundation Architecture**
- 6. Action plan & RFPs**
- 7. Awareness Plan**





THE PROJECT BLOCK DIAGRAM





- 1. Defining Strategic Objectives and services**
2. Current state assessment
3. International Benchmarking
4. Application Architecture
5. Technical Foundation Architecture
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# 1. Strategic Objectives



## Vision

To be an enabler for excellence in Research and Education, strengthening the quality of research, innovation, education and strategic collaboration in the Kingdom



## Mission

- Accelerate the development of the knowledge and information society
- Strengthen Saudi Arabia's position as a recognized regional leader for research and development
- Provide efficient communication and dissemination of information within the education and research communities



## Objectives

- Deliver networking excellence capitalizing on the latest technological development in networking, such as NGN, and hybrid technologies
- Establish a high bandwidth high availability secure network
- Provide cost-effective & best in class services 'through economies of scale'
- Connectivity to International RENs, such as Internet 2, Geant 2 and participating to world-wide NRENs associations, initiatives and forums
- Attract Saudi young scientists and researchers from different countries and disciplines



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## 2. Current State Assessment

### Methodology

Phase 1  
**Identify &  
Classify  
NREN  
Potential  
Member**

Phase 2  
**Site  
Survey  
Process**

Phase 3  
**Questionn  
aire  
Process**

Phase 4  
**Analysis &  
Findings**



**CSA**

### Main Findings:

- ❑ The Reliability is an issues as the majority of surveyed institutes connect to ISPs by single links.
- ❑ The majority of institutions have significantly increased their BW in the last few years.
- ❑ A huge demand on BW is expected due to the increase numbers of users and applications.
- ❑ The majority of surveyed institutions have adequate infrastructure and technical staff.



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## Developing a Saudi NREN

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### 3. International Benchmark



JANET - UK



AARNet – Australia



SINET – JAPAN



CANARIE - CANADA



ANKABUT - UAE



# 3. International Benchmark



JANET: Joint Academic Network (1983)

Budget: £29 M in 2008  
Fund:  
90% Government  
10% users

Number of users:  
18 Millions end users.  
Univ, RC, Schools, HEI.

Backbone BW:  
10 Gbps → 40 Gbps

Legal:  
JANET belong to Joint Information System Committee (JISC) for the UK  
Further higher Edu Funding Councils.



AARnet: Australia's Academic Research Network (1989)

Budget: \$ 35 M in 2006  
Fund:  
Gov: 25%  
Users/Clients: 73%  
35 directly employed staff

Number of users:  
38 Universities.

Backbone BW:  
5-10 Gbps → 40 Gbps

AARnet formed by Australian Vice-Chancellor's Committee (AVCC) of Universities.  
Legal: Operated and owned by AARnet Ltd Company non-profit telecom carrier



SINET: Science Information Network (1992)

Budget: ??  
Fund: Gov. 100%  
The government Fund SINET through NII  
142 directly employed staff

Number of users:  
63 members.  
Univ, RC, Libraries, museums, national archives, HEI.

Backbone BW: 1-20 Gbps

Ministry of Education Culture, Sports, Science and Technology  
•Research Organization of Information and Systems (ROIS)  
•National Institute of Polar Research  
•National Institute of Informatics (NII)  
•Cyber Science Infrastructure → SINET  
•Institute of Statistical Mathematics  
•National Institute of Genetics



CANARIE: Canadian Advanced Network & Research for Industry & Education (1993)

Budget: \$20 M in 2008  
Fund:  
Gov. 99%  
Users 1% connection fee  
142 directly employed staff

Number of users:  
48 members.  
Univ, colleges, schools, Gov labs, RC, hospitals.

Backbone BW:  
2.5- 40 Gbps

CANARIE Inc. is a non-profit corporation operating under government supervision



ANKABUT (2009)

Budget: 61M AED in 2009  
Fund:  
Gov. 75%  
KUSTAR: 25%  
After 5 yrs 100% by users.

Number of users:  
5 Universities

The Institute of Applied Technology has approached Khalifa University for Science Technology and Research (KUSTAR) to build a dedicated network for research and education purposes until the consortium is formed .

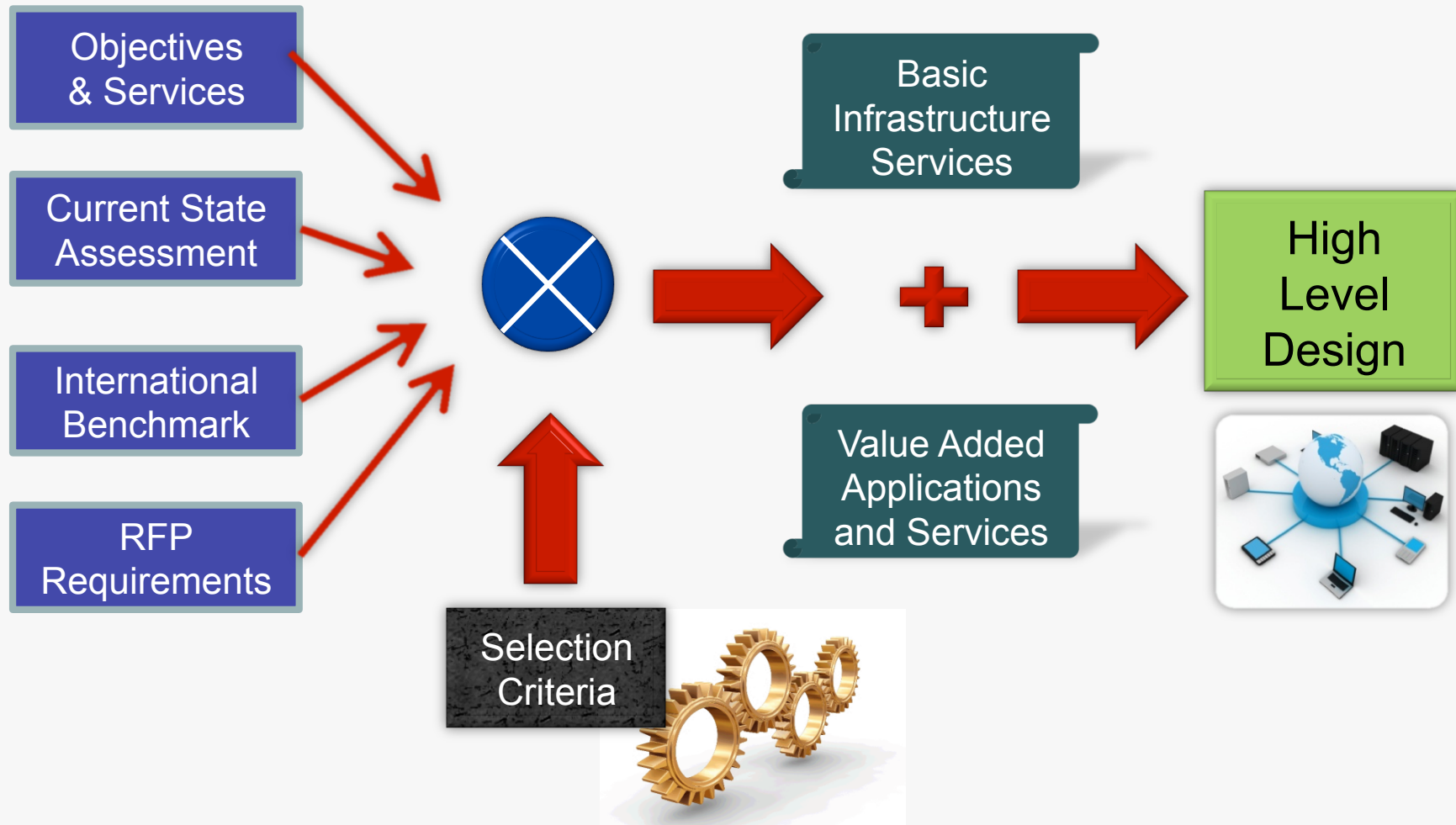


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# 4. Applications and Services Architecture

## Methodology



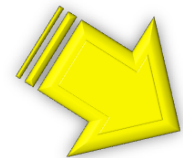
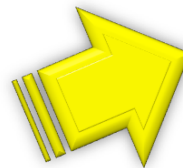




# 4. Applications and Services Architecture

## • Selection Criteria and Selection

Criteria and Sub-Criteria
<b>Support Research &amp; Education</b>
Knowledge Diffusion
Enable Data Exchange
Computing Power
<b>Support Collaboration</b>
Communication Improvement
Enable Resource Sharing
<b>Support Business Model</b>
Costs Reduction
Increase Admin. Effectiveness



### Domain 1: Basic Infrastructure (6)

1	Standard Networking Services
2	Security Services
3	Disaster Recovery Data Backup
4	Network Support Services
5	Network Monitoring / Accounting
6	Charge Model and Billing System

### Domain 2: Value Added (9)

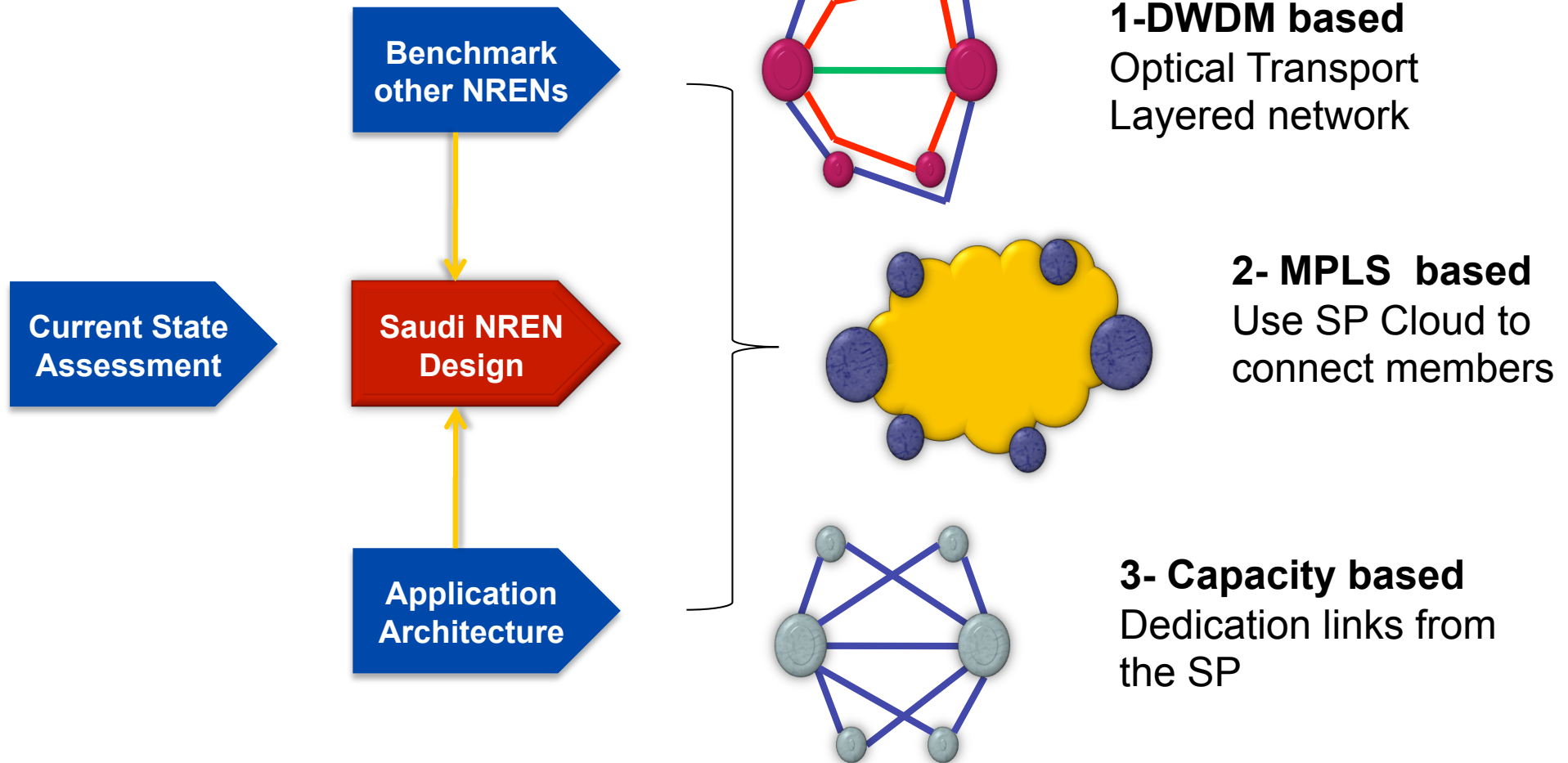
1	E-learning
2	Bandwidth On Demand
3	Digital database
4	Access grid
5	Videoconferencing
6	Grid Computing
7	VoIP or IMS
8	Access to High Performance Computing
9	Webportal



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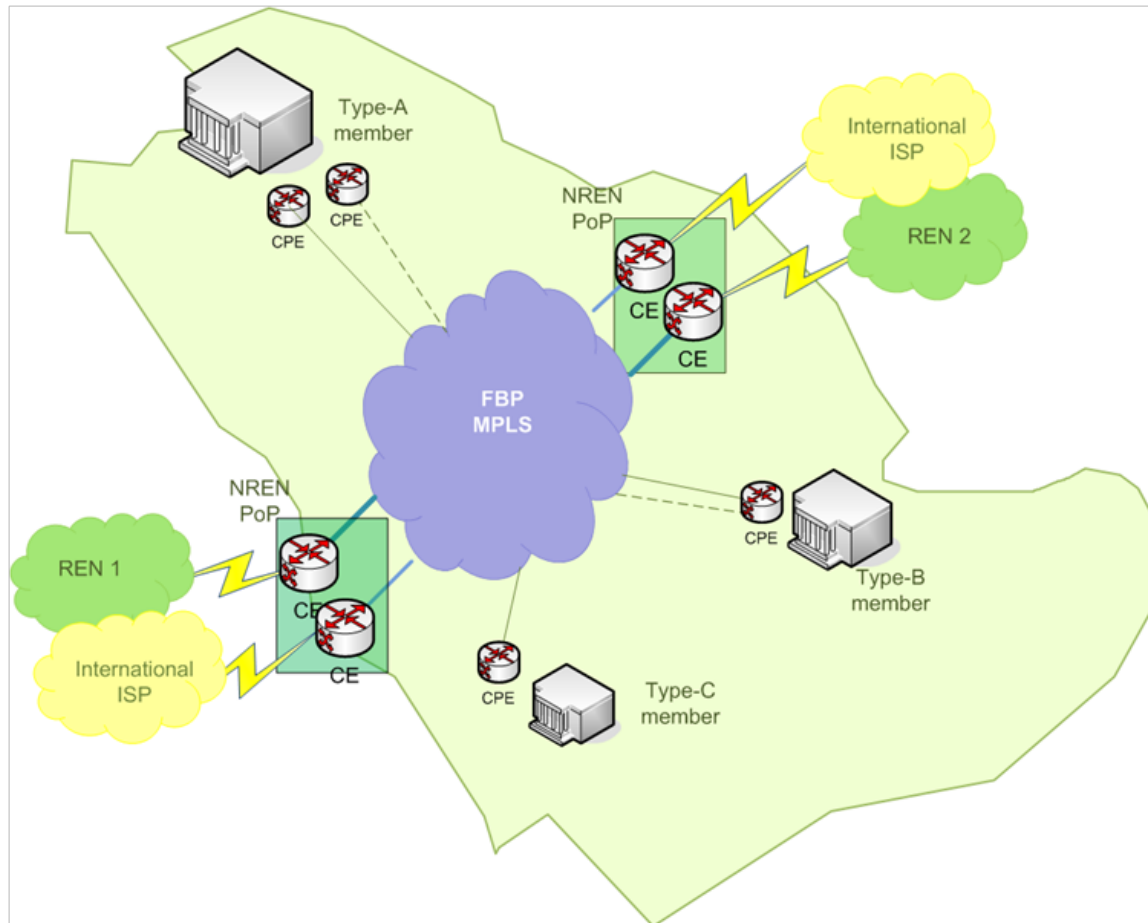
## • Network Alternatives





# SAREN Network Diagram

Local Network Diagram



## Network Characteristics

- Scalability
- High Availability
- IP/MPLS Routing Protocol
- QoS and Security
- IPv6 Support

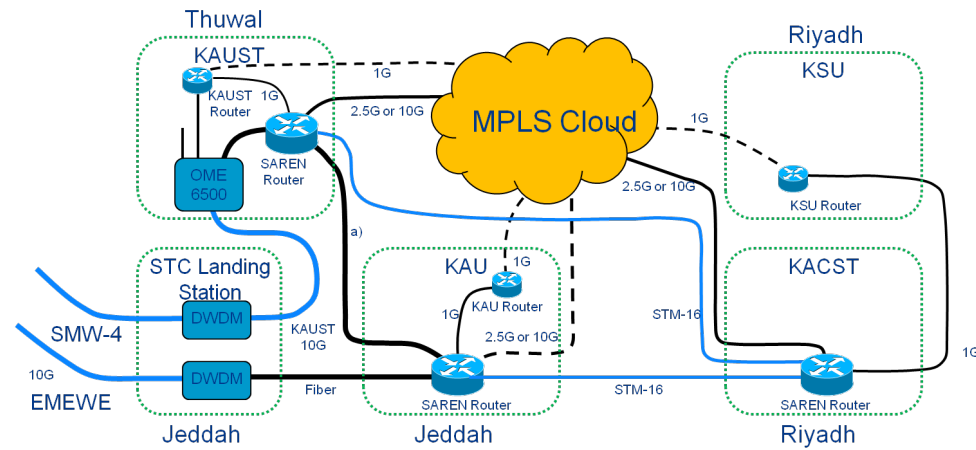


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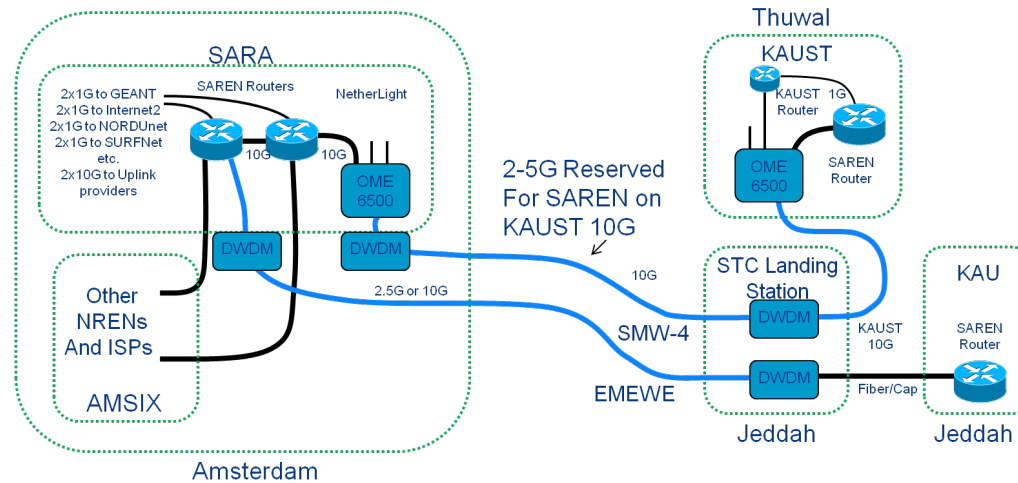
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# SAREN Network Diagram

International Peering

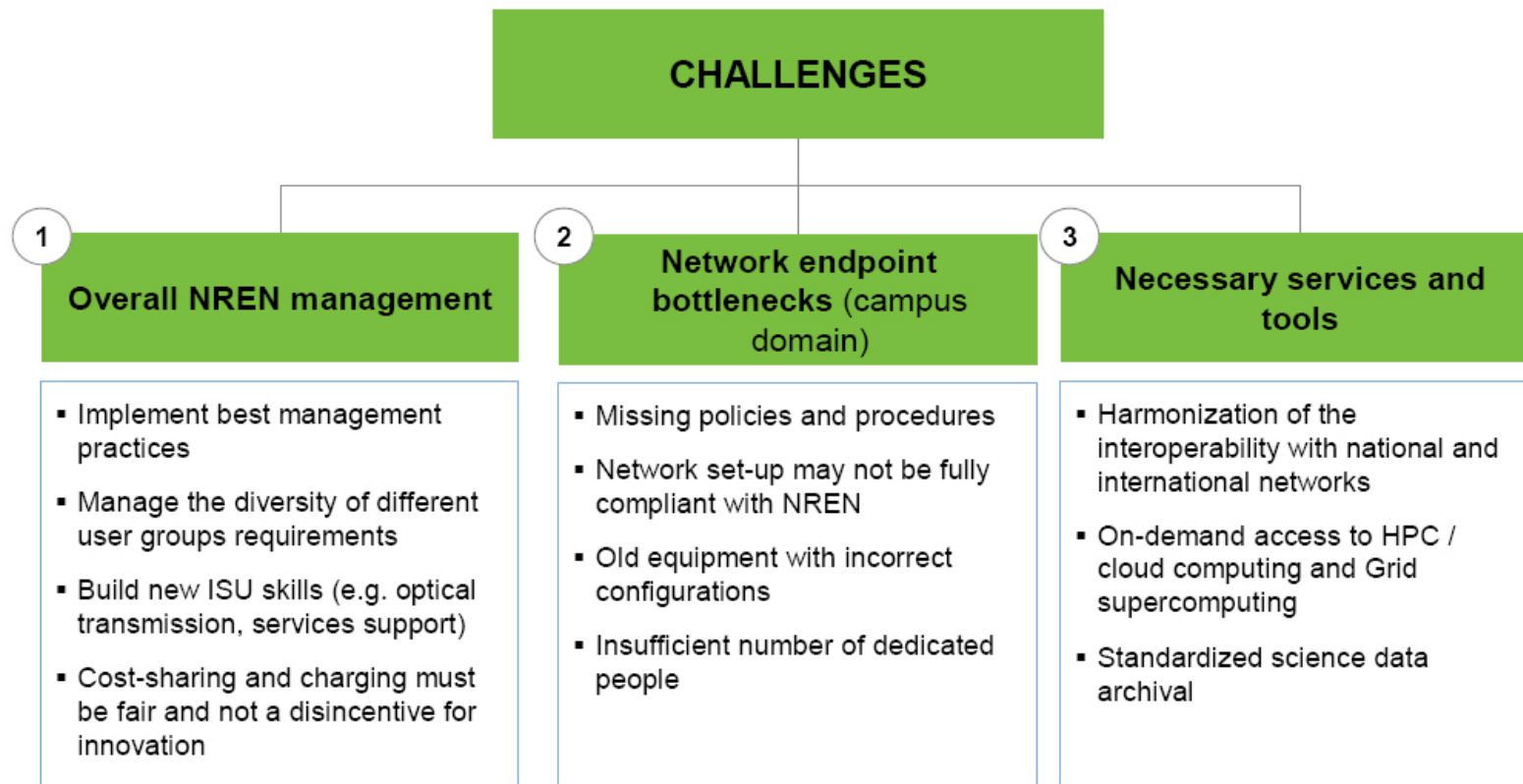


a) Link KAU/KAUST 10G on dark fiber with or without own DWDM





# SA NREN Challenges and Success Factors

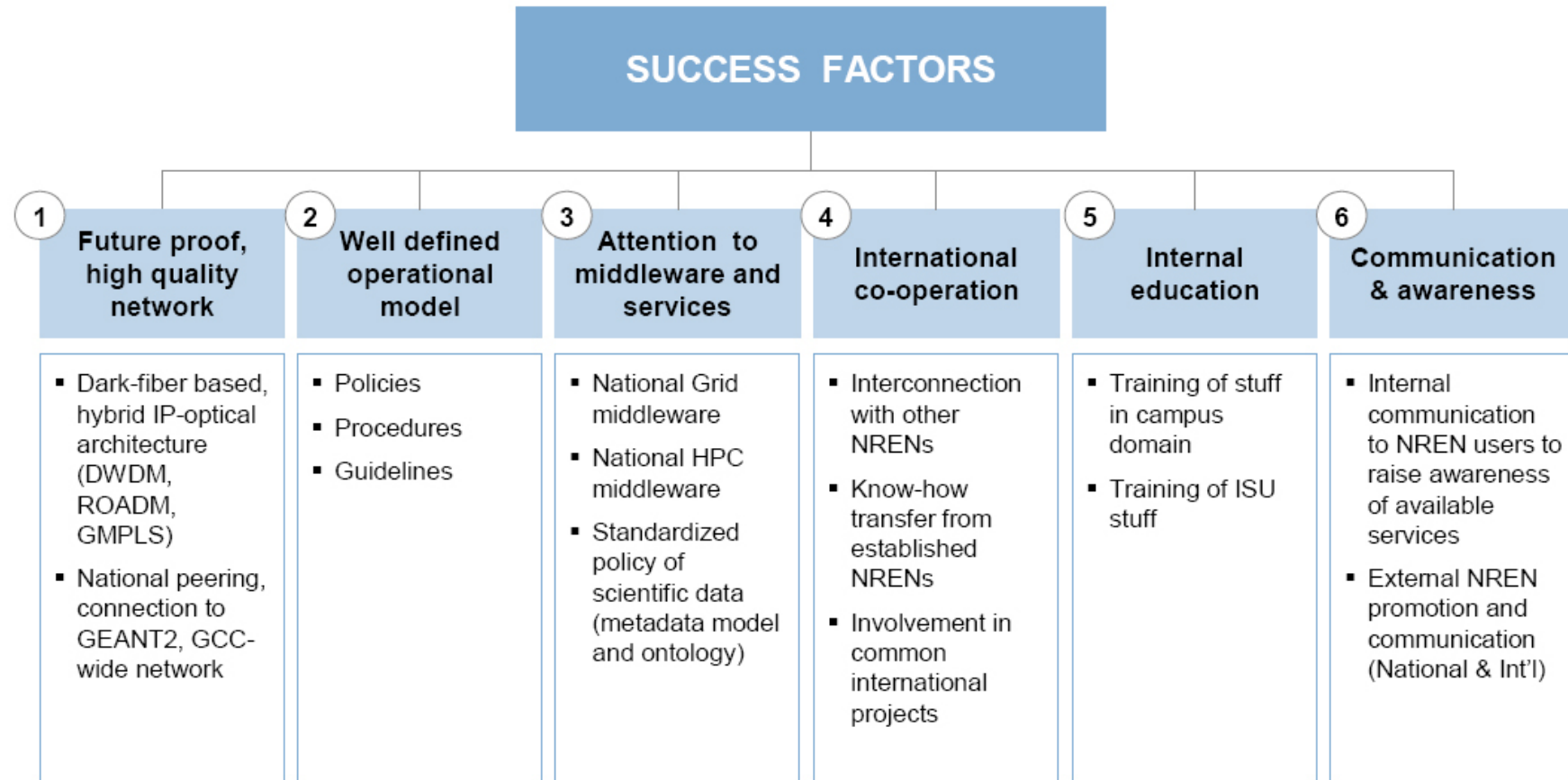


► On the physical network side, the major challenges will be (i) interoperability with campus network (e.g. E2E service provisioning and delivering), (ii) NW configuration and management (iii) the new technical challenges of the optical networking

Source: Oliver Wyman



# SA NREN Challenges and Success Factors



Source: Oliver Wyman



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