

National Knowledge Network

It is beyond doubts that creation of National Knowledge Network (NKN) is an absolute necessity for the development of the nation. NKN will enable scientists, researchers and students from different backgrounds and diverse geographies to work closely for advancing human development in critical and emerging areas. NKN will catalyze knowledge sharing and knowledge transfer between stakeholders seamlessly.



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The benefits of NKN are expected to go beyond the urban elitist groups as the ambience created by NKN is ubiquitous and globally unique. NKN is expected to encourage a larger section of research and educational institutions to create national intellectual assets. NKN is designed to inspire innovation and engage the researchers in the development of technologies that uplift the quality of human life with renewed vigour, zeal, and enthusiasm. Besides, NKN would enable use of specialized applications, which allow sharing of high-performance computing facilities, e-libraries, virtual classrooms, and very large data bases.

The objective of the National Knowledge Network is to bring together all the stakeholders in Science, Technology, Higher Education, Research & Development, and Governance with speeds of the order of 10s of Giga bits per second (Gbps) coupled with extremely low latencies. NKN will interconnect all institutions engaged in research, higher education and scientific development in the country, over a period of time. The architecture of the National Knowledge Network will be scalable and the network will consist of an ultra-high speed CORE (multiples of 10 Gbps), complimented with a Distribution layer at appropriate speeds. The participating institutions at the Edge shall connect to the National Knowledge Network seamlessly at speeds exceeding 1 Gbps or higher. The network architecture and governance structure shall allow the participating institutions an option to connect to the

Distribution layer through a last mile connectivity bandwidth.

The main emphasis in the National Knowledge Network is to establish a strong and robust internal Indian network that will provide a secure and reliable intra-Net connectivity. This fast information highway will ensure that India is seen and felt as one country. All vibrant institutions with vision and passion will be able to transcend space and time limitations in accessing information and knowledge and derive the associated social benefits. The National knowledge Network is designed to support Overlay Networks, Dedicated Networks, and Virtual Networks.

Applications such as Health, Education, Science & Technology, Grid Computing, Bio informatics, Agriculture, and Governance will influence the design principles of NKN. The entire network will seamlessly integrate with global science at multiple gigabits per second speed. NKN is a unique infrastructure which will be a critical information backbone for the nation. Besides, NKN will also be sensitive to the flow of scientific work which has tremendous IPR potential for the country.

NKN would enable

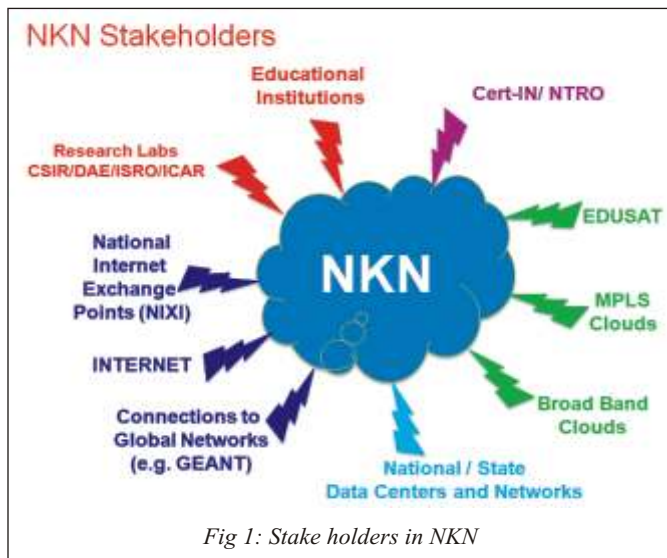
- Establishing Connectivity for Knowledge and Information Sharing
- Enabling Collaborative Research in emerging areas such as Climate Modelling

- Facilitating distance education in specialized fields such as medicine, emerging high technology areas covering info-bio-nano.
- Facilitating an ultra high speed e-governance backbone for information sharing
- NKN will also act as a test bed for research in the area of network, security and delivery models for various services.

Stakeholders in NKN

NKN aims at creating a network of networks with presence PAN-INDIA. As NKN is a new initiative, it will leverage from the existing initiatives, to ensure faster roll out with modest investment.

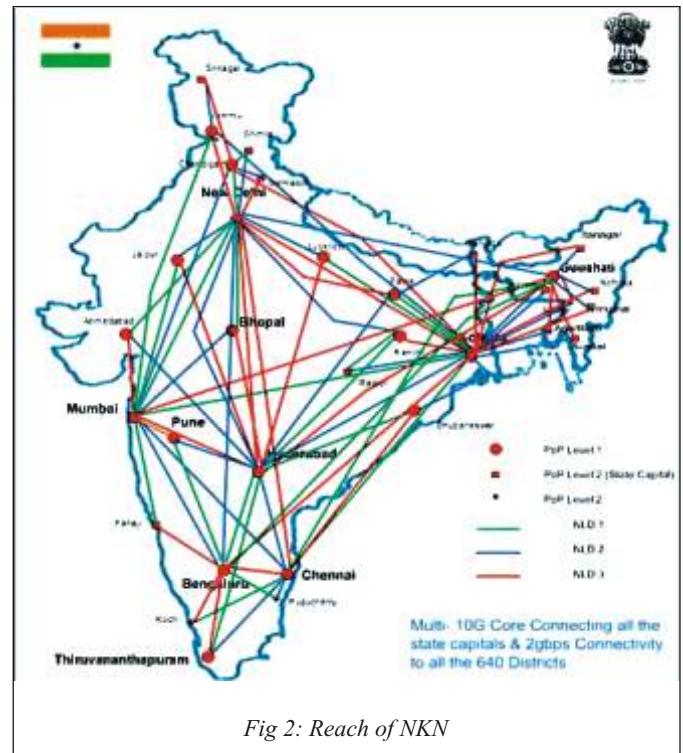
It will also terminate the various international R& D links from various countries (like the TIEN-3, CERN etc.) and the Internet. Figure 1 shows various stakeholders.



Reach of NKN

NKN SUPER CORE will be fully meshed with 7 locations. The rest of the state capitals will connect to at least 3 locations in the super core. Some of the state capitals where the not all the service providers exist, they will connect to at least 2 other CORE locations. Figure-2 shows the reach of NKN. To provide a low cost ultra high availability network NKN has been mandated by the HLC to reach up to all the districts with redundant 1 gbps. This will enable all the stakeholders at the district level to join the NKN with minimum cost and also can be a part of the VPN they so desire. As the NKN will reach as close as 50-

100km from the end user node, the last reliability to the NKN POP would automatically go up tremendously.



Salient Features of NKN

NKN is designed as a Smart Ultra High Bandwidth network that seamlessly interconnects the leading Scientific & Technological institutions and Government organisations. The design of is inherently proactive; it takes into account the requirements that may occur in the near term and long term. In addition to the above, NKN also demonstrates new possibilities that network technology offers for human development.

The Basic Characteristics of NKN are the following: Innovative; Reliable; Secure; Scalable; Robust

Based on the design objective, geographical spread and the expected usage, the following technical features are envisaged for NKN:

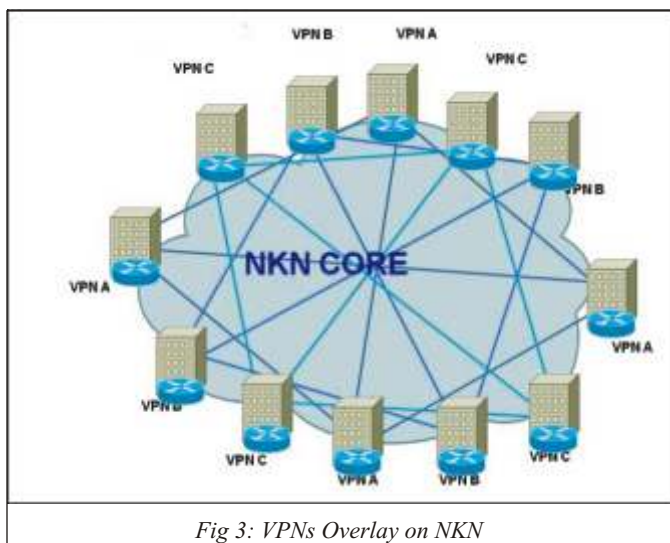
- Network created from multiple service providers to be fault tolerant.
- To carry multiprotocol traffic. NKN is based on MPLS (Multi-Protocol Label Switching)
- NKN will offer hierarchical Quality of Service (QoS) which is the key for real time traffic (voice and video)

and guaranteed bandwidth for business critical applications.

- NKN supports by design IPv6 transport.
- NKN design, implementation, management, and control is such that service provisioning is internal to the NKN network and does not depend on telecom service providers from whom “raw” bandwidth or fiber is likely to be leased.
- Supports Multicast enabled VPN.
- NKN management is capable of handling provisioning for the central services such as Multimedia Conferencing, e-access, digital library & central data centre to all users.
- Common Data Centers at at-least two locations for providing common services like the DNS, Messaging services, Web hosting, Content Delivery System (E-Learning), Authentication System, VPN services, collocation services etc.

Virtual Private Network Overlay on NKN

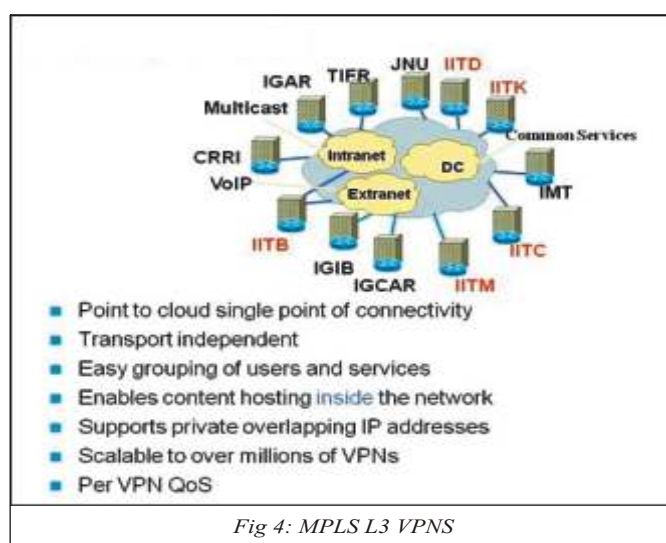
It is a common thing to see an organisation spread across the country with a number of branches geographically spaced. NKN provides a mechanism to provide connectivity to all the branches of an organisation by locally connecting each one of the branch to the local NKN points of presence. This NKN topology provides a scalable mechanism and secure way to connect the branches at a most economical way. The figure-3 shows the NKN core which provides connectivity to various VPNs



(closed user group). Figure-4 . The NKN shall provide VPN services at layer 2 and layer 3. As a result of this layering, after connecting to the nearest NKN pop one need not work over the WAN and the long distance connectivity and the cost associated with that. For instance, the CSIR labs after connecting to NKN at various PoPs of NKN need not bother about the WAN connectivity. Each CSIR lab can become a part of the CSIR intranet by implementing a few configurational changes at their end. This change might also require some equipment to be re-oriented at the CSIR level to be able to tap the advantages of the network.

Traditional overlay schemes require you to create tunnels between various endpoints (connection based and not network based). Not only does this limit connectivity, QoS & BW efficiency, it also requires a new network design for each user connection. Adding any new services becomes a big challenge and hence human error prone. In contrast, NKN leverages MPLS and allows one to build a VPN-based on networks, not connections. This makes it easy to add valuable services. Common services such as content hosting, web casting, multicast services becomes easy to realize. This also enables millions of VPNs to co-exist and also would be able to maintain the identity of each group.

In case the user group requires more security with respect to the data exchanged between their branches then it can implement bulk encryption system at their own end and the branches. This will provide confidentiality to the data that traverses through the network. While encrypting, one must take care of what exactly is getting encrypted. NKN



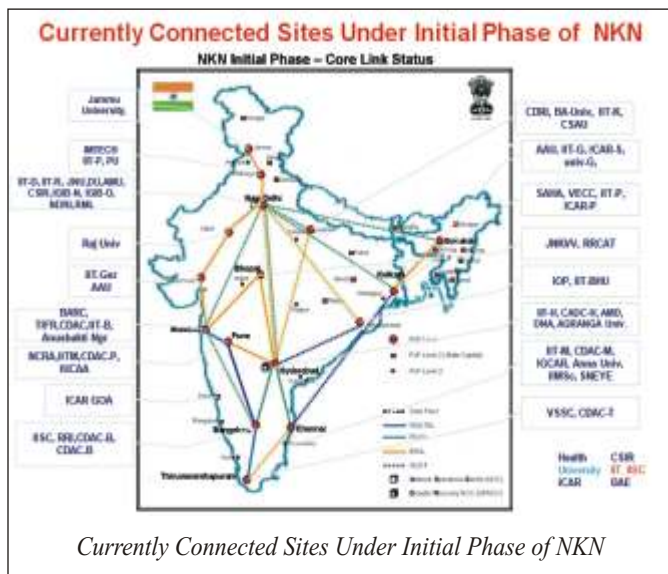
enables connectionless IP VPNs with multiple service classes and privacy.

Initial Phase NKN

President of India inaugurated the initial phase of NKN on the 9th April 2009. Initial phase of NKN aimed at connecting about 57 end user organisations. This consisted of all most all the IITs, and some of the DAEs, CSIR labs, ICAR labs, Universities, hospitals, agricultural universities etc.

The initial phase of NKN was overlaid on NIC infrastructure and 15 point of presence was created with 2.5 gbps link. Currently about 66 organisations are connected to NKN at various PoPs. It is intended to connect another 30 end user organisations by the end of April. Few workshops and trainings have been conducted at Delhi and Mumbai for the users. Many VPNs have been created at the organisations level and at project level. GARUDA one of the GRID computing project of CDAC has been migrated to NKN.

As a design philosophy of NKN, it provides the connectivity and a routing equipment with full support of MPLS to the end user organisations/ institute. NKN would have an MOU with the each on of the member organisation to have a NKN PoP at their premises. This allows reach out / Fan-out for the NKN and hence at a later stage these points could also be used for providing connectivity to others too from that locations. This will enable the NKN to provide a better reach out at a very low cost/labour.



Migration is a process and probably one of the biggest. Many migration templates have been created and handed over to the end user organisations for migration. One such migration plan is shown in figure-5.

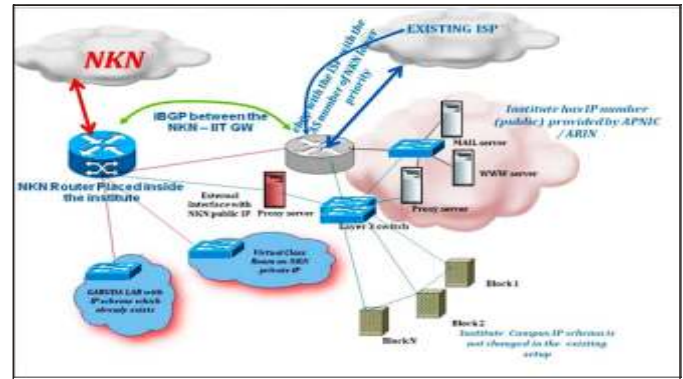


Fig 5: Institutes having their own Public IP from APNIC/ARIN

As a model project to provide better service level & reliability, few organisations have been identified which are close by (may be with in .5 to-2km) where the NKN plans to interconnect the organisations to with its own fiber. One such example is shown in fig-6.

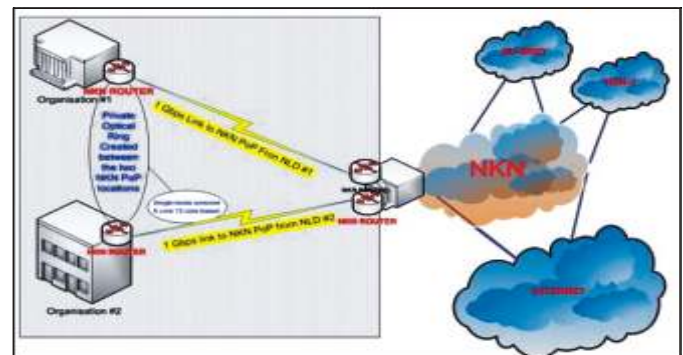


Fig 6: Connectivity between 2 or more organisations

Final Phase NKN

The Final Phase would connect about all the districts and the state capitals and would connect approximately 1400-1500 end user organisations at either 100mbps / 1 gbps. The cabinet has already approved the project in principle and the phasing of the financial outlay of Rs.5990/= crores is awaited. The project would be fully funded by the Government of India and would be supported for 10 years initially. The Core and the end nodes would be completed by 18-24 months.

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