

## **Background**

The National Internet Exchange of India ( NIXI) is the meeting point of the ISPs in India. It is a company formed under Section 25 of the Companies Act, 1956, limited by guarantee, not for profit and not having a share capital. Its main purpose is to facilitate handing over of domestic Internet traffic between the peering ISP members so that the domestic internet traffic is handled within the country resulting in better service and saving of International bandwidth. NIXI is a neutral exchange which is required to work on the principles of transparency and neutrality.

### **The General Principles of NIXI as outlined in its policy are as follows:**

- NIXI is not an ISP and will not provide Internet connections.
- The peering ISPs will enter into their own bilateral or multilateral commercial agreements as the case may be.
- NIXI will not guarantee the presence of any particular service provider in NIXI to peer with.
- NIXI will be carrier neutral i.e. it will not compete with its constituent/member ISPs on any of the services and would work on the basis of non-profit.

VSNL would like to reiterate its commitment to ensure its growth subject to above general principles and objectives of the NIXI and ensure end customer in India gets the best quality services. VSNL is of the opinion that NIXI should keep its regional separate setups limited to four Metros only to facilitate the ISPs to interconnect at regional levels instead of each state as it would lead to huge cost being incurred vis-à-vis value creation.

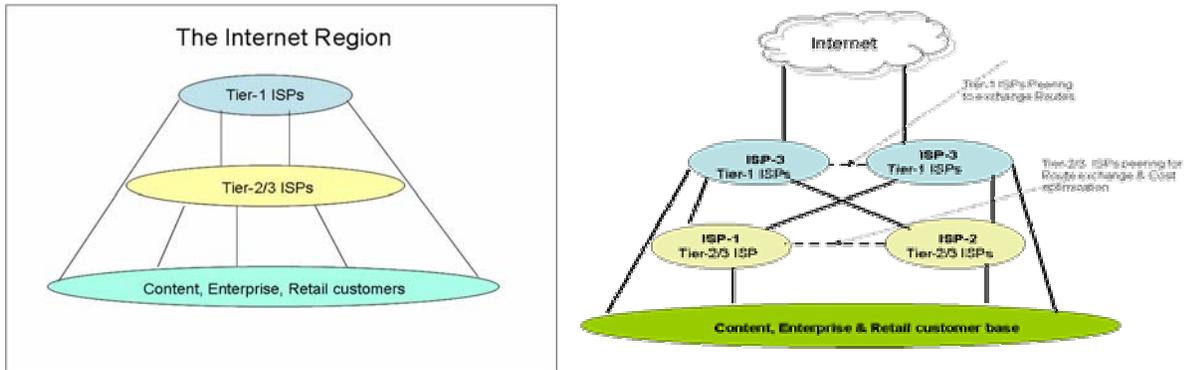
Instead of increasing the number of nodes within the country which introduce complexity in the internet environment of the country, more importance should be given to strengthening the existing nodes at the four Metros by facilitating presence of all regional/local ISPs at their respective regional nodes. This would also save (i) the cost of huge administrative set up if NIXI sets up nodes in all the States (ii) the operational cost of running the set up (iii) the CAPEX for funding such a set up etc. These savings can be used to facilitate local ISPs connectivity at the NIXI regional node which would in turn become viable due to increased participation and would serve the basic purpose of NIXI as well. NIXI, therefore, need to work on future architecture in country as aforesaid for ensuring domestic traffic remaining in India, formulating policy for the said objective, bringing policy and services control in the routing and ensuring that all ISPs in India get a fair, level playing field with protection of revenues.

In response to the discussions paper, we are also providing brief description of Internet region, ecosystems & best practices in other parts of world, which would help all of us to move forward in improving the effectiveness of NIXI.

### **The Internet Region & Eco System :-**

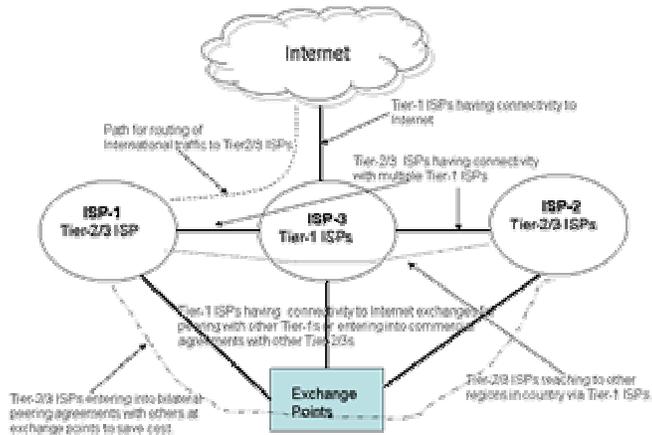
Internet is divided into various independent regions across the globe. An Internet Region is a portion of the Internet, usually defined by geographical boundaries (country or continent borders). In any Internet region across the globe, ecosystem of Internet evolves with time and settles down with multiple categories of ISPs, content providers & end consumers present in that region. The ISPs in any eco systems are termed as Tier-1 ISPs, also called as NSPs (Network Service Providers) in that region or Tier-2/3 ISPs, also called as Access providers to end consumers within that region. .

Tier-1 ISPs are the provider of Internet network in that region, having connections to various other regions of Internet via transit or peering arrangements and serving end customers within the region either directly or indirectly, whereas Tier-2 or Tier-3 ISPs operate within limited zone within that region to provide services to end customers directly and take transit services to reach in other parts of region or outside that region from one or multiple Tier-1 ISPs. The ecosystem allows all Tier-1 ISPs to come on common platform of regional peering to share the routes with each other and Tier-2/Tier-3 ISPs to come together for peering to optimize the costs. This entire eco system & connectivity between various ISPs & customers can be understood by diagrams below:-



In the above diagram – Tier-1 ISPs are equivalent to ISP-3 given in consultation paper illustration and Tier-2/3 ISPs are ISP-1 & ISP-2.

The traffic flows in a matured Internet eco-systems takes place on mutually beneficial commercial arrangement. The direction of traffic flows is described below in the diagram:-



NIXI is expected to come out with policies & framework, which ensures that Indian Internet eco-system, also takes the shape of a matured ecosystem like in any other country today. That would also ensure that entire domestic traffic stays within the country . NIXI as well as ISPs have an equally important role in achieving the objectives for which NIXI was set up namely to restrict the domestic traffic within the confines of our country. All domestic traffic passing through NIXI only, will make NIXI also in a category of ISP-3 , which is not as per the general principles and charter of NIXI.

Internet industry and technology across the globe is unregulated by nature and that has lead to continuous innovations in this industry. To quote from an OECD report, using regulation to intervene in Internet Interconnection may well distort a market outcome which is currently delivering greater provider and network diversity. NIXI should not be envisaged in a manner where it disturbs the natural process of settling of eco-system of Internet in the country, which would finally end up disrupting the growth of Internet in the country and deprive business profitability to the network service providers i.e. ISP-3, who have been investing hugely for the growth of entire community and currently at multiple levels of network availability across the country.

Every matured Internet ecosystem follows the 80-20 principle, means 80% of traffic is carried by top 20 ISPs. This has been stated in paper that in India also 98.2% of traffic is being carried by top-20 ISPs in country. This is the natural market dynamics of any matured Internet ecosystem in any country. We have certain regional Tier-1 ISPs (as explained above) who carries the major traffic of that eco system and help in growth of overall Internet Industry in that eco system. This is clearly visible in any country today, Example

- USA – AT&T, Sprint, Level-3, UUNET, SAVVIS,
- Japan – KDDI, NTT, Japan Telecom, Powerdcom
- Singapore – SingTel, Star Hub, Pacific Internet
- Australia – Telstra, Optus,
- Hong Kong – ANC, PCCW, Reach
- UK – BT, C&W, Colt

### **Internet Economics:-**

IP is a destination based technology, where traffic packet checks the destination IP address and best path for that to traverse in the network. The source of the traffic is not important. If two local ISPs i.e. ISP1 or ISP 2 are having transit connections via ISP 3 than either the entire traffic (domestic + International) would take the path of direct connectivity or via NIXI path. In case traffic is taking the direct connectivity path between the ISPs, than ISP1 & ISP2 need to pay to ISP-3.

This is part of any ecosystem in the nature, where some are seekers and some are providers. Typically ISP1 & ISP2 are having their service domains restricted to certain state/area/city in the country for reaching to other part of the country; they need services of the ISP-3, who has invested in making a national wide network. ISP1 & ISP2 becomes the seeker of national connectivity to other part of country from ISP3, for which ISP3 has to earn revenue for that service.

Typically charging patterns for this type of traffic is different by ISP3 and they do not charge for International transit charges. All major ISPs (Category 3 ISPs) in India have separate products (service offerings) and tariff structures for domestic traffic and International Traffic. For example VSNL has Compressed Internet BW product to cater in to the Domestic transit/traffic requirement of ISPs and standard Internet Bandwidth for traffic which is primarily International. Further even if an ISP does not have different product for meeting international/domestic transit traffic requirements, the portion of domestic traffic and international traffic is factored in to provide a blended price.

This takes care of the concern that the domestic traffic is charged only at the domestic bandwidth cost and not at International BW cost. Hence it would not be correct to say that today ISPs (type 1 & type 2) are being charged at International BW rates by type 3 ISPs. Charging for IP transit to ISP1/.ISP2 by ISP3 is part of Internet ecosystem for everyone to grow together.

### **Primary Objective & Philosophy:-**

The primary objective of the task force setup by TRAI in 2002 was to ensure that domestic Internet traffic remains within the country only. As per general principle of NIXI, this body was created to ensure Domestic traffic remains within the country, for which hair-pinning of traffic via NIXI is not required. In a matured ecosystem there are multiple ways to ensure that all domestic traffic remains with the country. NIXI need to come out with policies and framework in those lines instead of forcing traffic via NIXI. NIXI's main philosophy was to ensure that all domestic traffic is exchanged within the country and do not use International bandwidth for same. Creation of four standalone nodes for achieving this objective was correct, but NIXI general policies and architecture could not create the environment of trust and level playing field for ISPs to join and exchange the traffic.

To move ahead on achieving the philosophy of domestic traffic remaining within the country, NIXI need to enlarge its vision and policies and have multi-directional approach of NIXI, Private peering & transit buying etc for meeting the objective. NIXI should only provide a platform for ISPs to exchange traffic among themselves. The exchange of traffic among ISPs shall be done based upon the bilateral/multilateral agreement between the ISPs for providing

domestic transit/international transit/private peering etc and the commercials for this shall be as per the mutual agreement between the ISPs. This will help in setting up a more healthy and robust ecosystem.

The exchange of domestic traffic within the country ie providing domestic internet transit service by Tier-1 ISPs (ISP-3) is an essential part of category A ISP License and without such a license, NIXI may not be able to provide such transit services. The national transit services for internet traffic also has commercial value attached to it which plays a role in the economic viability of ISP3 i.e. Network Service Providers (NSP). Moreover, if NIXI starts providing such a transit service, it would according to us not only require a Category A ISP License but would also be acting in competition to its member ISPs which is against the very spirit on the basis of which NIXI was formed. We also need to take in to account the value of content supplied by an ISP as globally it is one of the most essential variables for a rational system of settlement between ISPs along with the other factors of coverage of network, size of subscriber base etc. The valuation of the content should be there, as lot of efforts & cost are put in to create content & infrastructure in the country.

### **NIXI Routing Policy:-**

Current routing policy of NIXI is to announce all regional routes at 4 locations and accept the routes received from NIXI router. VSNL has been announcing all regional routes to NIXI as agreed in original NIXI policy. Any NSP i.e. ISP3 would not be in a position to announce all the routes to NIXI at one location, because that would lead to use of his domestic internet backbone by regional ISPs free of cost. ISP 3 would not be getting the business viability in expanding the Internet network in the country and would not be able to get commensurate returns on the investment made in the spread of the network. ISP 3 may not be able to accept all the routes from the NIXI from ISP1 & ISP2 due to reasons that ISP1 & 2 may be customers of ISP3.

BGP manipulation by ISP-1/2 and misuse of NIXI platform for taking International traffic causes a revenue loss of ISP-3. Many ISPs have been found misusing the current routing policy of NIXI by manipulating the BGP to take International traffic from NIXI..This technical possibility of BGP manipulation and misuse of NIXI platform is becoming possible due to NIXI architecture & routing policy which allows 2 relationships between two ISPs (Transit/Peering). Currently **NIXI support infrastructure is not having sufficient tools & mechanism to curb misuse by some of the ISPs trying to get international traffic through NIXI by paying X-Y domestic charge. This need to be strengthens further by NIXI.** In any ecosystem, two ISPs only share one type of relationship (Transit or Peering) and it is left on nature for decision and settlement. Also ISP3 requires huge investments in doing deep packet analysis to find out the source of the traffic passing via NIXI, which is not possible in this low margin industry.

Mandating all ISPs announcing all the routes in NIXI would not resolve the main issue in ensuring entire domestic traffic remaining in the country. If all national ISPs announce all the routes in NIXI, their backbone would be used for domestic transit by small ISPs within a region , without compensating them for the cost incurred by them in setting up nation wide network for serving the country. VSNL has been supporting the existing Routing policy of regional routes in

each NIXI so that national backbones of Big ISPs are not misused by small ISPs without paying them.

If all the domestic traffic exchange has to pass via NIXI, this would mean licensing of exclusive right to NIXI for exchange of domestic traffic between all the ISPs and right of provision of domestic transit services also exclusively by the NIXI. This may not only require a Category A ISP License for the NIXI but would also be in derogation of the licenses of existing Category A ISPs as well as bring NIXI in direct competition with its members. Globally, there is no such example where the National Transit service for Internet traffic as well as IXP functionality have been entrusted to a sole Section 25 company. Introduction of partisan arrangement in the country in Internet network with NIXI becoming the sole provider would distort the eco-system of Internet services market in our country. These recommendations would be tantamount to giving NIXI exclusive rights to exchange domestic traffic, thus creating monopolistic network in the country. This is totally against the nature of Internet ecosystem and would discourage major ISPs in investing further in country's network growth in future.

Globally no Exchange point has a free route distribution policy, as currently adopted in NIXI. All the major Internet exchanges globally acts as a catalyst to provide infrastructure, environment & policies for ISPs to join them under economical conditions and exchange traffic with other ISPs depending upon requirement and internal policies of ISPs. No exchange point forces ISPs to exchange traffic with all participating ISP.

Further, it may not be correct to say that majority of the domestic traffic in India is not getting exchanged with in India. Since most of the ISPs (category B & C) are also customers of Category A ISPs ie. ISP-3 category (NSPs) hence the return traffic prefers the customer link than the peering link at NIXI. This insures that the domestic traffic is exchanged with in India only which is also the objective of NIXI. In this way NSPs(Category -3 ISPs) may be losing some revenue (in terms of X-Y) settlement with NIXI.

### **Connectivity to NIXI :-**

Connectivity to NIXI should be linked to business model and commercial viability of bigger & smaller ISPs to maintain its connectivity to NIXI. The current cost components in maintaining connectivity to NIXI like Collocation charges, NIXI switch port charges & Bandwidth charges for connecting to NIXI node may not be economically viable for many smaller ISPs in maintaining them.

Out of total 130 active ISPs operating in India, 27 are connected to NIXI. However to increase this number the ISPs should not be mandated to join in NIXI. By mandating all ISPs to join in NIXI, we may not be creating a healthy ecosystem. ISPs should have the choice to connect to NIXI or the upstream ISPs which shall be driven by individual ISPs business needs. All multi homed ISPs should be encouraged to join NIXI depending upon their business model..

Alternatively multihomed ISPs routes can be declared via Class-A ISPs to NIXI, but route propagation to other ISPs routing tables and traffic handling should be left to BGP best path only. In that case multihomed ISP would be required to ensure that they are getting NIXI traffic via his preferred Class-A ISP.

**Current status & Expansion of NIXI :-**

Use of MPLS technology in NSPs network (category 3 ISPs) as suggested need huge investments and testing to reach to envisaged solution . Converting entire network to MPLS need huge investment by all ISPs, which may not be viable for business model in this low margin service sector. Additionally this may also not be required because category 3 ISPs are already providing number of BW packages and hence the different tariff rates for different blend of domestic traffic and International traffic.

Increasing the network reach of NIXI by setting up of NIXI nodes at state capitals will lead to huge investment without any commensurate value addition as the content hosted in the country is limited to 9-10 major cities. Currently out of 4 NIXIs, Kolkata has not even started building the traffic and other three are on maturing phase. Currently the Indian market is not mature enough to have content distributed across many cities and it also does not mesh with content provider business model, who is one of the main components of Internet eco system. Let the traffic at existing main nodes reach to a certain maturity level and we have enough content for distribution locally within the states and large ISP distributions in states.

VSNL is in favor that Cost benefit analysis of setting up more NIXI nodes in other parts of country, cost of managing them should be taken into consideration before reaching to any conclusion on this issue. External professional consultants should be given job of doing this cost benefit analysis and come out with recommendations.

The interconnection of nodes of NIXI to each other would make NIXI a domestic transit provider providing transit services to ISPs in India in competition to other national ISPs and is against the NIXI general principles of neutrality and non-compete. This would also mean that NIXI would lose its carrier neutral status which is the prime binding force for attracting member ISPs.

Apart from this NIXI would also become standalone and only service provider of this service and its backbone would easily be misused by ISPs taking interconnections at 2 locations. This has already been observed by big ISPs (ISP-3) having connectivity to multiple NIXI and technically manageable with NIXI also, if NIXI nodes are interconnected. This would be a serious commercial Impact to NIXI, whose national backbone required for Interconnecting NIXI nodes would be used for transiting traffic without any commensurate revenue thus impacting NIXI commercially.

NIXI would also be required to take CAT-A ISP license for interconnection between multiple nodes and carry the domestic transit traffic of ISPs between its nodes. This would be totally against the general principle of NIXI and eventually NIXI would become a Carrier of carrier in country for domestic transit, which is against the nature of Internet eco system and market dynamics. All the domestic traffic would start depending upon NIXI infrastructure in the country. In future failure of any equipment in NIXI node would be able to bring entire country traffic down. This move would be against the growth of Internet network in the country.

Further this would not be in long term good health of the industry as the type 3 ISPs have already made huge investments in setting up the domestic backbones would become a

mere International transit providers. Such a move will deter the category 3 ISPs in making any further investments as there will be duplication of resources and erosion of the huge investments made by them. These ISPs would not get a level playing field as they will have most of the traffic and hence may be required to pay out to NIXI. However, these ISPs have already made huge investments in setting up the domestic backbones in India and hence such a move will not only erode their present investments, but will also increase their operating cost. This will be detrimental to the growth of Internet in India.

Hence such a move will not create a healthy ecosystem in the country.

## **CHAPTER 5 - ISSUES FOR CONSULTATION**

### **5.1 What is the basic reason holding back effective utilization of the NIXI? In your view what actions are required to ensure all domestic traffic passes through NIXI?**

VSNL has, and always been supportive of various efforts undertaken to strengthen NIXI's basic objective of keeping domestic IP traffic within the country. NIXI has been doing an excellent job in meeting this objective up to a certain extent, however NIXI's current architecture is not able to bring level playing field and belief in ISPs for exchanging the traffic. We respectfully would like to submit that cause of sub-optimal utilization of NIXI facilities in India is not related to any technical deficiency but rather to its lack of commercial appeal for India's Internet ecosystem.

No control of routes getting into other ISP routing tables, lack of policies and controls, potential of misuse by ISPs of this facility, poor infrastructural & operational support and quality of services are few of the main reasons, which need to be substantially improved to meet its objective. NIXI need to work on future architecture in country for ensuring domestic traffic remaining in India, Policy formations for that, bringing policy and services control in the routing and ensuring that all ISPs in India gets a fair, level playing field with protection of revenues.

Current NIXI architecture is not allowing development of bilateral and multilateral relationships between the ISPs based on their business policies, which is most important for success of any exchange model and Internet eco-systems. The current service levels provided in NIXI facilities and support for day to day operational requirements need to be improved a lot to increase effective utilization of NIXI platform.

Further the traffic at NIXI may not be the right benchmark of saying that the domestic traffic in India today is not being exchanged within India. As explained earlier also most of category B&C ( category 1 ) ISPs are also customer of Category 3 ISPs so most of the traffic may be following up the customer link between the category 3 and category 2 ISPs as per Global practice for Internet routing . Further most of Category-3 ISPs ( NSPs) have multiple

bilateral agreements ( transit/peering) among themselves hence majority of domestic traffic is being exchanged directly between them This is meeting the NIXI objective of encouraging the local exchange of traffic even though the usage at NIXI platform may not be much. As long as domestic traffic is exchanged with in India by whatever model, the low usage as NIXI shall not be interpreted as the benchmark of effectiveness of NIXI in meeting its objective.

Further the Category 2 ISPs are charged only as per domestic BW rates and not as per the international BW rates as most of category 3 ISPs have separate product to cater in to domestic and international traffic requirement of category 2 ISPs. Even if some Category 3 ISP does not have some separate product for domestic BW, the category 3 ISP takes care of blended cost by taking proportion of domestic and international BW usage pattern.

## **5.2 Should all ISPs or their Up stream providers be mandated to connect at NIXI? If So,**

No where in the world, ISPs are compulsorily mandated to join any particular INAP or exchange point and exchange traffic with others. All INAPs & exchange points works as catalyst and facilitator in creating the infrastructure, environment and policies for all ISPs to join by their wish and enter into bilateral or multilateral relationships with other ISPs. The question being proposed above is against the very nature of Internet eco-system and would lead to entire country traffic dependency on NIXI, hamper the growth of Internet industry in country & business losses to bigger ISPs.

The ISPs should not be mandated to connect at NIXI. By mandating all ISPs to join in NIXI, we may not be creating a healthy ecosystem. ISPs should have the choice to connect to NIXI or the upstream ISPs which shall be driven by individual ISPs business needs.

NIXI shall only provide a platform for ISPs to come in voluntarily and exchange the traffic among them depending upon the mutual bilateral/multilateral commercial agreements between each ISPs instead of NIXI forcing any commercial model for exchange of traffic. However lot of efforts are required for creating environment and policies, which attracts ISPs to join NIXI and facilitate effective exchange of traffic by the ISPs in order to meet the overall objective. The current model of free route exchange with NIXI router should be changed with Layer-2 switch model, followed in all exchange points globally.

### **5.2.1 Should minimum connection size, space requirement, power requirements etc be also defined based on the slab of customer base of the ISP?**

This is not necessary at this point of time. Currently all ISPs should be allowed to choose their pipe to NIXI. They should be maintaining certain service quality in the utilization of that pipe. Focus need to be given on other infrastructural requirements in NIXI.

### **5.2.2 Will it increase interconnect cost with upstream provider?**

If all the ISPs are mandated to connect to NIXI then the over all cost of operation of ISPs vis-à-vis cost of operations if ISP connects to NIXI via upstream provider would not be much different. However in case of all ISPs connecting to NIXI directly, they would be required to take

& maintain separate links to connect to NIXI and upstream ISPs, where as via upstream provider they can manage with single link.

### **5.2.3 Will there be any limitations when an ISP has multi-homing?**

ISPs having multihoming and coming to NIXI via upstream provider may have certain technical issues of routing and traffic via NIXI to ISP. Multihoming ISPs would be announcing their routes to all upstreams, which in turn would reach to NIXI router. NIXI router would use the BGP best path policy to select the route to ISP via certain upstream provider. There may be one off case where traffic takes the path of non-preferred route by ISP. In that case multihoming ISP needs to ensure that he is getting NIXI traffic via his preferred Class-A ISP by way of BGP manipulations.

### **5.3 Should ISPs connected to NIXI be mandated to announce all of their routes on NIXI? If so**

ISPs should not be mandated to announce all the routes to NIXI, because every ISPs routing table consist of multiple type of routes, which are having different SLAs, objectives and commitments to its customers.. Alternate solutions should be proposed which focus on fulfillment of basic philosophy of NIXI (which is creating an environment to encourage that all domestic traffic is exchanged with in Country instead of forcing all the traffic exchange via NIXI). VSNL would like to propose not to implement this policy and let all ISPs have right to choose the bilateral/Multilateral relationships with other participating ISPs.

#### **5.3.1 Should only regional traffic be announced on NIXI regional node?**

Yes, only regional domestic routes should be announced by all participating ISPs in NIXI. That would ensure that Tier-1 ISPs backbone is not getting misused by regional ISPs for national domestic transit traffic.

#### **5.3.2 How to handle situations where connecting ISPs have regional presence?**

ISPs with regional presence, if wants to connect to all the NIXIs, should connect on long haul bandwidth or buy transit from locally available National ISP to reach to other parts of country.

#### **5.3.3 Whether announcing all routes at NIXI node can result in misuse of national backbone of class A ISPs?**

Yes, Exchange of all the routes at all the NIXI locations will lead to Class –A national ISPs domestic backbone being misused by other Class B / C ISPs without any transit service revenue to ISP giving such non-regional routes on NIXI. This would be a serious commercial Impact to any Class-A national ISP, whose national backbone would be used for transiting traffic without any commensurate revenue thus impacting him. National ISPs, who are basically Network service Providers in the country, would get badly impacted in this full route announcement scenario. This would eventually lead to withdrawal of Class-A ISPs from investing more in growth of network in the country.

#### **5.3.4 What are the alternatives and solutions?**

Alternative solution for this problem is to create the environment by which ISPs ensures entire domestic traffic exchange within the country but method and policies of that are left to market forces. That would start taking the shape of every matured market of Internet, where we have 3-4 National level NSP ( Network services provider –ISP) and many regional/local ISPs. All regional/local Tier-2/3 ISPs buy transit from any or multiple of National ISPs and do bilateral commercial peering arrangements with other Tier-2/Tier-3 ISPs which ensures that all Domestic traffic between these ISPs remain in country. These small ISPs can exchange the traffic between themselves at neutral exchange points like NIXI. All the national ISPs also can enter into mutually beneficial commercial peering arrangement so that domestic traffic remains within country. NIXI can play the role of policy formulator, regulator and provider of carrier neutral peering facility at layer-2 to all ISPs to exchange traffic.

#### **5.4 Do you feel Interconnection of 4 nodes of NIXI is necessary? If so**

Interconnection of NIXI nodes to each other may make NIXI a domestic transit provider providing transit services to ISPs in India in competition to other national ISPs and is against the NIXI general principles. This would also mean that NIXI would lose its carrier neutral status. This is not at all required as this is against the founding principles of NIXI.

##### **5.4.1 Whether NIXI will become a transit service provider thereby competing with its members, contrary to the role assigned to it?**

Yes. NIXI would become domestic transit provider by doing so and start competing with its members. It would be contrary to the original role assigned to NIXI.

##### **5.4.2 Whether NIXI will require any licence from DoT as it will start carrying of traffic between two stations and distributing between the ISPs?**

Domestic transit service for internet traffic is a part of portfolio of services covered under Cat A ISP licence and the same is not a standalone licensed service. NIXI will be required to take a Cat A ISP license for enabling it to carry traffic between two stations and distributing between the ISPs.

##### **5.4.3 Can links interconnecting NIXI nodes be misused by connecting ISPs to carry their traffic between two stations on NIXI backbone? If so, can it be prevented technically?**

It can be easily used by any member ISP, Prevention of that technically is not possible as it is part of transit services provided. This has also been explained earlier in the response.

##### **5.4.4 Since NIXI is an organization not for profit, how cost towards interconnecting lease line etc will be collected from the members?**

It would be additional burden on ISPs, who are already incurring costs for connectivity and collocation charges to NIXI. NIXI should change its model to Layer-2 exchange facility provider and do the charging mechanism done by other exchange points globally. The

settlement of traffic among ISPs shall be done on mutually agreed bilateral agreement between ISPs.

#### **5.4.5 Whether interconnection of NIXI nodes will increase NIXI popularity and effectiveness.**

This would not increase the NIXI popularity because the domestic traffic is already exchanged by NIXI or other category 3 ISPs and NIXI would start competing with its member ISPs, which may lead to withdrawal of affected ISPs from NIXI in future.

#### **5.5 Is there a need to establish NIXI nodes at all state capitals?**

No, This will lead to huge investment in putting infrastructure at each node without any commensurate value addition as the content hosted in the country lies at approximately 9 – 10 major cities. Currently the Indian market is not mature enough to have content distributed across many cities and it also does not mesh with content provider business model.

VSNL’s recommendation is that before taking this decision, cost benefit analysis of infrastructure, its management, traffic growth etc should be done. Let the traffic at existing main nodes reach to a certain maturity level and we have enough content for distribution locally within the states and large ISP distributions in states.

##### **5.5.1 Whether there will be adequate traffic?**

Please see above, currently there is not sufficient traffic for opening more nodes of NIXI.

##### **5.5.2 What purpose will it serve if traffic is less?**

It would not serve any purpose other than increasing cost of operation & management of NIXI. The latency reduction which may be achieved would not be beneficial against the cost of operation. Further opening more nodes would lead to huge regionalization of routing tables in India.

##### **5.5.3 What should be the basis to take such decisions?**

Detailed cost benefit analysis for this should be carried out by professionals and work should be done on their recommendations.

#### **5.6 How segregation of domestic and international traffic can be done when a ISPs is peering as well as transiting the traffic of other ISP?**

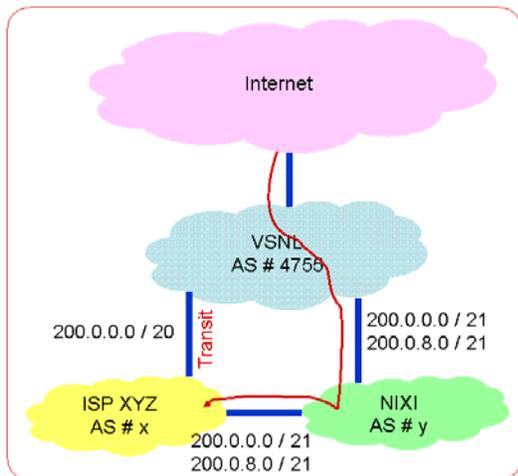
It can be done technically by Source based routing, which is operationally nightmare to manage and not possible by any big service providers. Traditionally two ISPs share only one relationship, either peering or Transit. IP is a destination based technology, where all traffic destined for one route follows a path irrespective of its source.

##### **5.6.1 Can NIXI platform be misused for routing international traffic?**

Yes, It has been observed and proved that NIXI platform has been used by ISPs for taking International traffic, which is very easy by technically manipulating the routes in BGP. IP being the destination based technology, all the traffic for one destination IP flows via a single path, irrespective of its origin.

Most of the ISPs in India are transit customers of VSNL, and are announcing certain prefixes to VSNL on their BGP sessions. However, if they start peering to NIXI also, and start exchanging routes with VSNL, they effectively become peering sessions with VSNL.

By doing small BGP manipulation of announcing aggregate IP addresses to VSNL on customer link and specifics to NIXI, the International transit traffic can be drawn via NIXI. This setup is explained in figure below.



### 5.7 Is there a need to upgrade NIXI nodes to facilitate implementation of IP V6?

NIXI is an operating network carrying critical traffic. Upgrading this network to IP V6 may not add much value at this time, but VSNL would recommend to setup a test bed network on IPv6 to study the benefits & migration plan..

### 5.8 Is there a need to define QoS for NIXI nodes? If so

QoS definition can be defined at NIXI nodes for traffic exchanging between NIXI router and Member routers, however robust and advanced NMS systems should be in place at NIXI NOC to measure these parameters on regular basis.

#### 5.8.1 What parameters need to define and how should it be monitored?

The parameters need to be defined as non-blocking switching architecture of NIXI, Packet loss/Utilization in Provider router connectivity to NIXI switch & his backbone from NIXI location to its hub location. For measurement of these parameters, NIXI NOC should have robust NMS systems and publish the reports regularly.

**5.9 Should NIXI settlement formula be considered for modification to encourage Data center and WEB hosting in India? If so, give your suggestions.**

Currently NIXI settlement formula should not be changed. However NIXI roadmap should be to create a platform where in various ISPs shall enter into voluntary bilateral/multilateral commercial model/agreements among themselves to exchange the traffic.

**5.10 Any other suggestion, which you feel will increase the effectiveness of NIXI?**

The National Internet Exchange of India (NIXI) was formed with main purpose to facilitate handing over of domestic Internet traffic between the peering ISP members. This would enable more efficient use of international bandwidth, save foreign exchange & further improve the Quality of Services for the customers of member ISPs, by being able to avoid multiple international hops and thus lowering delays. The current model and approach given in this paper is digressing original NIXI framework and general principles.

- **NIXI is not an ISP and will not provide Internet connections.** – By Interconnecting the nodes and providing Domestic Transit services, NIXI would become an ISP
- **The peering ISPs will enter into their own bilateral or multilateral commercial agreements as the case may be.** – Current model of NIXI is not allowing ISPs to enter into own bilateral or multilateral commercial agreements. It is forcing all ISPs to provide its traffic to other ISPs free of cost. The current model may be one of the detriments for less exchange of traffic at NIXI. NIXI shall only facilitate traffic exchange at layer 2. The ISPs shall voluntarily enter into a mutual bilateral/multilateral commercial agreement among themselves. The market forces will determine such commercial model instead of NIXI forcing it on to the members.
- **NIXI will not guarantee the presence of any particular service provider in NIXI to peer with.** – By mandating in ISP license for all ISPs to join NIXI would mean that this principle would not be valid.
- **NIXI will be carrier neutral** -- NIXI would not remain as Carrier neutral but become Carriers of Carrier.

VSNL would like to propose that improvements in the effectiveness of NIXI can be best achieved by fostering market conditions that nurture competition, maintaining the regulatory framework in such a way that Internet ecosystem in developed in natural way without affecting the business models & governance of participating members. A series of such actions can be quickly put in place to ensure that the basic objective of NIXI of ensuring domestic traffic remains within the country arises normally by commercial imperatives rather than by regulations.

Following are the main three changes proposed for improving the NIXI effectiveness:-

- 1) Modify NIXI's structure from that of a limited liability company to that of a mutual not-for-profit organization. ISPs should have the same member status and rights and obligations to seek the best strategic direction and promote best practices operations. The most

successful IX in the world in terms of adhesion are member associations (AMSIX, LINX, De-CIX);

- 2) Make the prime role of NIXI that of a state-of-the-art, neutral collocation facility provider in order to attract a critical mass of Internet players in convergent exchange points across the country;
- 3) Modify NIXI’s current routing policy from *forced regional multi-lateral peering* to *discretionary bilateral commercial peering*. This should allow market conditions and members’ commercial interests to flourish thus leveling the competitive playing field.

### **Mutual not for profit organization**

Successful IXs in Europe have embraced this organizational model in the past decade as it first and foremost conveys a message of inclusion to all prospective members. Attracting large numbers of Internet players and building a critical mass of traffic are key success factors to a growing exchange. Members will naturally converge when they see value for their money. Value is often represented by the sheer mass of traffic exchange between members. By developing the type of conditions noted above, NIXI will naturally attract members. It should be noted that mutual organizations typically elect their board from amongst the participating members.

### **Neutral Carrier-grade Facility (Colocation) Operator**

The main goal of an Internet Exchange points is to become a convergent point for Internet players. Throughout the world, successful convergent points have developed when the following conditions were present:

- a carrier-grade facility with built-in power resiliency for all HVAC requirements and power-hungry Internet equipment;
- an abundance of transmission providers competing for customers (neutral physical access);
- appropriate space configuration (racks, bays, cages)
- strict security measures and practices to absolutely protect against tampering
- *smart-hands* services for installation, configuration and maintenance.

In the USA, the main IX operators are known as Equinix & Switch and Data ( PAIX).They have developed best practices for the 24/7 operation of carrier neutral facility and internet exchange that have earned them the trust of all large backbone operators for whom they house their respective core Internet infrastructure.

There is an opportunity for NIXI to fill this role across India. India needs convergent points for its Internet infrastructure. Members will converge based on the value offered.

It should be noted that linking various NIXI nodes among each other is not advisable. IX operators in the USA, for instance, do not link their various collocation centers. It is up to the Internet players to do so according to their business plans and commercial goals. Linking NIXI nodes would make NIXI a competitor to national backbone providers and thus a competitor to its members.

### **Routing Policy:**

We would like to state that peering agreements across the globe are made more for commercial reasons rather than technical. Internet players in any matured Internet region have different business plans, goals and means. Together they form an ecosystem whereby they all thrive mutually.

The commercial Internet exchanges enjoying a growing member-base and explosive traffic-growth are those that have left announcements and routing decisions to the bilateral partners negotiating a given peering agreement (formal or informal). Bilateral partners make the decision to exchange the subsets of routes best suited to their mutual commercial interests. The agreement could be implemented in one of two ways: via a session over the public peering switch; or via private network interconnections

We strongly believe that forced multi-lateral peering is a severe impediment to any Internet exchange point growth (It can be observed clearly in HongKong). Under forced peering conditions Internet players tend to work “around” the IX not through it. (A reality that NIXI is experiencing today.) The obligation for an ISP to announce all its regional routes, which are in turn available to all NIXI participants, impedes NIXI’s growth and usefulness by negating the commercial advantage of individual Internet players.

NIXI should remain focused on primary objective of ensuring domestic traffic exchange within the country irrespective of its passing via NIXI. This will also increase effectiveness of NIXI. NIXI should create the environment & policies to ensure all ISPs in the country grow in a natural way to make India Internet region a matured & balance ecosystem and all domestic traffic should be exchanged within the country.

A working committee may be setup comprising of Technical, Regulatory, Business & Financial experts from Internet Industry to conduct the study of current state of Internet in India and future roadmaps for overall growth of industry in country and development of matured ecosystem. The future roadmap should be inline with the best practices followed in every matured Internet ecosystem across the globe.

Below, we are sharing business models and infrastructure setup of some of the main exchange points in the globe:-

Most of the countries are having multiple Internet exchanges, which are independent in nature and not interconnected. This is the stage of evolution of the ecosystem of the Internet in any country, where many exchange points come up and ISPs join them for exchanging traffic based on their own business models. We would like to highlight some details of major exchange points in the other parts of geography:-

#### **1. PAIX ( Palo Alto Internet Exchange Point) – United States ( USA)**

**Model :-** PAIX owned by Switch and Data Inc, is one of the biggest public exchanges in US providing hosting, interconnect and public switch peering options. Based on layer 2 model, where all the Service Providers (SP) are connected to common switch with SPs having freedom to choose the peers to peer with. The

setup allows the SPs to come closure and decide on peering based on traffic exchange between two in case it is commercially viable and meeting the policy criterions. The service providers setup multiple BGP sessions on the same connection to switch. The setup also offers private peering facilitating private interconnection between the SPs.

Switch and Data delivers comprehensive Internet exchange, collocation and interconnection solutions in a neutral marketplace with 34 datacenters in 23 markets and PAIX in 11 markets across North America. Switch and Data has already become the largest neutral interconnection and Internet exchange provider in the market offering interconnection to more than 330 distinct networks. PAIX have multiple points in US available for SPs to interconnect however these interconnect points are independent and not interconnected to each other due to wide geographies and the nature of services offered by PAIX.

**Interconnection :-** The interconnection between the switch and the SP router is installed and maintained by PAIX for which PAIX charges SPs a nominal fee. Moreover the infrastructure is owned by the internet exchange admin.

**Costing Model :-** The SP pays for interconnects and port connected to the switch on monthly basis. The charges may differ based on the traffic shared and commitments.

**Who benefits :-** The SPs connected choose peers based on the traffic shared and the cost involved and thus get the maximum benefit along with the infrastructure provider. The traffic is shared locally and thus the end user gets the benefits of reduced latency and packet loss.

**Infrastructure:-** Infrastructure (Collocation, power etc) is completely owned by PAIX.

## 2. EQUINIX – United States ( USA)

**Model :-** With a global footprint of more than 1.7 million square feet in 11 strategic markets across the United States and Asia Pacific region, Equinix Internet Business Exchange™ (IBX®) centers serve as core hubs for critical IP networks and Internet operations worldwide with direct access to more than 200 networks, including all of the top global Tier 1 networks. Majority of the networks have direct interconnection to Equinix for unmatched service diversity, flexibility and reliability making approximately over 90% of the world's Internet networks access via Equinix. It hosts major content and enterprise customers, companies like IBM, Google, Sony Online, General Electric, Electronic Arts, Primedia/About.com, Hotwire, Yahoo!, and Microsoft, who have all selected Equinix as their outsourced IT infrastructure partner.

Equinix, offers premium data center services with secure collocation; diverse, reliable and cost-effective IP connectivity; next-generation traffic exchange and peering; and managed outsourced IT infrastructure services for greater control, improved performance and lowered costs for their network and Internet operations.

Primarily designed for companies operating large IP backbone in North American region, Equinix is currently expanding in Asia Pacific region. Equinix participants are free to interconnect as they find it fit. The peering model is similar to PAIX where in the SPs are connected to the equinix switch to peer with other participants.

**Interconnection :-** Both the interconnection between Equinix switch and participant router or between two participants (Equinix Internet Core (ICE) participants) is managed by Equinix. No records of interconnection between Equinix data centers.

**Costing Model :-** Equinix charges for the interconnect between ICE participants and the port charges for interconnecting to Equinix along with interconnection charges on monthly.

**Who benefits :-** Both Carriers and their customers.

**Infrastructure :-** Owned by Equinix.

### 3. NAP ( NAP of AMERICAS) – United States ( USA)

**Model :-** NAP of Americas popularly known as NAP is one of the famous exchange points in North American region with approx 160 member peers. NAP facilities help increased traffic efficiency and reduced transit cost are among few places in the world where North American and International Service Providers choose to peer with one another. NAP is a carrier-neutral operator of a core Internet Exchange. It allows to establish Public or Private Peering arrangements.

Public Peering – VLAN connections to peers are established without using dedicated circuits. The data is securely carried by the VLAN shared only between peering or transit partners.

Private Peering – fully-redundant Exchange Point Platform which provides flexibility and functionality for private peering between participants with robust L2/L3 control platform..

**Interconnection :-** Two most common interconnections from SP router to NAP switch for public peering and between partners.

**Costing Model :-** The NAPs act as facilitator to carriers providing infrastructure and interconnection options with other carriers providing layer 2 separation. The charges for public port and the cross connection between carriers other than infrastructure charges.

**Who benefits :-** Carriers and customers.

**Infrastructure :-** Owned / leased

### 4. LINX ( London Internet Exchange point) - UK

LINX, the largest internet exchange in UK, has been facilitating carriers and ISPs for interconnection and traffic exchange since 1994. With approx 200 members as of

now it approx 170 Gbps of traffic is exchanged between its participants. LINX is a non-profit organization run for the benefit of members and governed by them collectively.

**Model :** LINX have at least two switches from different vendor installed in every LINX location, and the locations are interconnected by multiple 10 gigabit Ethernet circuits (across dark fibre) to form two physically separate backbone rings. Most LINX members connect to both switching platforms for extra redundancy, some members even connected at multiple locations.

LINX also has routers providing an IP network for our own systems and management of the switched network. However the routing between participating members is done at layer 2 using VLANs to transfer data between two members. The Linx router is just for route visibility and does nothing for routing decisions. LINX offers services to its members along with traffic analysis tool with source and destination of any traffic entering into the network useful for peering analysis.

LINX do have a private interconnect service on a separate infrastructure to enable bilateral connections to be provisioned efficiently and cost effectively between its members.

**Interconnection :** Both Public and Private Interconnections

Public – VLAN based, carriers to decide whom to peer with.

Private – Dedicated interconnect between members

**Costing Model :** Charges for cross connect, Public switch port and arranging private interconnects other than infrastructure.

**Who benefits :-** Carriers, content providers and end users.

**Infrastructure :-** LINX is present across 7 locations in London and do not own any of the sites. At each of them LINX is tenants in some form of co-location facility or carrier hotel.

## 5. MaNAP ( Manchester NAP) - UK

MaNAP is neutral, non-profit exchange facilitating operators to interconnect. Its members include the content providers and enterprises at 9 locations including Manchester and London.

**Model :-** MaNAP has switches located at all 9 locations to which partners / members can connect and can peer via shared infrastructure.

**Interconnection :-** Both Private and Public

Public – VLAN

Private – Private interconnects

**Costing Model :-** Similar to that of other peering exchanges.

**Who benefits :-** Customers and Carriers, It offers peering with its other switch interconnection but at a premium.rates.

**Infrastructure:** Owned.

## 6 LIPEX ( UK)

LIPEX was started as second exchange in London. With 6 points and approx 17 switches it has currently 70 peers with port speed from 10 Mbps to 1Gbps. The main members connected here are enterprise and content providers along with some European carriers.

**Model :-** Based on layer 2 with maintaining a route server to see the routes.

**Interconnection :**Public and Private. Majority of the traffic shared is via public ports.

**Costing Model :-**Based on port speed and cost of interconnect.

**Who benefits :-**Members joining it.

**Infrastructure:-**Owned

## 7. HKIX ( HongKong Internet Exchange) - HongKong

**Model :-** HKIX is co-operative project of internet access providers to share Hong Kong traffic locally. HKIX is layer 2 settlement free multi-lateral internet traffic exchange. This is also used to route the member’s customer traffic in other regions as well. HKIX at CUHK is a layer-two Internet Exchange over Ethernet. All participants connecting to HKIX at CUHK are exchanging data via an Ethernet that is a layer-two technology. All routers on the Ethernet are exchanging routing tables (or peering) with the route server set up by HKIX using BGP4.

The main purpose of the HKIX at CUHK is for routing of intra-HongKong traffic but it is acceptable if participants allow others to exchange traffic with their peer or downstream network(s) at other countries free of charge. HKIX has set up route servers for peering; participants must only peer with these servers. Participants can also peer with other participants directly as long as the arrangement does not violate any of the policies and guidelines of HKIX.

These routers are for the purpose of seeing BGP table only, the traffic is exchanged at layer 2. It provides minimal operational support.

**Interconnection :** Both Public and Private. Public to HKIX switch & Private between partners

**Costing Model :** Settlement-free in terms of traffic. Charges for interconnect to switch and between partners

**Who benefits :-** Customers and carriers due to local traffic exchange

**Infrastructure** : Owned.