



BITSYM

Smart Connections

**Xbits: Software Defined Internet
Services at an IXP**

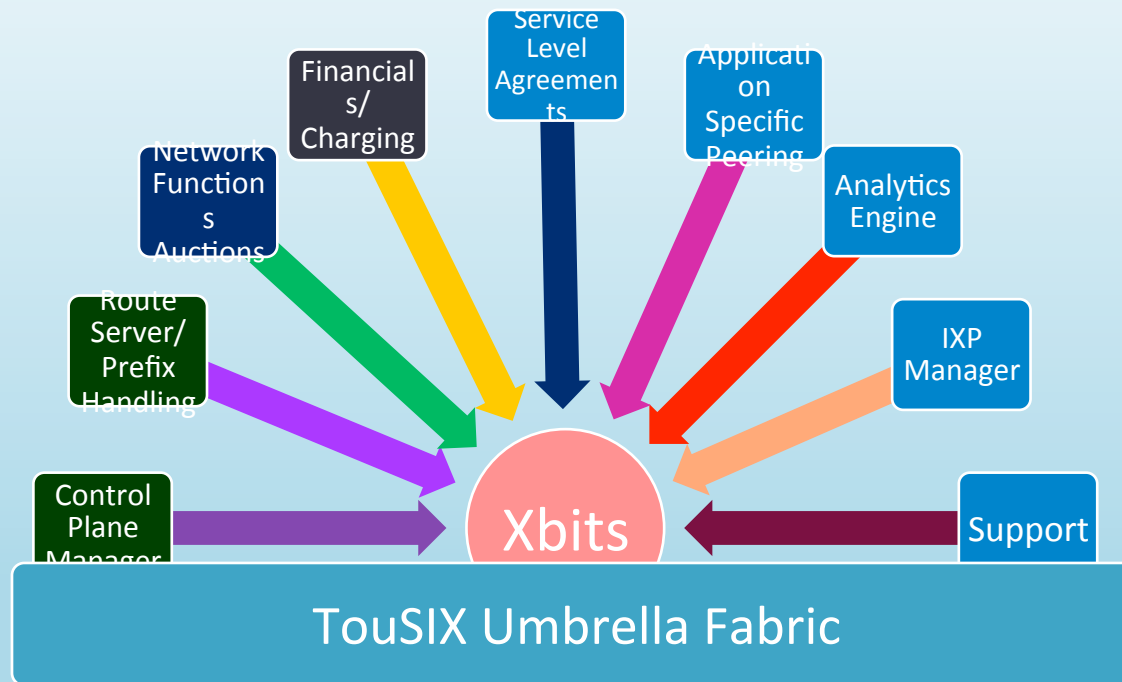
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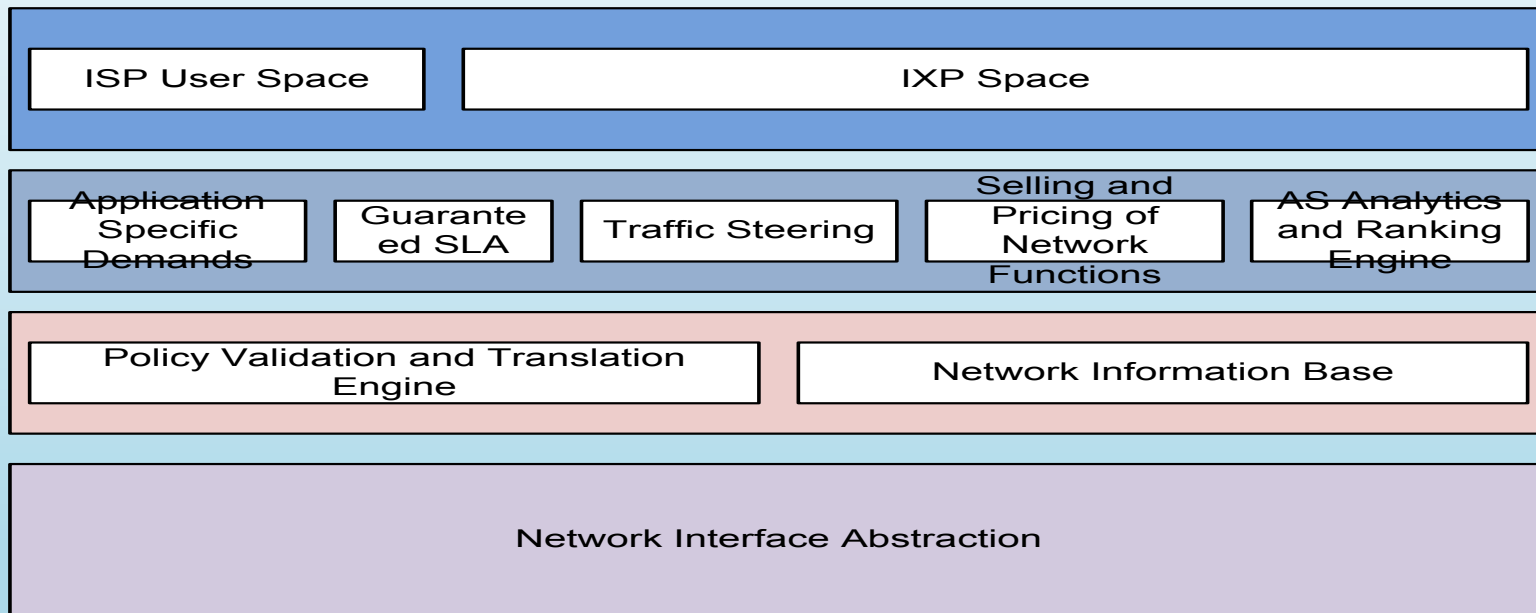
Xbits

- An upcoming effort to introduce programmable services at internet exchange points
- Makes possible/easier tasks such as:
 - Domain based or application specific peering.
 - Remote control peering
 - Enforceable inter-domain routing policies
 - Time of day routing
 - Dynamic traffic engineering for peering policy compliance

Xbits and TouSIX: Complementing Architectures



Architecture of IXP Application Interface



Possible Use Cases

Network Security

- Enhanced network security
- Provision of security services at line speeds such as:
 - Real-time attack detection
 - Flow diversion

Network Security: Attack Detection

- Behavioural flow analysis
- Monitor behaviour of protected traffic against requested class of service
- Builds peacetime (normal) traffic baselines
- Set flow entries for selected network flows to read traffic statistics for each of the Autonomous Systems
 - aggregating statistics collected for a given autonomous system from multiple locations

Network Security: Flow Diversion

- If the anomaly detector detects variation from the baseline traffic
 - Invokes redirection service to redirect only the suspicious traffic towards the scrubbing centre
 - After attacks, restores network to original configuration
 - First line of defence for ISPs

Brokerage: Pricing and Selling of Network Functions

Network functions auctioning with following major components:

- Resource advertising
- Resource auctioning mechanism
- Resource allocation mechanism
- Tracking of resource utilization
- Billing and charging functions

Brokerage: Example scenario

- A multimedia content provider intends to livecast a game event to selected set of customers a distinct autonomous system
 - e.g. in a specific state
- Customers have subscribed for distinct quality of service requirements
- Reach ability to end customers via multiple autonomous systems

Brokerage: Example scenario (contd.)

- Transit autonomous systems advertise their QoS with a base priceline
- Content provider bids for the resource, transit autonomous system accept or reject request
- Brokerage provides platform for matching buyers and sellers of network functions
- At the end of session, charges are settled from accounts of respective providers

Application Specific Peering

- Two users in distinct autonomous systems peering at the IX require temporary expansion of bandwidth for offering specific application
- The originating AS place the request at the IX brokerage with its acceptance criterion
- The destination and transit AS broadcast charges
- An automated/assisted best match is established at the brokerage
- Relationship terminates on conclusion of the session

Analytics Engine

- Aggregation of statistics at the controller
- Provision of decision feedback to individual clients on peering agreements
 - Quality
 - Time of day
 - Load balancing
- Steering of traffic through middleboxes based on
 - intelligent collection of statistics
 - participant policy

Customer Controlled and Configurable Services

- Basic SDN paradigm follows a principal: SDN interfaces should be extensible and abstract.
- In the designs of IXP applications, customers should be able to specify their peering criterion.
- In Xbits, customer given access to their own specific AS space and the services that are available from other AS.
- Based on these, customers would be able to develop their own custom applications.

Consumer Specific Dynamic Delivery of Applications

- Differential consumer specific traffic handling and treatment is another feature that maybe desired by individual IXPs.
- An example is popular web destinations (e.g facebook) and video streaming services (e.g. youtube)
 - may require dynamic servicing through multiple AS based on QoS demands from end use customers.
- ISPs can advertise these demands to the IXP , bid and obtain resources that meet these application demands.

Consumer Specific Dynamic Delivery of Applications

- e.g. Broadcast services can also monetize ISP (and IXP) to allocate better resources to their services.
- This feature can be implemented as a dynamic policy framework in the designed application interface.

Selling and Pricing of Network Functions

- With the proposed architecture, network functions could be offered at a price to other network owners.
- Network owners will open up selected programmatic interfaces to their networks to third party independent software vendors
- Creates an ecosystem of network application developers using network intelligence
 - Enrich existing network applications
 - Possibly new network applications

Selling and Pricing of Network Functions

- Application developers jointly with backing of their network owners
 - can assign pricing functions to their services
- IXP can act as a facilitator to reach an agreement between the two autonomous systems
 - a) completely automated
 - b) with minimal human intervention.

Selling and Pricing of Network Functions: Example Scenario

- Offloading of an AS traffic to another AS during peak hours
 - paying the transit fee based on the pricing introduced for forwarding.
- The pricing function can also make use of embedded analytics to create new services
 - enrich existing applications through programmatic interfaces.

Charging

- Base set of IXP peering / interconnect services offered at no charge
- Charging based on value added services offered

Conclusion

- Xbits offers a promising interconnect mechanism with added flexibility to offer differentiated services
- Opens up L2 IXP interfaces for innovation for a robust SD-WAN