

ANGEL - Moving your Home Broadband Experience to Heaven

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- ANGEL System
 - Goals
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 - Basic Protocol Information
- Summary

Motivation



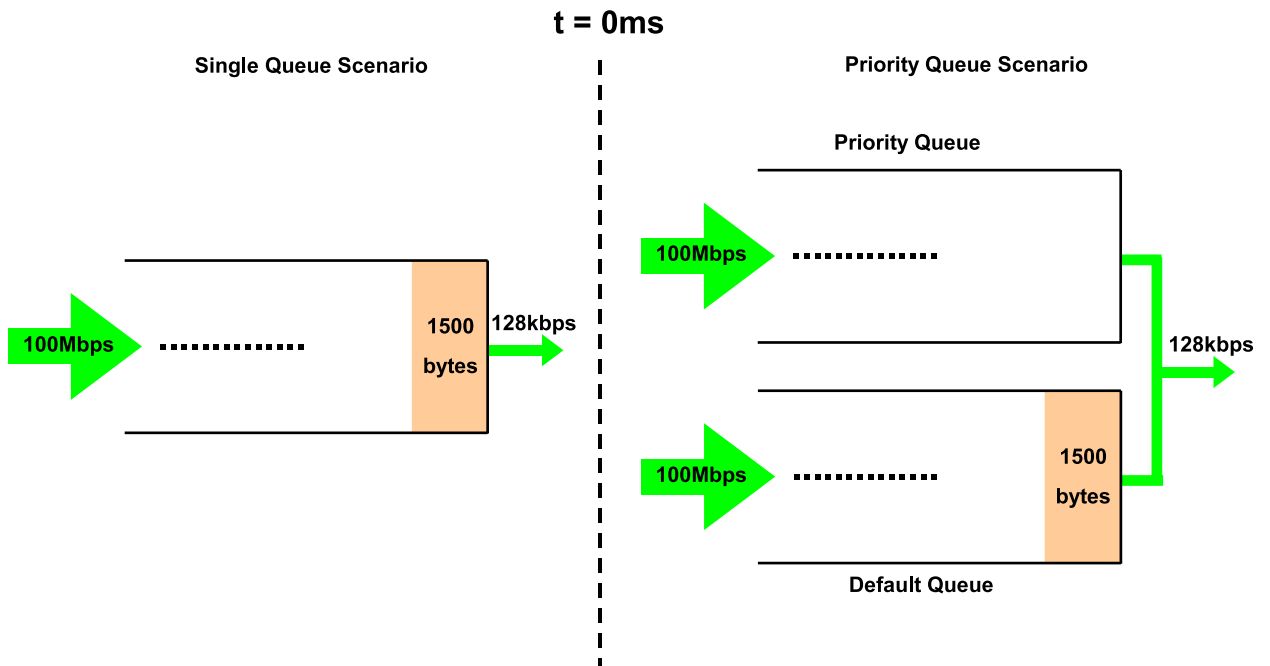
- Last-mile access links are typically bottlenecks
- Traffic from one (or more) PCs arrives at access router at LAN bitrates
- Even traffic from one PC can result in queuing - concurrent applications
- Queuing of packets is inevitable
 - Queued at access router and serialised onto Internet Link
 - Can affect both realtime and TCP flows
- Variable latency and loss experienced by network flows
- We assume that most QoS problems are due to the bottleneck link
- QoS can be improved by prioritising traffic over these links

Motivation

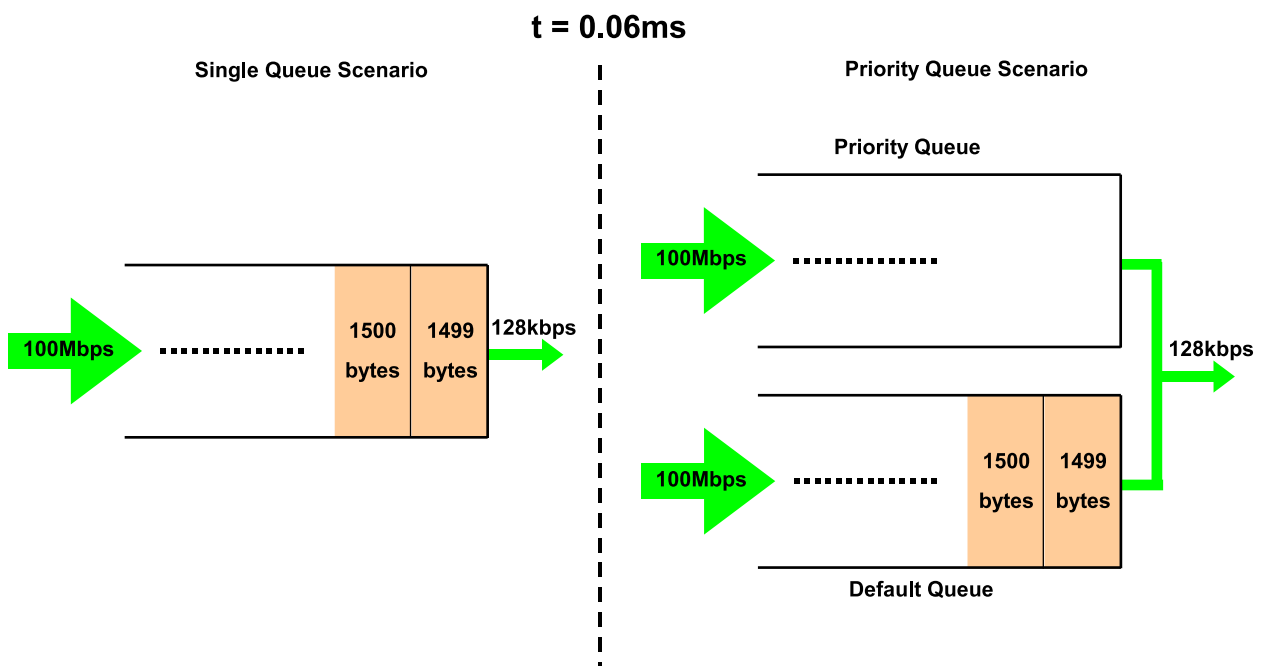


- Existing QoS schemes not widely implemented
 - End-to-end QoS (IntServ) too complex and not scalable
 - Class-based QoS (DiffServ) requires an unreasonable level of trust and co-operation between network operators
 - End host applications do not signal QoS requirements to the network
 - Too complex for the technically illiterate user
 - Too many different technologies

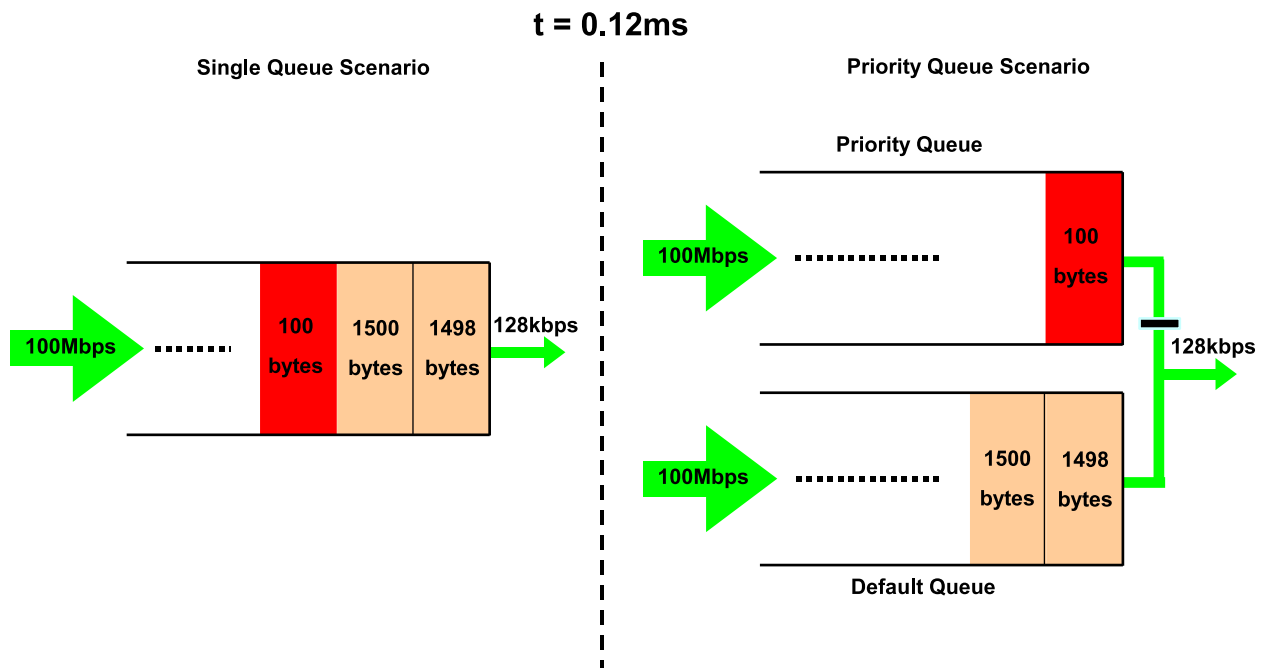
Prioritising Traffic



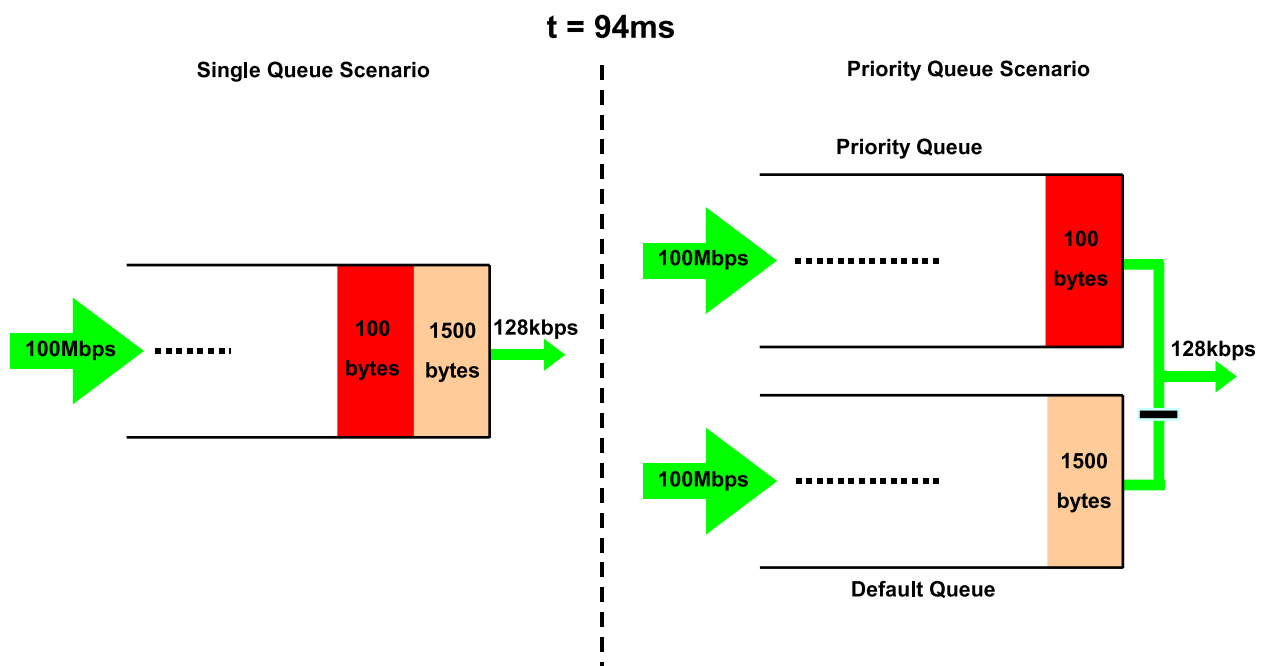
Prioritising Traffic



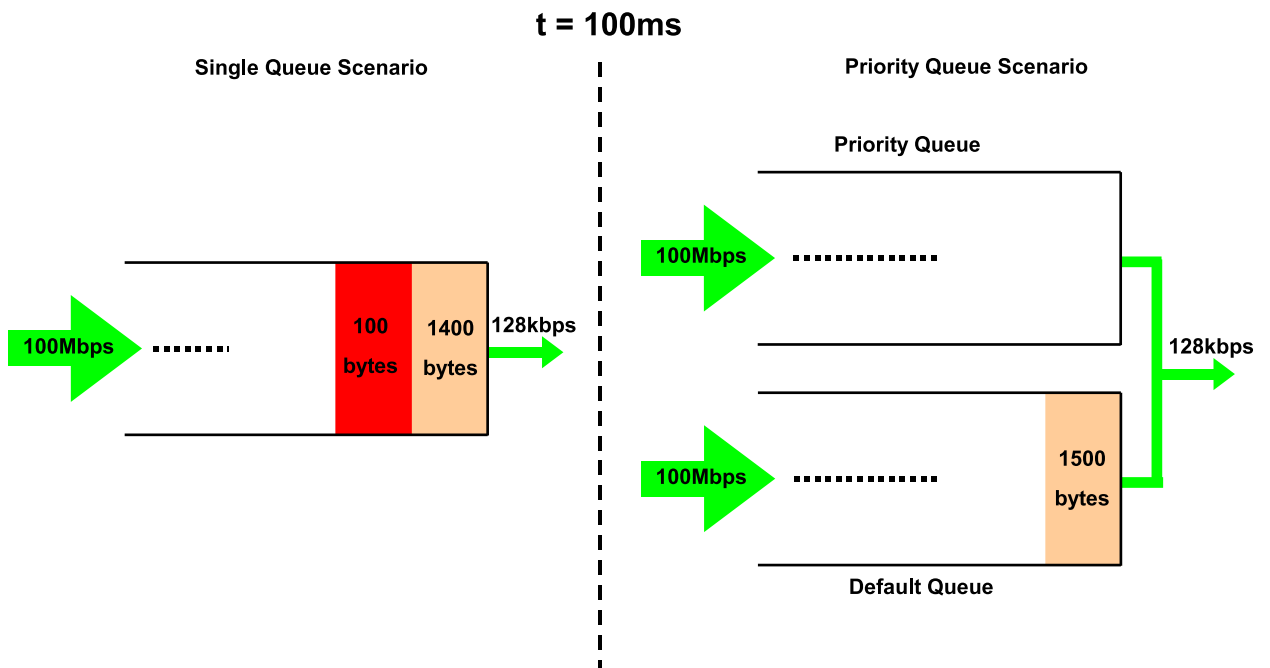
Prioritising Traffic



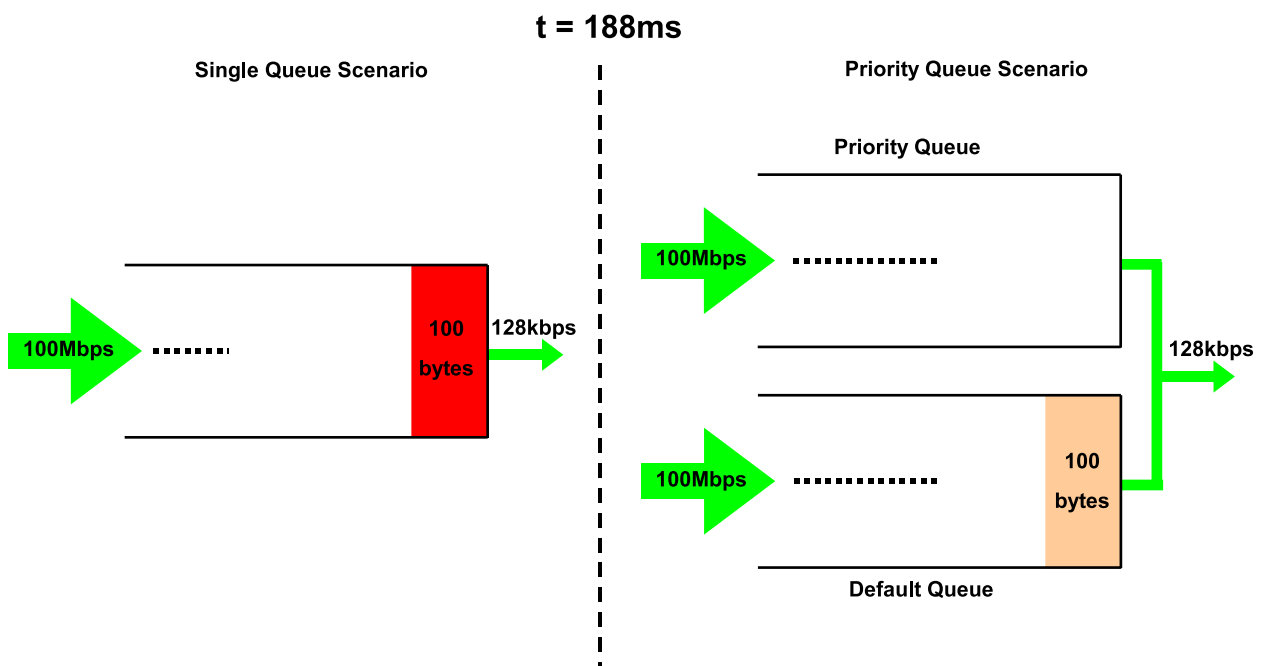
Prioritising Traffic



Prioritising Traffic



Prioritising Traffic





- **ANGEL - Automated Network Games Enhancement Layer**
 - Based on existing work at CAIA¹
 - Focusses on prioritising traffic at bottleneck links between the ISP and end user
 - No signalling across different ISPs
 - Transparent to end host applications
 - Transparent to end users
 - Minimal requirements on end user access router equipment

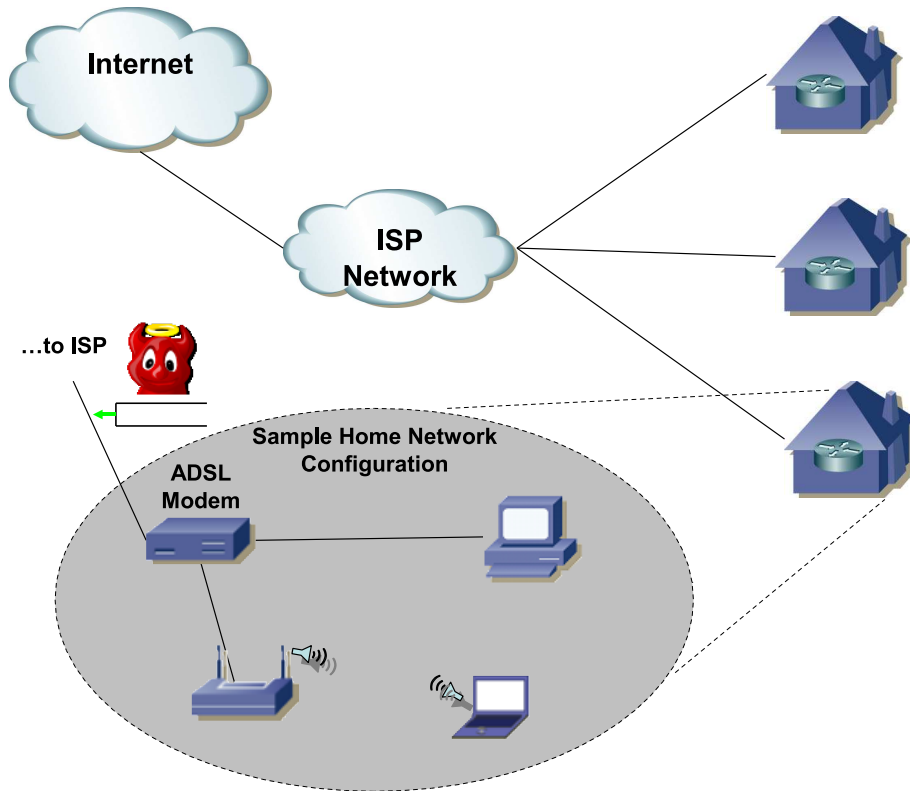
¹L.Stewart, G.Armitage, P.Branch, S.Zander, "An Architecture for Automated Network Control of QoS over Consumer Broadband Links," IEEE TENCON 05 Melbourne, Australia, 21 - 24 November, 2005



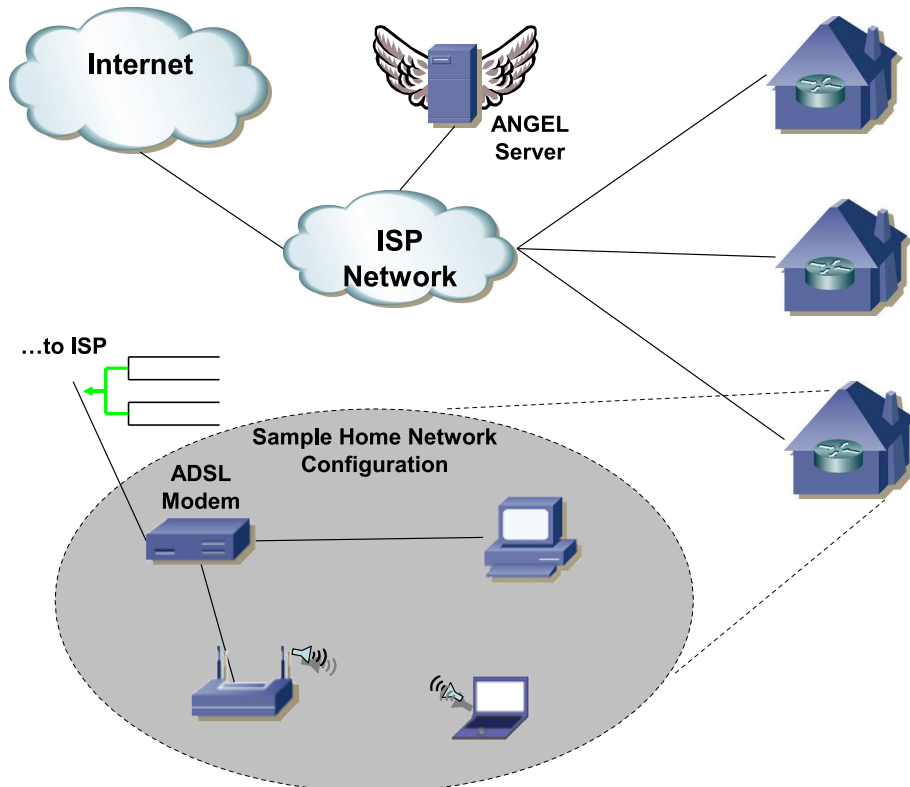
- Equipment within the ISP detects presence of network game traffic flows
 - Online gaming is a large industry²
 - CAIA has extensive experience in network games related research
 - Network games have strict QoS requirements
 - The technique is expandable to other real-time flows in the future (eg. VoIP, streaming multimedia)
- Reconfigures the network (consumer access routers and possibly ISP routers) to prioritise these flows

²"Revenue from online games will grow threefold to \$1.1 billion by 2008, helping the nascent industry corner 10 percent of the global video game market" - Source CNet News, Published July 12, 2004 http://news.com.com/Study+Online-game+revenue+to+skyrocket/2100-1043_3-5266062.html

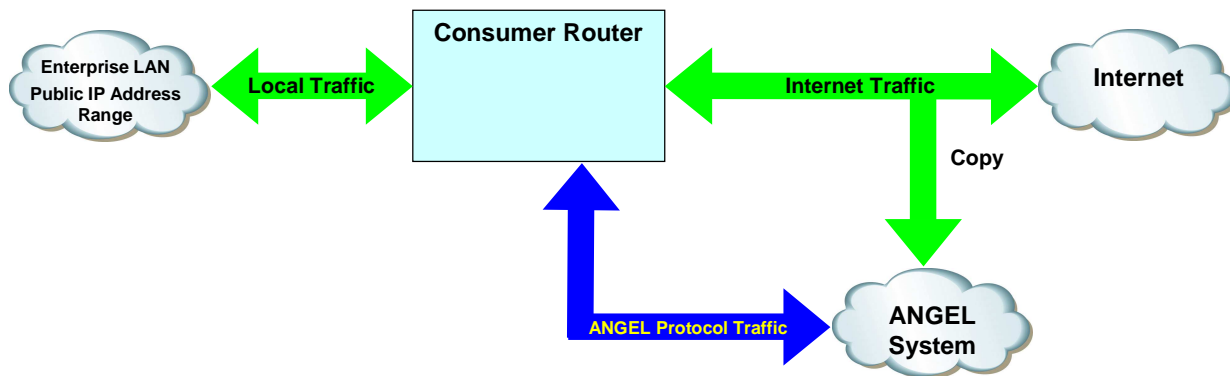
Living in broadband hell



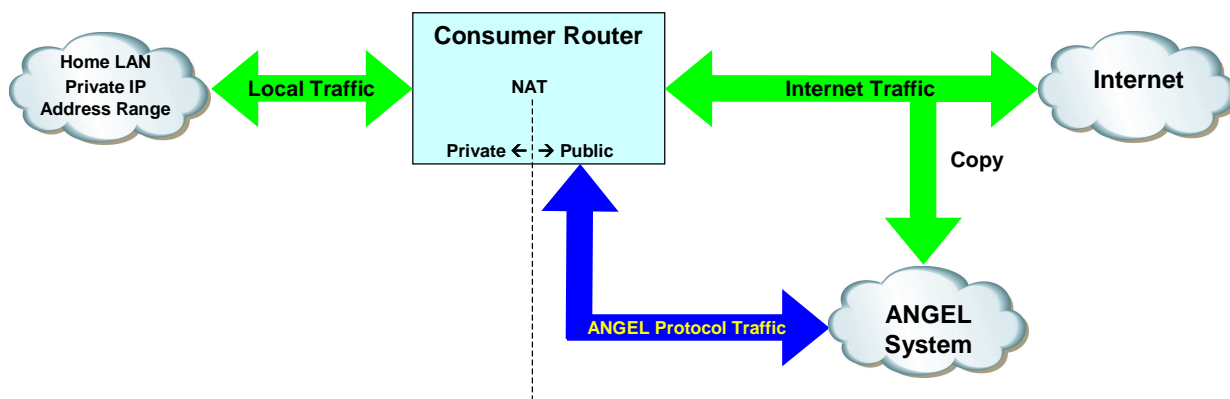
Living in broadband heaven



Common Usage Scenarios (1)

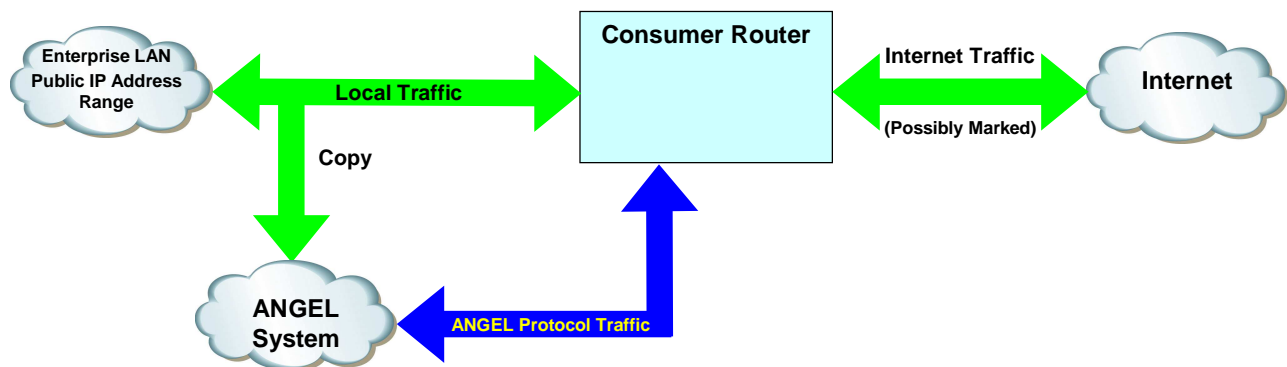


Common Usage Scenarios (2)



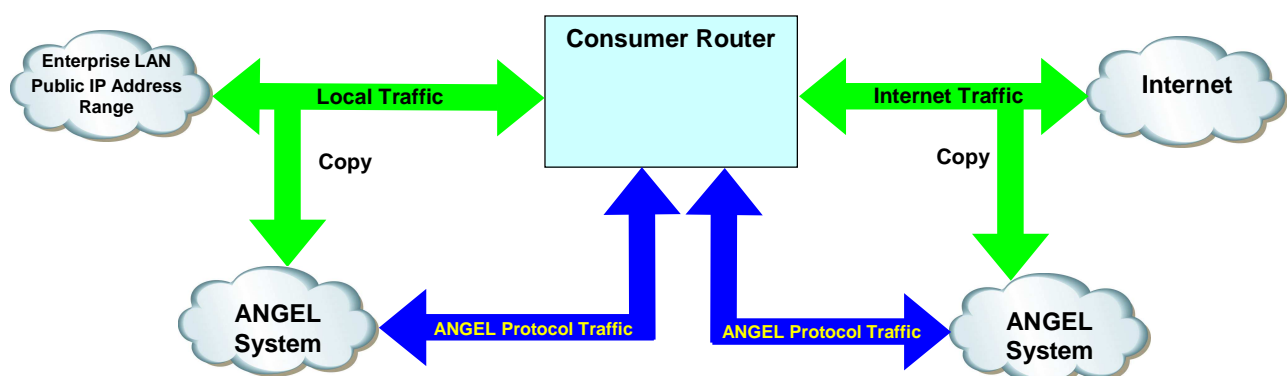
- ANGEL must work where NAT is used in the router/network

Common Usage Scenarios (3)



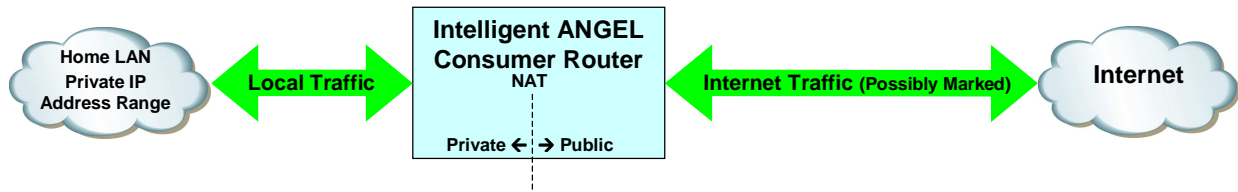
- ANGEL should also work where the ISP does not offer ANGEL services and the customer wishes to run their own ANGEL System

Common Usage Scenarios (4)



- ANGEL must work where the user wishes to use both their own ANGEL System and ANGEL services provided by the ISP

Common Usage Scenarios (5)



- ANGEL must be able to be deployed internally within a smart broadband access router

Requirements



- Overall System Requirements
 - Independent of different network access technologies
 - Scalable to support a large number of both subscribed (tens of thousands) and simultaneously online (several thousand) users
 - Failover mechanisms to provide a reliable and predictable service
 - Transparent to existing end host network applications and end users
 - Deployable in networks with equipment that is not ANGEL enabled

Requirements



- ANGEL Consumer Premises Router
 - Must support a means of prioritising traffic
 - Must support dynamic modification of traffic prioritisation rules
 - ANGEL support must be configurable
 - Should support user defined rules
 - Auto discovery of ANGEL enabled ISP network
 - ANGEL traffic should be prioritised

Requirements



- Flow Metering
 - Must be able to differentiate network flows
 - Must implement timeouts to detect the end of a flow
 - Must export flow feature sets at regular intervals
 - Feature sets being calculated should be configurable
 - Must be fast enough to process traffic of a number of customer routers

Requirements



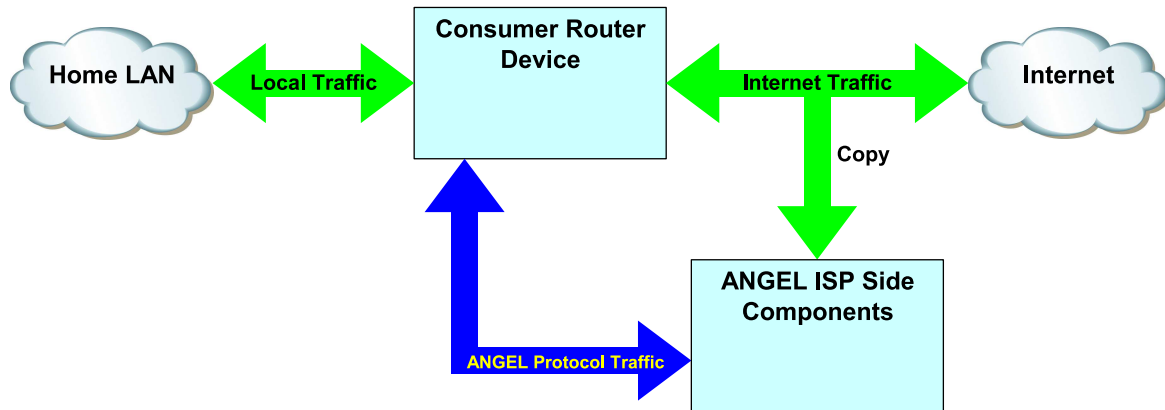
- Flow Classification
 - Must provide reasonably high (> 95%) accuracy
 - Must provide classification within a short time from the start of the flow and continuously for the flow duration
 - Must be fast enough to classify hundreds of flows per second
 - Must be flexible in supporting a range of existing and future classification techniques
 - Must keep some state per flow (to detect changes in state)
 - Must not export information where classification has not changed

Requirements

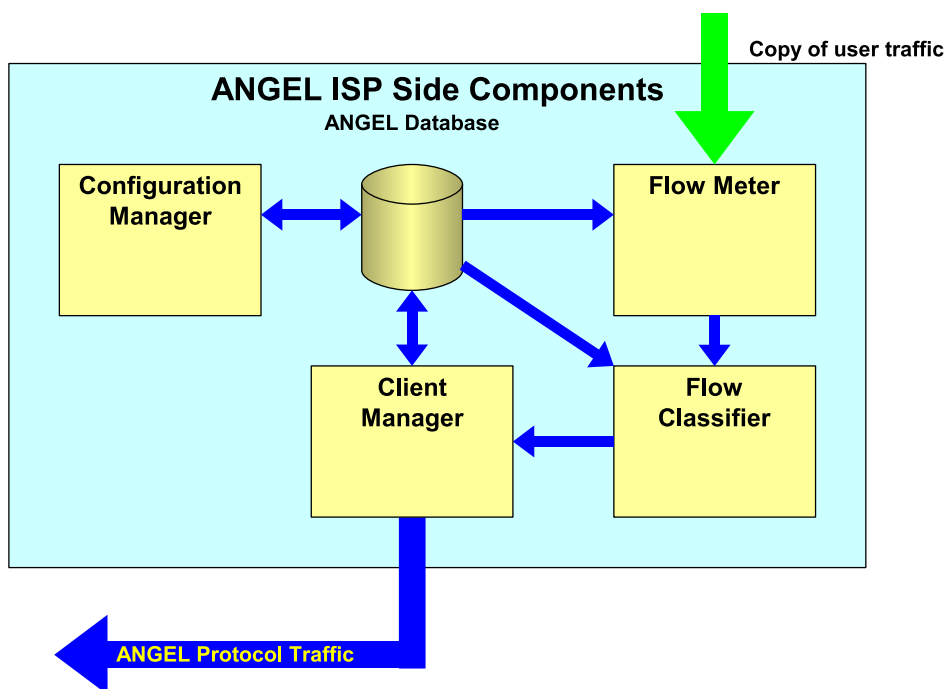


- QoS Signalling Protocol
 - Must run over IPv4 and IPv6
 - Must run over one of UDP, TCP or SCTP
 - Must be flexible to support new messages and data fields
 - Prioritisation rules must be generic
 - Simple - minimise router and network resource requirements
 - Must support reliable message transfer
 - Should support communications over an insecure network
- A more complete set of requirements can be found in the ANGEL Architecture document

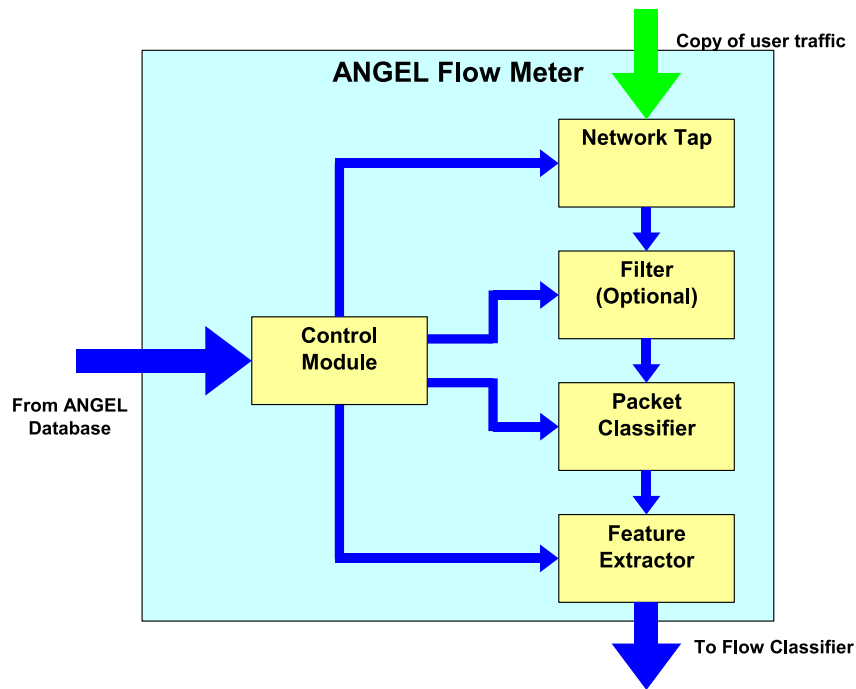
ANGEL - System Architecture



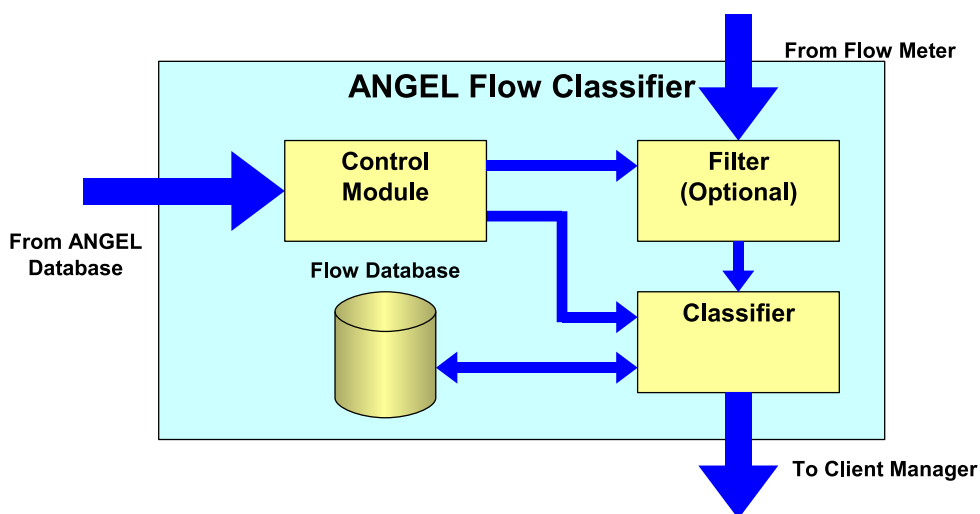
ISP Component Architecture



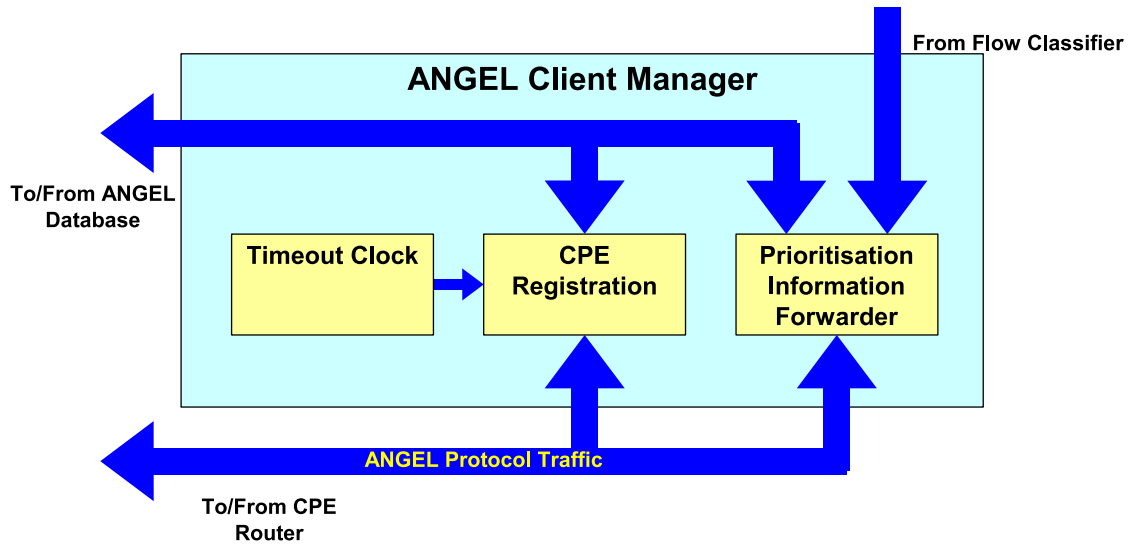
Flow Meter Architecture



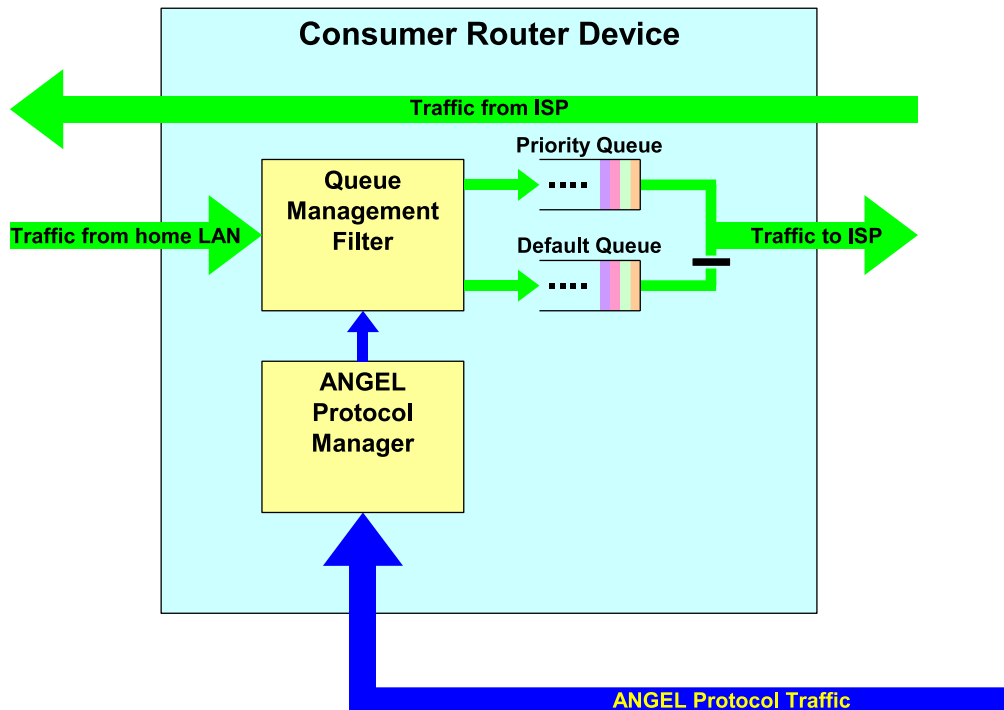
Flow Classifier Architecture



Client Manager Architecture



Consumer Router Architecture



Scalability & Redundancy (1)



- Multiple distributed Flow Meters
- Locations dictated by userbase, network design and traffic patterns
- Flow Meter implemented as a cluster
 - All machines receive a copy of the same network traffic
 - All machines calculate same set of flow features
 - One machine in the cluster forwards results to the Flow Classifier
 - In event of failure, another machine in the cluster assumes control

Scalability & Redundancy (2)



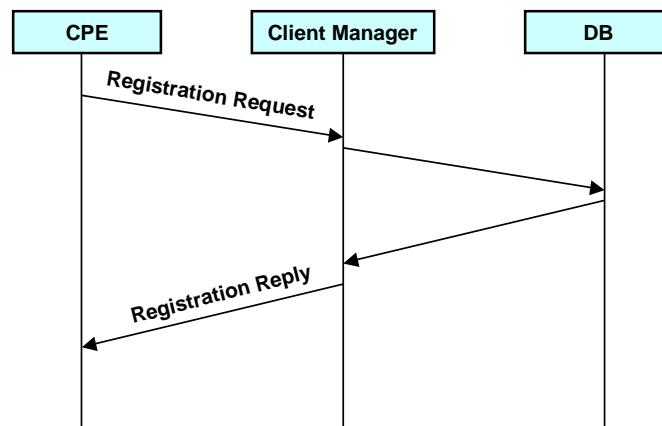
- Flow Classifier implemented as a cluster
 - Increase available processing power - more flows
 - Support for single machine failure
 - State information about classified flows must be available to all machines in the cluster
- Optionally implement as a single virtual machine - transparent implementation to Flow Meter units

Scalability & Redundancy (3)

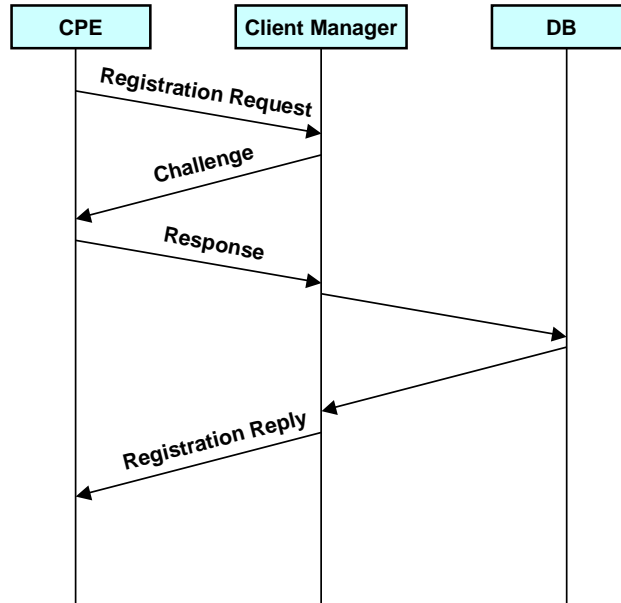


- Client Manager
- Similar approach to Flow Classifier implementation
- ANGEL Database stores consumer router details - any machine can manage communications with the end routers

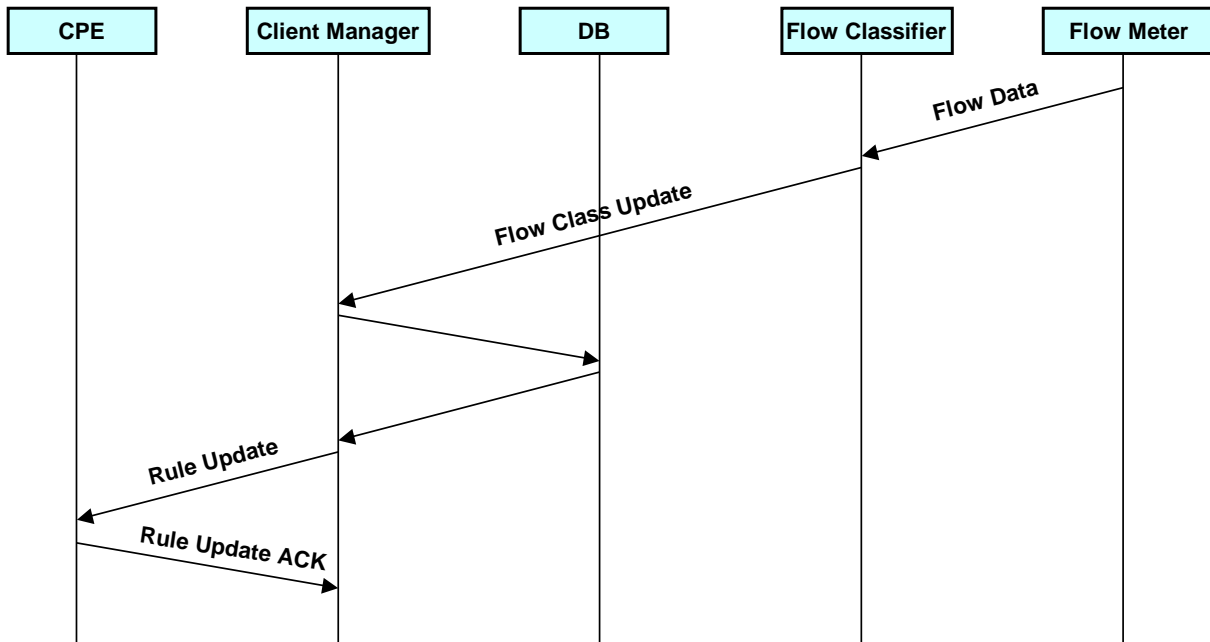
Protocol - Registration Phase



Protocol - Secure Registration



Protocol - Rule Update



Summary



- ISP-Customer access links are bottlenecks
- Existing QoS schemes are too complex
- ANGEL:
 - Focusses on prioritising traffic at access links
 - Simple, Transparent, Scalable
- Currently under development