

ANGEL - Automated Network Games Enhancement Layer

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(Presented by Grenville Armitage)
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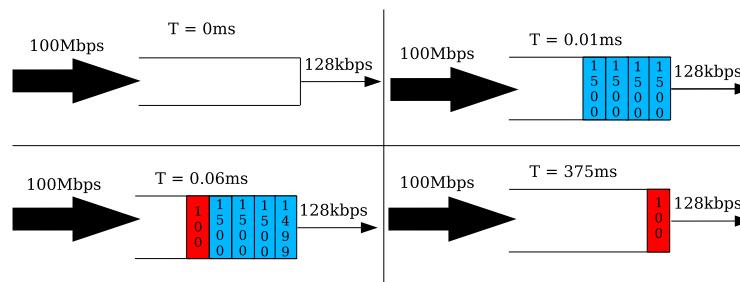
Outline

- The issues
- The Queuing Problem
- Benefits of Priority Queuing of Game Traffic
- ANGEL
 - Requirements
 - Stakeholders
 - Basic Architecture
- Flow Classification
- Machine Learning



- Highly interactive network games have different network requirements compared to other applications
- Users ability to play successfully is highly dependent on network QoS
- With the increase in broadband popularity
 - Internet connections being shared amongst multiple users
 - Users often run network applications concurrently
- End-to-end QoS solutions are not practical
 - Requirements of application not properly understood by developers
 - Network equipment often does not implement QoS solutions
 - Configuration complex for average home users

The Queuing Problem

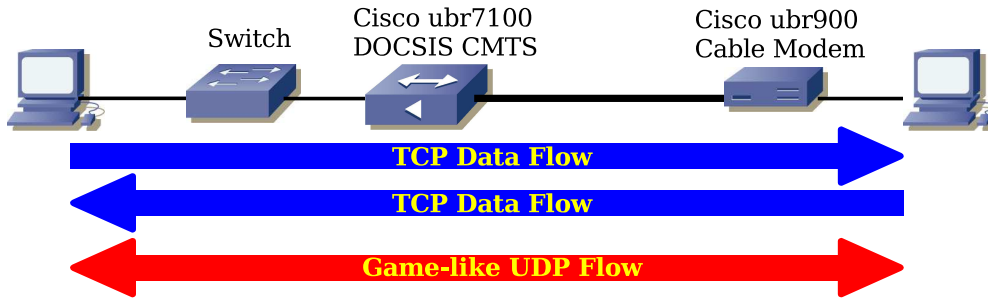


- Imagine a low-bandwidth consumer upstream link (128kbps) sharing:
 - TCP upload using as much bandwidth as the network will allow
 - Network game application generates small periodic UDP packets
- TCP is bursty - each burst will be queued by the gateway for transmission
- The game packet is queued behind the TCP burst
 - Priority queueing of game traffic should improve performance at minimal cost to TCP throughput

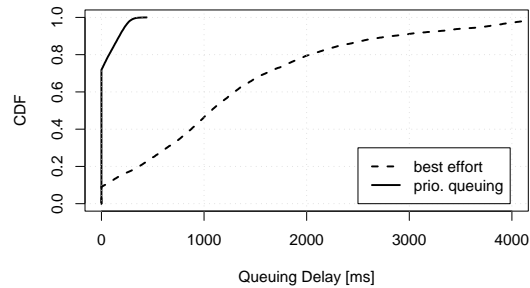
Priority Queuing Game Traffic



Experimental Configuration



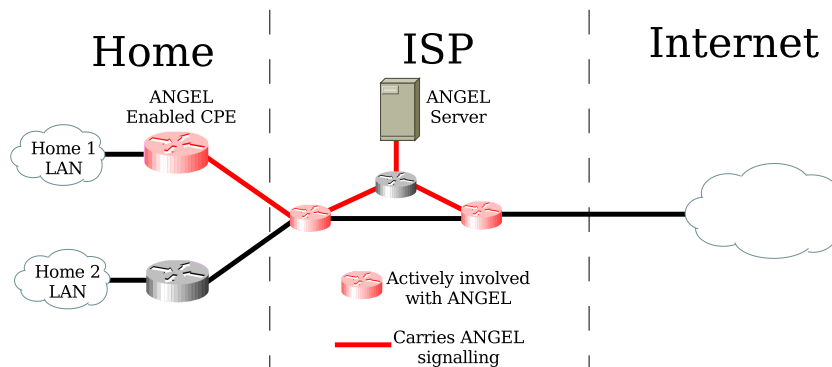
Parameter	Best Effort	Game Traffic Priority Queued
	U/stream TCP Thruput	~170kb/s
D/stream TCP Thruput	~580kb/s	~380kb/s
U/stream Game PLR	28%	0.06%



Game Packets Queuing Delay CDF



ANGEL - Requirements



- A prototype system to identify game flows within the ISP and forward this information to CPE devices for prioritisation purposes
 - **Scalability** - Potentially support all ISP customers
 - **Access Technology Independence** - Must work at IP layer
 - **Transparency** - Transparent to end-host network applications
 - **Flexible Prioritisation** - CPE device chooses prioritisation means
 - **Heterogeneous Networks** - Not all users may be running ANGEL
 - **Minimal CPE requirements** - CPE processing capabilities



ANGEL - Potential Stakeholders



End Users

- Improved perceived performance in network gaming applications

Internet Service Providers

- Better customer service - both users and game service providers

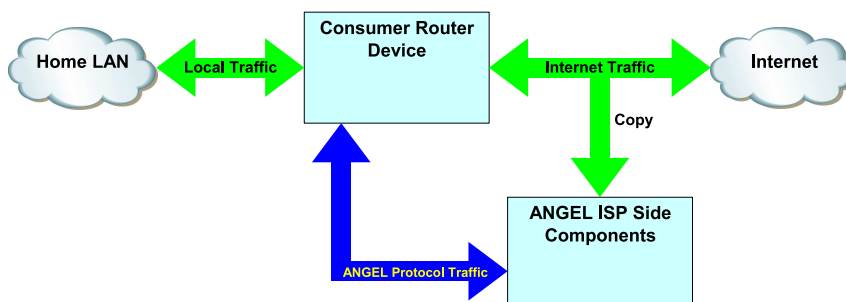
Game Service Providers

- Improved online gaming performance will increase user base

Network Equipment Manufacturers

- Deploy ANGEL into CPE and/or ISP side network equipment
- Potential early adopter relationships between manufacturers and ISPs as preferred suppliers

ANGEL Architecture



ISP Side components

- **Flow Meter** - Monitors network traffic at a location, filters into flows, forward packet and flow information to Flow Classifier
- **Flow Classifier** - Classifies flows into gaming or non gaming classes. Change in classification of a flow is forwarded to Client Manager
- **Client Manager** - Manages database of registered users/CPE devices. Forward flows to be prioritised information to CPE and other network devices

Key ANGEL Advantages



- Flow detection moved into ISP network
- Minimal resources required in CPE equipment
- New classification models easier to propagate
- Choice of classification technique independent of ANGEL architecture

Flow Classification



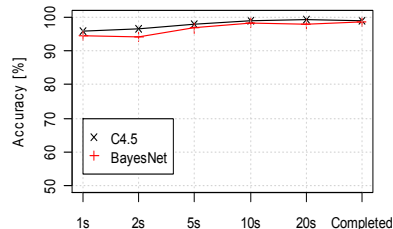
- ANGEL does not specify **how** to classify flows
 - Architecture specifies how packets are captured and passed to the Flow Classifier
 - Classifier can use any means to perform classification
- Traditional Classification Techniques - packet inspection
 - Port numbers - new applications, dynamic allocation
 - Stateful Flow Reconstruction - not scalable, encrypted flows
- Our prototype will use Machine Learning
 - System trained using representative flow data
 - Flows classified from commonly available features (*eg. packet size, inter-arrival times*)
 - No payload information required - privacy issues

ML for Real-time Classification



- Problems
 - **Build accurate models** - Need to create training data that allows classifier to quickly/accurately identify flows
 - **Processing** - Need to classify potentially tens of thousands of flows, each within a short timeframe

- Two commonly used algorithms are able to quickly and accurately identify these flows



- Other work¹ shows that Enemy Territory can be accurately separated from non-game traffic using a sliding window of 25 packets

¹T.T.T. Nguyen, G. Armitage, "[Training on Multiple Sub-flows to Optimise the use of Machine Learning in Real-World IP Networks](#)", IEEE Local Computer Networks Conference LCN2006 (*to be presented*)

Summary



- Networked games are typically played within a local topological region
 - Which often leads to geographical locality performance
- Majority of bottlenecks occur at the edge of the network
- Priority queuing of game traffic
 - Improves game traffic QoS - player performance
 - Minimal effect on TCP throughput
- ANGEL:
 - Does not attempt to solve end-to-end QoS issues
 - System to detect network game flows in the ISP network
 - Forward information to ANGEL-enabled CPE devices
 - CPE device prioritise these applications
 - Processing shifted to ISP
 - Uses Machine Learning techniques to classify flows in real-time