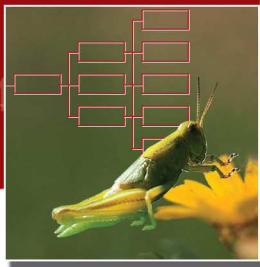


ClassHopper

for VxWorks

Alternate Queuing Disciplines



ClassHopper is a robust, lean, high performance, alternate queuing discipline framework for VxWorks®. **ClassHopper**'s unique, advanced features include a class-based queues implementation and a framework for supporting custom queuing disciplines. Its small footprint and flexible APIs have been specifically designed for use in an embedded environment. In addition, **ClassHopper** performs traffic classification, conditioning and scheduling in the input as well as output directions, enabling bandwidth control for different packet types. It offers unsurpassed flexibility through its built-in queuing implementations and customizable features. **ClassHopper** is the optimal solution for voice and video applications that require guaranteed real-time throughput and bandwidth allocation for critical data streams in the network stack. It also enables the network stack to handle overload

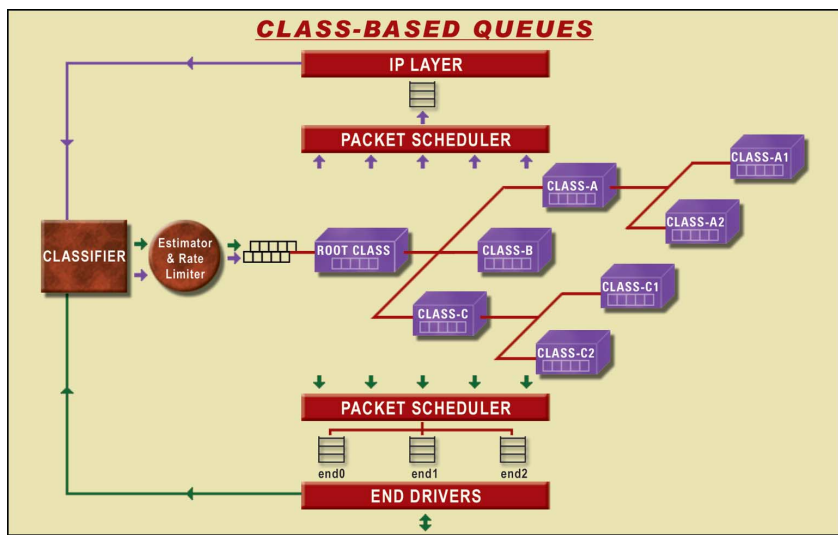
conditions gracefully with selective packet discard and for effective avoidance of Denial of Service attacks at the network layer or higher, by effectively policing the boundary between the driver and the stack using custom configured rules. It can also be used to implement traffic regulation for Multi-Class / Multi-Link PPP implementations such as **TeamF1's GrandPPPrx** product.

Traffic Prioritization

Today's heterogeneous networks use a variety of protocols which creates an acute need to prioritize traffic to satisfy time-critical applications such as audio/video streaming while fulfilling the needs of less time-dependent applications, such as file transfers. Without active management of QoS in the network stack, different classes of traffic may share the same network queues and can interact with one another in ways that adversely affect application

Features

- ❖ Implements CBQ, WFQ, and other queuing disciplines.
- ❖ Hierarchical bandwidth classes for both input & output directions.
- ❖ Scheduler combines priority, weighted round-robin and borrowing.
- ❖ Defends against denial of service (DoS) attacks by rate limiting based on traffic classification.
- ❖ Integrates well with MC/ML-PPP for traffic shaping of IP backhaul traffic.
- ❖ Support for Layer 2 fields such as 802.1p tags.
- ❖ Support for CPU types of either endian-ness including PowerPC, MIPS, X86, ARM/XScale.
- ❖ High-performance, minimal latency.
- ❖ Royalty-free!



VxWorks Edition Features

- ❖ Designed exclusively for VxWorks and VxWorks based Platforms
- ❖ Requires no special VxWorks source modifications
- ❖ Integrated with VxWorks build & install methodology
- ❖ Project Facility componentization in Tornado IDE
- ❖ Enhanced memory management & partition support
- ❖ Native support for VxWorks 5.3, 5.4.x, 5.5.x, 6.0 and AE

performance. **ClassHopper** enables the use of sophisticated queuing disciplines instead of the standard tail-drop queues used in network stacks. This enables a tightly controlled yet flexible system of traffic prioritization and congestion management for network packets based on criteria such as Layer 2 fields (such as VLAN tags and 802.1p prioritization fields), Layer 3 fields (ToS bits, source and destination IP addresses or TCP/UDP ports), or any custom fields within a network packet.

Flexible Framework

The **ClassHopper** framework contains APIs that provide:

- ❖ Abstractions to support a wide variety of QoS functions.
- ❖ A platform to easily implement new queuing disciplines without knowledge of the underlying kernel implementation.
- ❖ A system model with 3 independent components.

Also Available

- ❖ **FireFly & GNAT**
IP-Filtering Firewall & NAT
- ❖ **GrandPPPrx**
Multi-Class / Multi-Link PPP
- ❖ **SSecure Family**
SSL, SSH, IPsec/IKE
- ❖ **Switchcraft Family**
Layer 2 protocols - LACP, STP, RSTP, MSTP, 802.1x

Custom Solutions

TeamF1's professional services can provide the resources and expertise to build customized implementations of **ClassHopper** solutions and support for custom queuing disciplines.

Customization Flexibility

- ❖ Available in full-source format
- ❖ Modular design enables overriding the class management, estimator, and scheduler
- ❖ Controllable timer granularity for traffic bursts
- ❖ Framework for adding custom queuing disciplines
- ❖ Customization hooks and callouts
- ❖ Unwanted components can be scaled out

- **Classifier:** classifies a packet to a scheduling class based on predefined rules.
 - **Queuing Discipline:** implements packet scheduling and buffer management algorithms.
 - **Queue Regulator:** limits the amount that a driver can dequeue at a time.
- ❖ A string based command interface to configure the system parameters and functionality.

Queuing Disciplines

ClassHopper's ALTQ (alternate queues) system allows various queuing disciplines and traffic conditioning models to be seamlessly implemented using the framework.

These include:

- ❖ **CBQ:** Class Based Queuing.
- ❖ **WFQ:** Weighted-Fair Queuing.
- ❖ **RED:** Random Early Detection.
- ❖ **ECN:** Explicit Congestion Notification.
- ❖ **RIO:** RED with IN and OUT.
- ❖ **Flow-valve.**
- ❖ **H-FSC:** Hierarchical Fair Service Curve.

A complete implementation of CBQ and WFQ is included with **ClassHopper** and can be used as a reference to implement the above disciplines, or custom disciplines using its framework.

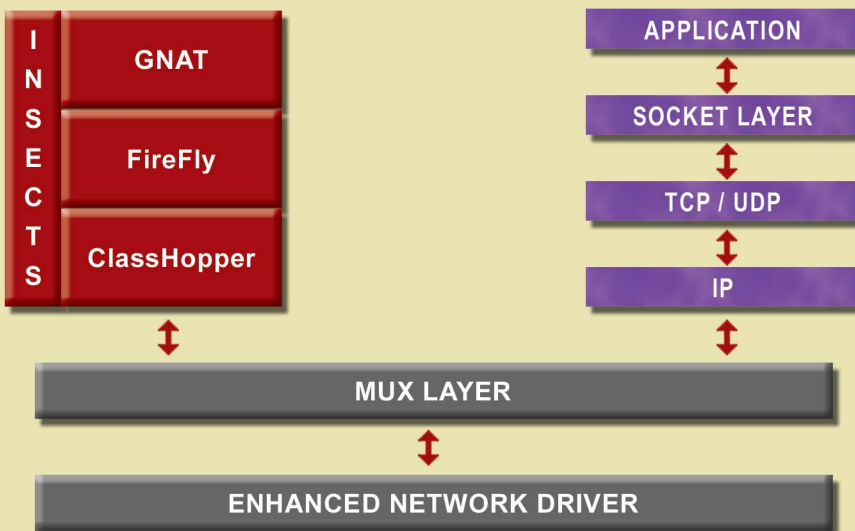
Management Support

ClassHopper supports an easily customizable management interface that can be programmatically controlled or managed using a string-based command layer, controlled through a web-server, structured data files such as XML or via a CLI. **ClassHopper's** rules can use a variety of criteria including custom field specifications based on headers at Layer 2 (data-link layer) or higher. These fields can be used for classification of incoming traffic as well as for tagging outgoing traffic. This combined with the highly flexible framework for adding custom queuing disciplines enables the provisioning of highly sophisticated congestion management and traffic prioritization policies, and enabling end-to-end QoS.

Built for VxWorks

The **VxWorks** edition of **ClassHopper** is a drop-in component for **VxWorks 5.x, 6.0** and **AE**. It has been extensively validated on a variety of CPU

INSECTS "BUMP-IN-THE-STACK" MODEL



architectures, and this minimizes development and integration efforts. **ClassHopper** is especially optimized for **VxWorks** and **VxWorks** based Platforms such as PNE, PCD and PID, with support for multi-tasking and memory partitions and transparently works with the native network stack in **VxWorks** or with **TeamF1's NetF1** high-performance stack as well as other third-party stacks. Like the other members of the **INSECTS** suite, it is built as a network service that binds itself with the MUX layer, thereby guaranteeing compatibility with any **VxWorks** application with minimal to no changes, and without any special network stack source code requirement.

This product includes software developed by the SMCC Technology Development Group at Sun Microsystems, Inc.

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