CI&SS Lab

UNIVERSITÀ PARTHENOPE
DiST
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Intelligent Signal Processing

Multimedia Kernels

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Introduction

- From the '90s to today there has been a wide development of Operating Systems (OS) for Multimedia applications

- We take a brief look at the following OSs and Kernels
  - BeOS
  - Haiku
  - kernel Qlinux

BeOS

- BeOS is an OS for personal computers produced by Be Inc. in 1991
- Main objectives
  - provide a system particularly suited to the development and execution of multimedia applications
    - audio, video and 3D graphics
  - OS highly modular
  - single user
  - symmetric multiprocessing by utilizing modular I/O bandwidth
  - pervasive multithreading
  - preemptive multitasking
  - provide a 64-bit journaling file system for high dimensional data

BeOS

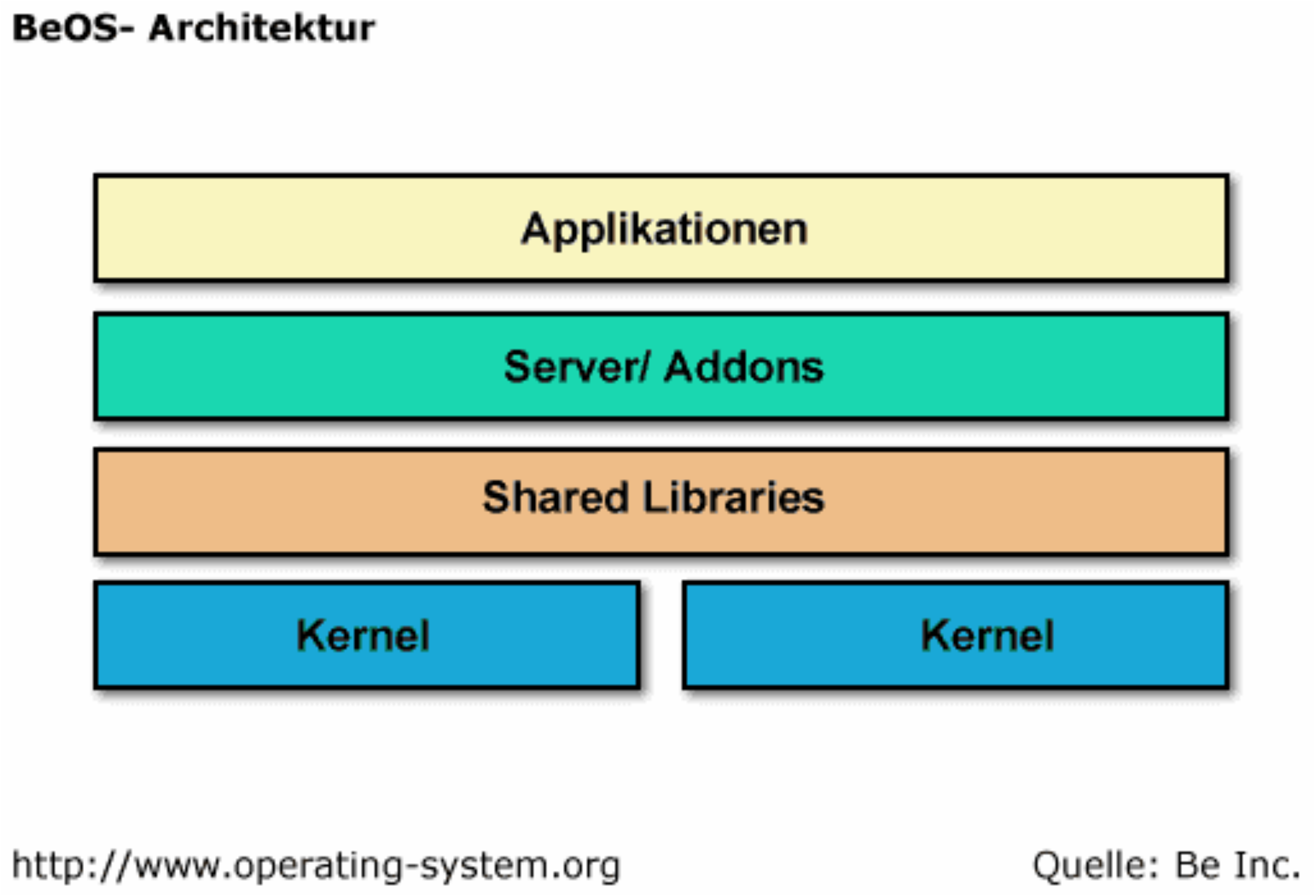
- The company Be Inc. was founded by Jean-Louis Gassée and Steve Sakoman
  - they left the Apple company
- BeOS was
  - Initially designed to run on AT&T Hobbit-based hardware (BeBoX)
  - Later modified to run on PowerPC-based processors
- The company was acquired by Palm Inc.
- OpenBeOS (OBOS) has been founded in 2001 as the official successor of BeOS as open source project

BeOS

- Today BeOS is mainly used and developed by a small population of enthusiasts

- BeOS (and now Zeta) continue to be used in Media appliances
  - Edirol DV-7 video editors from Roland corporation
  - Tascam SX-1 digital audio recorder runs a heavily modified version of BeOS
  - iZ Technology sells the RADAR 24 and RADAR V, hard disk-based, 24-track professional audio recorders based on BeOS 5
  - Magicbox, a manufacturer of signage and broadcast display machines
  - Final Scratch, a 12” vinyl timecode record-driven DJ software/hardware system, was first developed on BeOS

Architecture



BeOS- Architektur

Applikationen

Server/ Addons

Shared Libraries

Kernel

Kernel

http://www.operating-system.org

Quelle: Be Inc.

Architecture of BeOS

BeOS features

- BeOS is designed for handling large amounts of data
  - it is suitable outstanding for Multimedia applications such as video and audio processing as well as Raytracing
- Structural short response time of 250 microseconds between individual Threads
  - suitable for time-critical tasks like the recording of videos in real time
- The access to files takes under 10 milliseconds, depending on the used hardware

BeOS features

- BeOS is capably to use Plug&Play devices

- The object-oriented Design allows it to activate new drivers without complete restart

- During the loading only the depending media module is restarted in few seconds

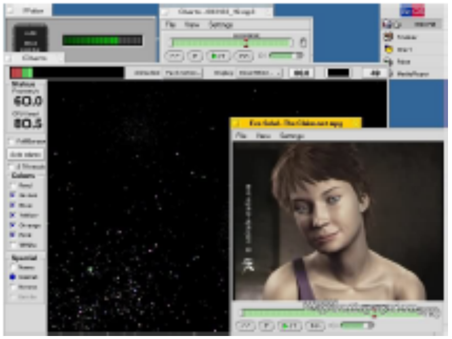
BeOS features

- Memory protection
  - an application crashes without having any disturbance on other running applications

- BeOS has an extremely advanced file system
  - 64-bit
  - characteristics of a relational database
  - protection against file corruption
  - multithread

BeOS

BeOS 4.5, boot



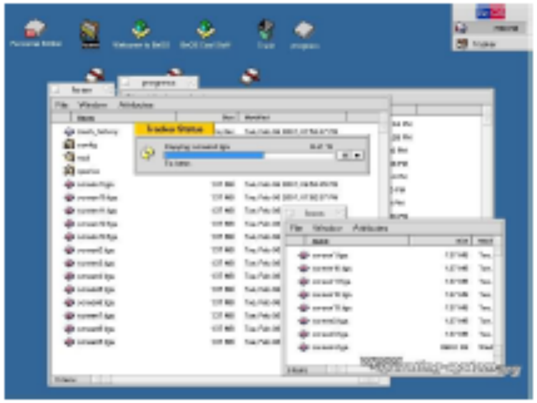
BeOS 5.0, multithread

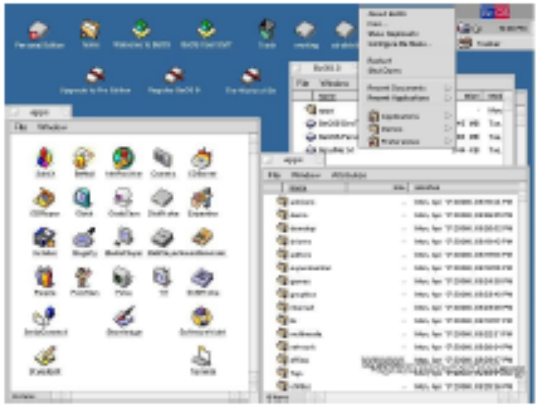
BeOS

netpositive

Welcome to NetPositive

BeOS 5.03





Haiku

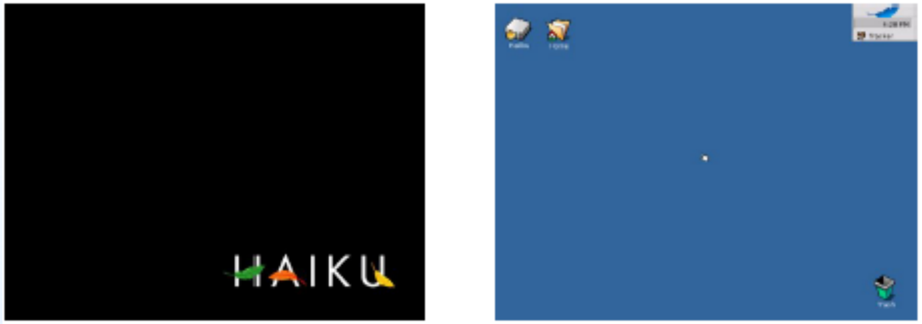
https://www.haiku-os.org

- OpenBeOS (OBOS) is the new founded project on 18 August 2001 for the official continuation of BeOS as open source project
- Not Shared Source of BeOS is rewritten to avoid licensed source code
- Michael Phipps announced at the event WalterCon 2004 19 the renaming of OpenBeOS in Haiku
- The name reflects the elegance and simplicity, the name given to Japanese poems composed of several predetermined sentences

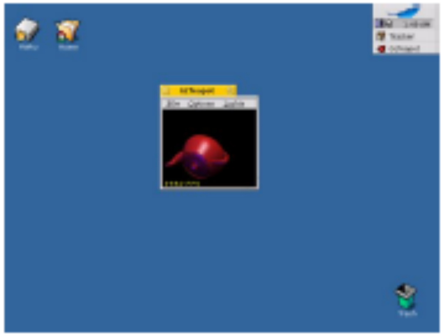
Haiku

- Objectives of this project are the creation of a desktop operating system that
  - requires no administration
  - easy to use
  - has open source code
  - developed in C++
  - provides object-oriented API
- Development platform
  - x86 32-bit and PowerPC architecture
  - SMP is supported
  - Linux and BSD derivatives are used in future

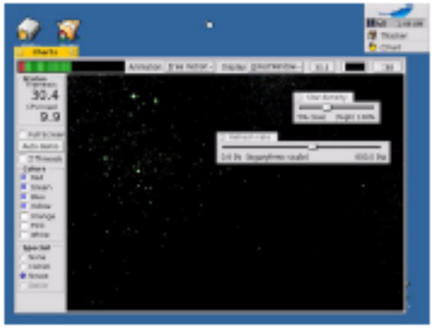
Hiku



Boot e Desktop



OpenGL



Astronomy

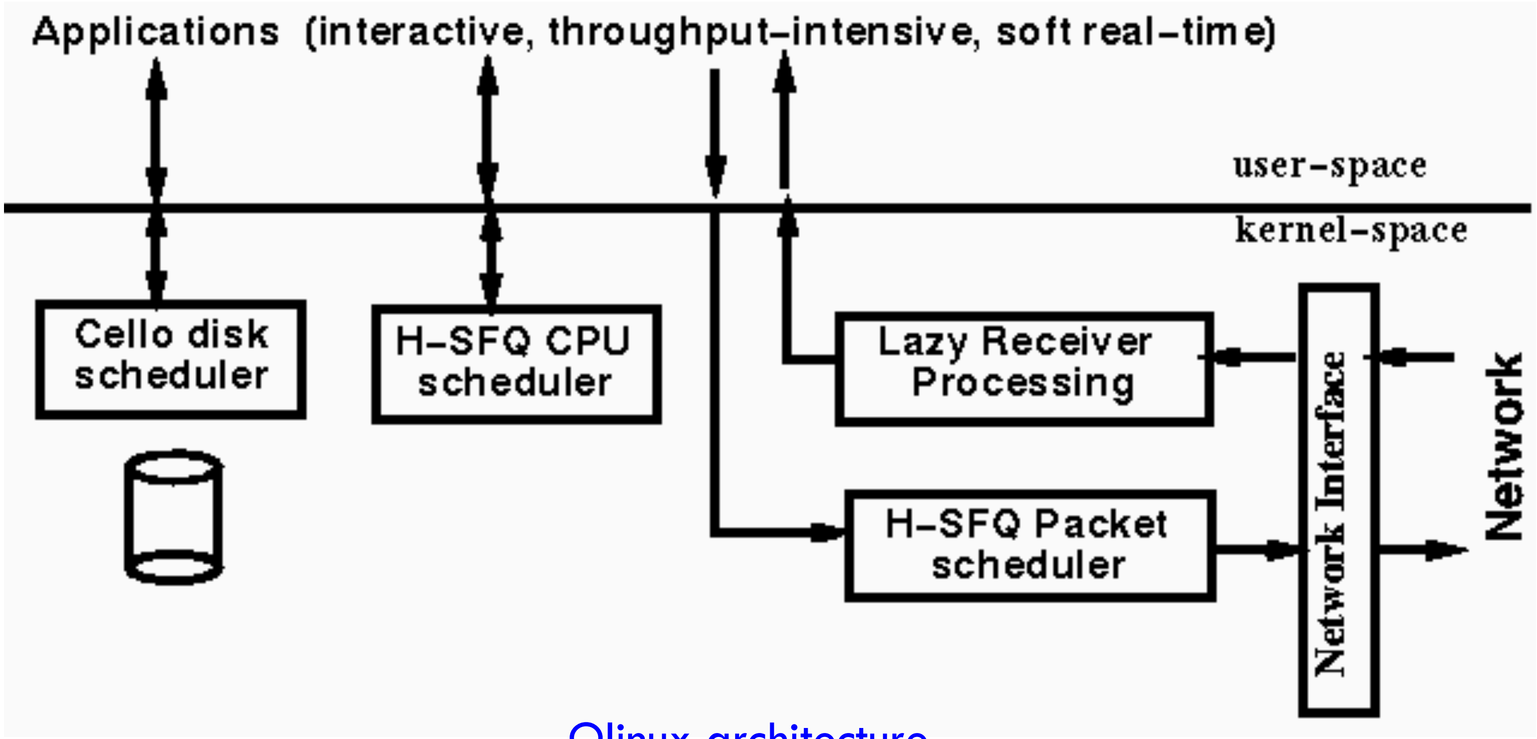
Graphic

QLinux

- Is a QoS enhanced Linux Kernel for Multimedia Computing (Q is for Quality)

- Qlinux combines some of the latest innovations in OSs research and it includes
  - Hierarchical Start Time Fair Queueing (H-SFQ) CPU scheduler
  - Hierarchical Start Time Fair Queueing (H-SFQ) network packet scheduler
  - Cello disk scheduling algorithm
  - Lazy receiver processing (LRP) network subsystem

QLinux



Qlinux architecture

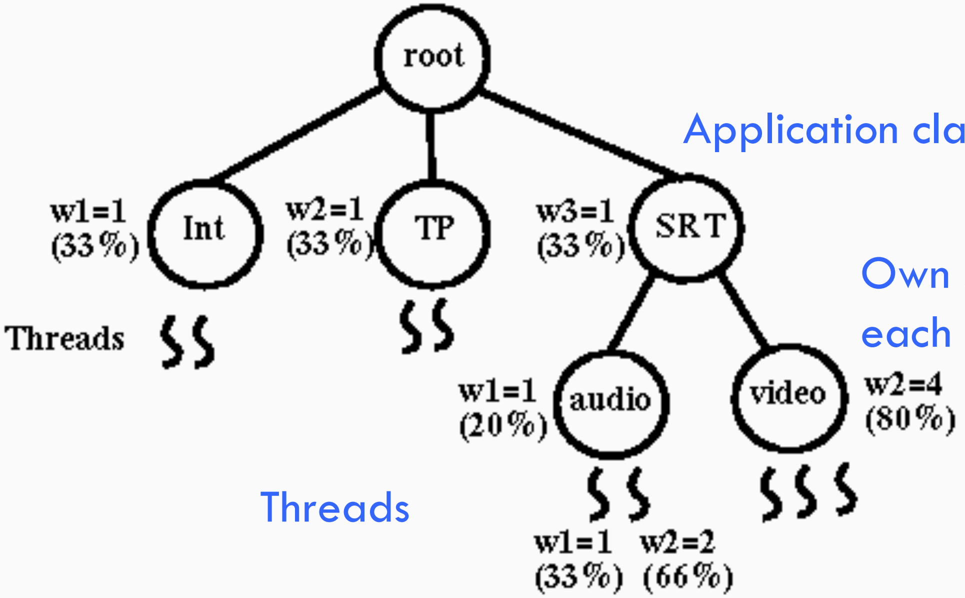
H-SFQ CPU scheduler

- It enables hierarchical scheduling of applications by fairly allocating CPU bandwidth to individual applications and application classes

Weights (parent class)

$$B_i = \left(\frac{w_i}{\sum_j w_j} \right) * B$$

Tree



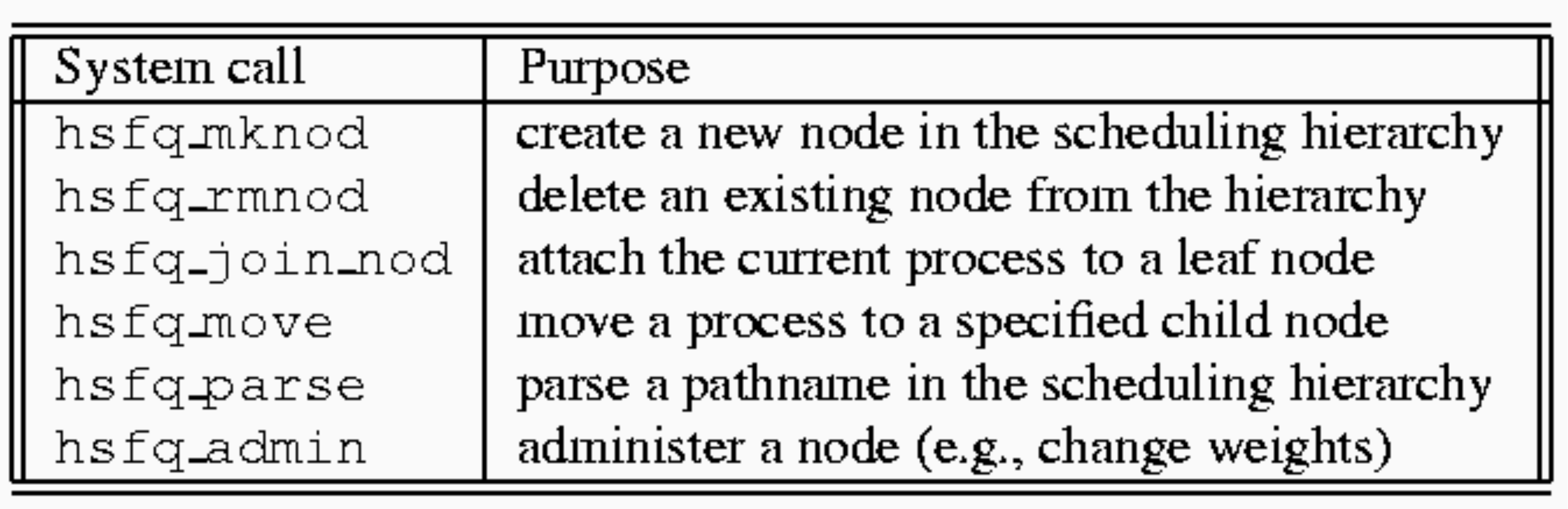
Application class

Own scheduler for each node

Threads

H-SFQ CPU scheduler

- Features
  - Nodes can be created on the fly
  - Threads can move from node to node
  - Defaults to top-level fair scheduler if not specified

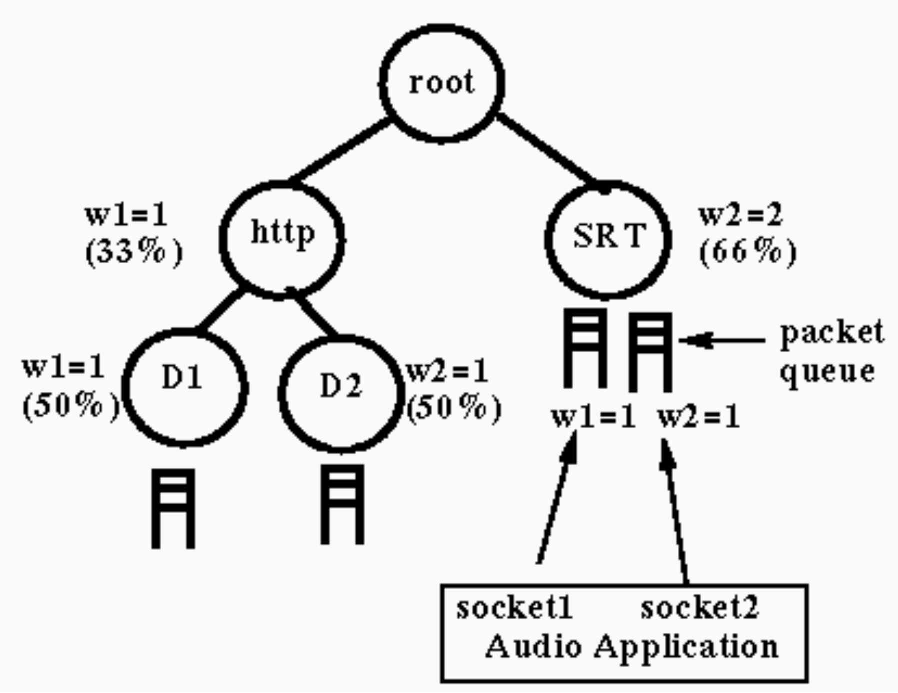


System call	Purpose
hsfq_mknod	create a new node in the scheduling hierarchy
hsfq_rmnod	delete an existing node from the hierarchy
hsfq_join_nod	attach the current process to a leaf node
hsfq_move	move a process to a specified child node
hsfq_parse	parse a pathname in the scheduling hierarchy
hsfq_admin	administer a node (e.g., change weights)

Qlinux system calls

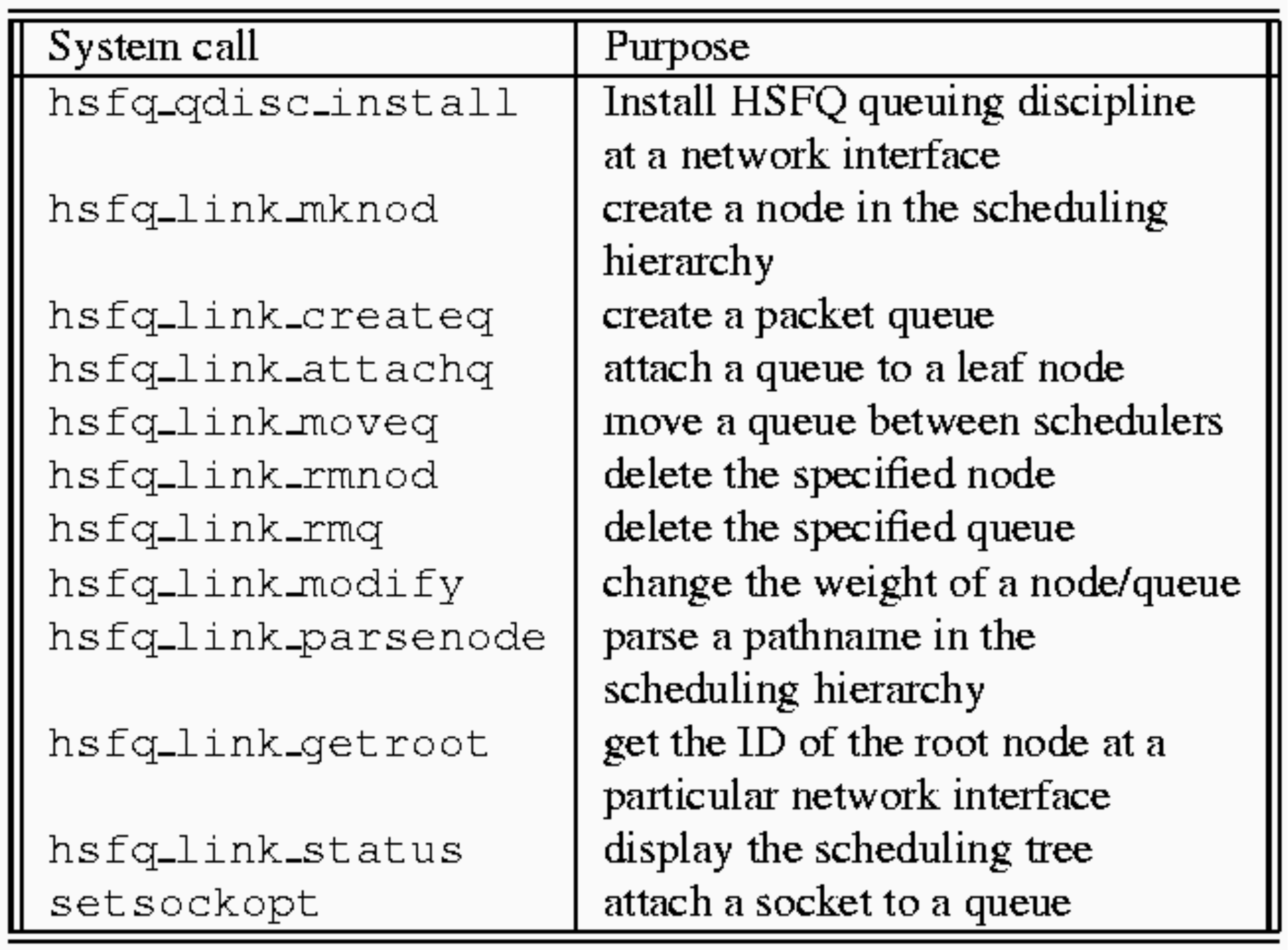
H-SFQ packet scheduler

- The H-SFQ packet scheduler provides rate guarantees and fair allocation of bandwidth to packets from individual flows as well as flow aggregates (classes)



H-SFQ packet scheduler

- Features
  - Operations on the fly

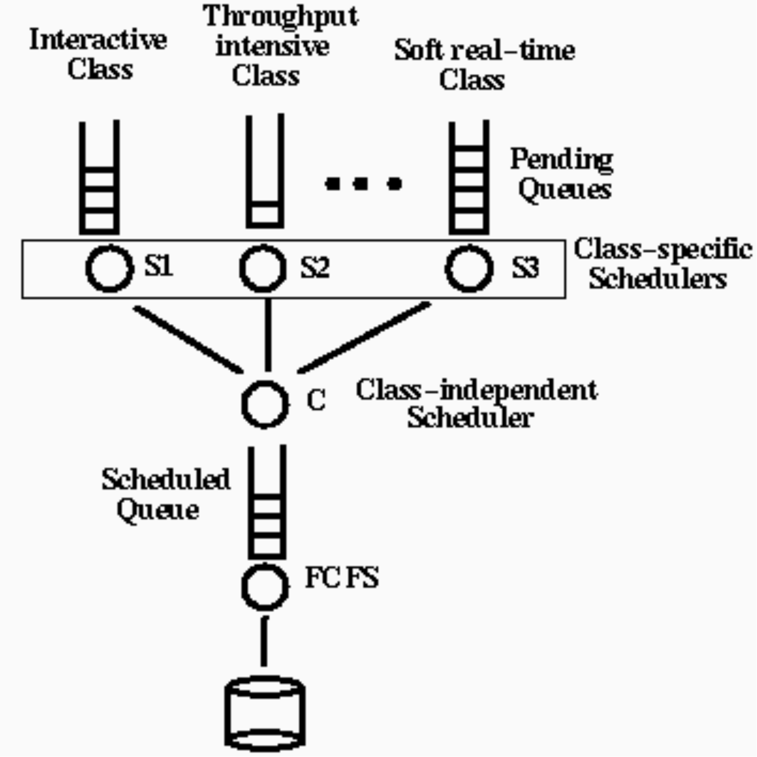


System call	Purpose
hsfq_qdisc_install	Install HSFQ queuing discipline at a network interface
hsfq_link_mknod	create a node in the scheduling hierarchy
hsfq_link_createq	create a packet queue
hsfq_link_attachq	attach a queue to a leaf node
hsfq_link_moveq	move a queue between schedulers
hsfq_link_rmnod	delete the specified node
hsfq_link_rmq	delete the specified queue
hsfq_link_modify	change the weight of a node/queue
hsfq_link_parsenode	parse a pathname in the scheduling hierarchy
hsfq_link_getroot	get the ID of the root node at a particular network interface
hsfq_link_status	display the scheduling tree
setsockopt	attach a socket to a queue

Qlinux system calls

Cello disk scheduler

- The Cello disk scheduler supports multiple application classes and fairly allocates disk bandwidth to these classes
  - interactive best-effort
  - throughput-intensive best effort
  - soft real-time


Interactive Class
Throughput intensive Class
Soft real-time Class
Pending Queues
S1
S2
S3
Class-specific Schedulers
C
Class-independent Scheduler
Scheduled Queue
FCFS

Lazy receiver processing

- Simulation
  - Process *A* running
  - Packet arrives for process *B*
    - Interrupt, IP, TCP, Enqueue gets charged to *A*!
  - LRP postpones until process does a read
  - Tricky! Some steps, e.g. TCP ack, requires it to happen right away
    - Special thread for each process for packets
- QLinux uses special queues, decodes only as far as needed
  - Special queue for ICMP, ARP …

Other OSs and Kernels

- Linux Kernel Media Subsystems
  - developed by LinuxTV community
  - provides support for devices like
    - webcams, streaming capture and output, analog TV, digital TV, AM/FM radio, Sofware Digital Radio (SDR) and remote controllers
- Ubuntu Studio
  - is a free and open OS
  - full range of multimedia content creation applications
    - audio, graphics, video, photography and publishing

MSs and Lab of MSs – Multiemedia Kernels

Other OSs and kernels

Debian Multimedia

- Developed by the Debian Multimedia Maintainers team

- Good platform for audio and multimedia work
  - packaging/maintaining multimedia applications and libraries
  - collaborating with other maintainers or teams as well as upstream projects in order to improve audio/video support in Debian