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Subject: [PATCH 1/2] dm-ioband: I/O bandwidth controller v1.2.0: Source code and patch

Posted by [Ryo Tsuruta](#) on Fri, 04 Jul 2008 03:41:42 GMT

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Here is the patch of dm-ioband.

Based on 2.6.26-rc5-mm3

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```
diff -uprN linux-2.6.26-rc5-mm3.orig/drivers/md/Kconfig linux-2.6.26-rc5-mm3/drivers/md/Kconfig
--- linux-2.6.26-rc5-mm3.orig/drivers/md/Kconfig 2008-06-25 15:58:50.000000000 +0900
+++ linux-2.6.26-rc5-mm3/drivers/md/Kconfig 2008-07-04 12:21:10.000000000 +0900
@@ -271,4 +271,17 @@ config DM_UEVENT
    ---help---
    Generate udev events for DM events.
```

```
+config DM_IOBAND
+ tristate "I/O bandwidth control (EXPERIMENTAL)"
+ depends on BLK_DEV_DM && EXPERIMENTAL
+ ---help---
+ This device-mapper target allows to define how the
+ available bandwidth of a storage device should be
+ shared between processes, cgroups, the partitions or the LUNs.
+
+ Information on how to use dm-ioband is available in:
+ <file:Documentation/device-mapper/ioband.txt>.
+
+ If unsure, say N.
+
+ endif # MD
```

```
diff -uprN linux-2.6.26-rc5-mm3.orig/drivers/md/Makefile linux-2.6.26-rc5-mm3/drivers/md/Makefile
--- linux-2.6.26-rc5-mm3.orig/drivers/md/Makefile 2008-06-25 15:58:50.000000000 +0900
+++ linux-2.6.26-rc5-mm3/drivers/md/Makefile 2008-07-04 12:21:10.000000000 +0900
@@ -7,6 +7,7 @@ dm-mod-objs := dm.o dm-table.o dm-target
dm-multipath-objs := dm-path-selector.o dm-mpath.o
dm-snapshot-objs := dm-snap.o dm-exception-store.o
dm-mirror-objs := dm-raid1.o
+dm-ioband-objs := dm-ioband-ctl.o dm-ioband-policy.o dm-ioband-type.o
md-mod-objs := md.o bitmap.o
raid456-objs := raid5.o raid6algos.o raid6recov.o raid6tables.o \
    raid6int1.o raid6int2.o raid6int4.o \
@@ -36,6 +37,7 @@ obj-$(CONFIG_DM_MULTIPATH) += dm-multipa
obj-$(CONFIG_DM_SNAPSHOT) += dm-snapshot.o
obj-$(CONFIG_DM_MIRROR) += dm-mirror.o dm-log.o
obj-$(CONFIG_DM_ZERO) += dm-zero.o
+obj-$(CONFIG_DM_IOBAND) += dm-ioband.o
```

```

quiet_cmd_unroll = UNROLL $@
cmd_unroll = $(PERL) $(srctree)/$(src)/unroll.pl $(UNROLL) \
diff -uprN linux-2.6.26-rc5-mm3.orig/drivers/md/dm-ioband-ctl.c
linux-2.6.26-rc5-mm3/drivers/md/dm-ioband-ctl.c
--- linux-2.6.26-rc5-mm3.orig/drivers/md/dm-ioband-ctl.c 1970-01-01 09:00:00.000000000 +0900
+++ linux-2.6.26-rc5-mm3/drivers/md/dm-ioband-ctl.c 2008-07-04 12:21:10.000000000 +0900
@@ -0,0 +1,1315 @@
+/*
+ * Copyright (C) 2008 VA Linux Systems Japan K.K.
+ * Authors: Hirokazu Takahashi <taka@valinux.co.jp>
+ *          Ryo Tsuruta <ryov@valinux.co.jp>
+ *
+ * I/O bandwidth control
+ *
+ * This file is released under the GPL.
+ */
+#include <linux/module.h>
+#include <linux/init.h>
+#include <linux/bio.h>
+#include <linux/slab.h>
+#include <linux/workqueue.h>
+#include <linux/raid/md.h>
+#include <linux/rbtree.h>
+#include "dm.h"
+#include "dm-bio-list.h"
+#include "dm-ioband.h"
+
+#define DM_MSG_PREFIX "ioband"
+#define POLICY_PARAM_START 6
+#define POLICY_PARAM_DELIM "=:,"
+
+static LIST_HEAD(ioband_device_list);
+/* to protect ioband_device_list */
+static DEFINE_SPINLOCK(ioband_devicelist_lock);
+
+static void suspend_ioband_device(struct ioband_device *, unsigned long, int);
+static void resume_ioband_device(struct ioband_device *);
+static void ioband_conduct(struct work_struct *);
+static void ioband_hold_bio(struct ioband_group *, struct bio *);
+static struct bio *ioband_pop_bio(struct ioband_group *);
+static int ioband_set_param(struct ioband_group *, char *, char *);
+static int ioband_group_attach(struct ioband_group *, int, char *);
+static int ioband_group_type_select(struct ioband_group *, char *);
+
+long ioband_debug; /* just for debugging */
+
+static void do_nothing(void) {}

```

```

+
+static int policy_init(struct ioband_device *dp, char *name,
+    int argc, char **argv)
+{
+ struct policy_type *p;
+ struct ioband_group *gp;
+ unsigned long flags;
+ int r;
+
+ for (p = dm_ioband_policy_type; p->p_name; p++) {
+ if (!strcmp(name, p->p_name))
+ break;
+ }
+ if (!p->p_name)
+ return -EINVAL;
+
+ spin_lock_irqsave(&dp->g_lock, flags);
+ if (dp->g_policy == p) {
+ /* do nothing if the same policy is already set */
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return 0;
+ }
+
+ suspend_ioband_device(dp, flags, 1);
+ list_for_each_entry(gp, &dp->g_groups, c_list)
+ dp->g_group_dtr(gp);
+
+ /* switch to the new policy */
+ dp->g_policy = p;
+ r = p->p_policy_init(dp, argc, argv);
+ if (!dp->g_hold_bio)
+ dp->g_hold_bio = ioband_hold_bio;
+ if (!dp->g_pop_bio)
+ dp->g_pop_bio = ioband_pop_bio;
+
+ list_for_each_entry(gp, &dp->g_groups, c_list)
+ dp->g_group_ctr(gp, NULL);
+ resume_ioband_device(dp);
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return r;
+}
+
+static struct ioband_device *alloc_ioband_device(char *name,
+    int io_throttle, int io_limit)
+{
+ struct ioband_device *dp, *new;
+ unsigned long flags;

```

```

+
+ new = kzalloc(sizeof(struct ioband_device), GFP_KERNEL);
+ if (!new)
+ return NULL;
+
+ spin_lock_irqsave(&ioband_devicelist_lock, flags);
+ list_for_each_entry(dp, &ioband_device_list, g_list) {
+ if (!strcmp(dp->g_name, name)) {
+ dp->g_ref++;
+ spin_unlock_irqrestore(&ioband_devicelist_lock, flags);
+ kfree(new);
+ return dp;
+ }
+ }
+
+ /*
+ * Prepare its own workqueue as generic_make_request() may
+ * potentially block the workqueue when submitting BIOs.
+ */
+ new->g_ioband_wq = create_workqueue("kioband");
+ if (!new->g_ioband_wq) {
+ spin_unlock_irqrestore(&ioband_devicelist_lock, flags);
+ kfree(new);
+ return NULL;
+ }
+
+ INIT_WORK(&new->g_conductor, ioband_conduct);
+ INIT_LIST_HEAD(&new->g_groups);
+ INIT_LIST_HEAD(&new->g_list);
+ spin_lock_init(&new->g_lock);
+ mutex_init(&new->g_lock_device);
+ bio_list_init(&new->g_urgent_bios);
+ new->g_io_throttle = io_throttle;
+ new->g_io_limit[0] = io_limit;
+ new->g_io_limit[1] = io_limit;
+ new->g_issued[0] = 0;
+ new->g_issued[1] = 0;
+ new->g_blocked = 0;
+ new->g_ref = 1;
+ new->g_flags = 0;
+ strcpy(new->g_name, name, sizeof(new->g_name));
+ new->g_policy = NULL;
+ new->g_hold_bio = NULL;
+ new->g_pop_bio = NULL;
+ init_waitqueue_head(&new->g_waitq);
+ init_waitqueue_head(&new->g_waitq_suspend);
+ init_waitqueue_head(&new->g_waitq_flush);
+ list_add_tail(&new->g_list, &ioband_device_list);

```

```

+
+ spin_unlock_irqrestore(&ioband_devicelist_lock, flags);
+ return new;
+}
+
+static void release_ioband_device(struct ioband_device *dp)
+{
+ unsigned long flags;
+
+ spin_lock_irqsave(&ioband_devicelist_lock, flags);
+ dp->g_ref--;
+ if (dp->g_ref > 0) {
+ spin_unlock_irqrestore(&ioband_devicelist_lock, flags);
+ return;
+ }
+ list_del(&dp->g_list);
+ spin_unlock_irqrestore(&ioband_devicelist_lock, flags);
+ destroy_workqueue(dp->g_ioband_wq);
+ kfree(dp);
+}
+
+static int is_ioband_device_flushed(struct ioband_device *dp,
+ int wait_completion)
+{
+ struct ioband_group *gp;
+
+ if (wait_completion && dp->g_issued[0] + dp->g_issued[1] > 0)
+ return 0;
+ if (dp->g_blocked || waitqueue_active(&dp->g_waitq))
+ return 0;
+ list_for_each_entry(gp, &dp->g_groups, c_list)
+ if (waitqueue_active(&gp->c_waitq))
+ return 0;
+ return 1;
+}
+
+static void suspend_ioband_device(struct ioband_device *dp,
+ unsigned long flags, int wait_completion)
+{
+ struct ioband_group *gp;
+
+ /* block incoming bios */
+ set_device_suspended(dp);
+
+ /* wake up all blocked processes and go down all ioband groups */
+ wake_up_all(&dp->g_waitq);
+ list_for_each_entry(gp, &dp->g_groups, c_list) {
+ if (!is_group_down(gp)) {

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+ set_group_down(gp);
+ set_group_need_up(gp);
+ }
+ wake_up_all(&gp->c_waitq);
+ }
+
+ /* flush the already mapped bios */
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ queue_work(dp->g_ioband_wq, &dp->g_conductor);
+ flush_workqueue(dp->g_ioband_wq);
+
+ /* wait for all processes to wake up and bios to release */
+ spin_lock_irqsave(&dp->g_lock, flags);
+ wait_event_lock_irq(dp->g_waitq_flush,
+ is_ioband_device_flushed(dp, wait_completion),
+ dp->g_lock, do_nothing());
+}
+
+static void resume_ioband_device(struct ioband_device *dp)
+{
+ struct ioband_group *gp;
+
+ /* go up ioband groups */
+ list_for_each_entry(gp, &dp->g_groups, c_list) {
+ if (group_need_up(gp)) {
+ clear_group_need_up(gp);
+ clear_group_down(gp);
+ }
+ }
+
+ /* accept incoming bios */
+ wake_up_all(&dp->g_waitq_suspend);
+ clear_device_suspended(dp);
+}
+
+static struct ioband_group *ioband_group_find(
+ struct ioband_group *head, int id)
+{
+ struct rb_node *node = head->c_group_root.rb_node;
+
+ while (node) {
+ struct ioband_group *p =
+ container_of(node, struct ioband_group, c_group_node);
+
+ if (p->c_id == id || id == IOBAND_ID_ANY)
+ return p;
+ node = (id < p->c_id) ? node->rb_left : node->rb_right;
+ }
+}

```

```

+ return NULL;
+}
+
+static void ioband_group_add_node(struct rb_root *root,
+ struct ioband_group *gp)
+{
+ struct rb_node **new = &root->rb_node, *parent = NULL;
+ struct ioband_group *p;
+
+ while (*new) {
+ p = container_of(*new, struct ioband_group, c_group_node);
+ parent = *new;
+ new = (gp->c_id < p->c_id) ?
+ &(*new)->rb_left : &(*new)->rb_right;
+ }
+
+ rb_link_node(&gp->c_group_node, parent, new);
+ rb_insert_color(&gp->c_group_node, root);
+}
+
+static int ioband_group_init(struct ioband_group *gp,
+ struct ioband_group *head, struct ioband_device *dp, int id, char *param)
+{
+ unsigned long flags;
+ int r;
+
+ INIT_LIST_HEAD(&gp->c_list);
+ bio_list_init(&gp->c_blocked_bios);
+ bio_list_init(&gp->c_prio_bios);
+ gp->c_id = id; /* should be verified */
+ gp->c_blocked = 0;
+ gp->c_prio_blocked = 0;
+ memset(gp->c_stat, 0, sizeof(gp->c_stat));
+ init_waitqueue_head(&gp->c_waitq);
+ gp->c_flags = 0;
+ gp->c_group_root = RB_ROOT;
+ gp->c_banddev = dp;
+
+ spin_lock_irqsave(&dp->g_lock, flags);
+ if (head && ioband_group_find(head, id)) {
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ DMWARN("ioband_group: id=%d already exists.", id);
+ return -EEXIST;
+ }
+
+ list_add_tail(&gp->c_list, &dp->g_groups);
+
+ r = dp->g_group_ctr(gp, param);

```

```

+ if (r) {
+ list_del(&gp->c_list);
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return r;
+ }
+
+ if (head) {
+ ioband_group_add_node(&head->c_group_root, gp);
+ gp->c_dev = head->c_dev;
+ gp->c_target = head->c_target;
+ }
+
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+
+ return 0;
+}
+
+static void ioband_group_release(struct ioband_group *head,
+ struct ioband_group *gp)
+{
+ struct ioband_device *dp = gp->c_banddev;
+
+ list_del(&gp->c_list);
+ if (head)
+ rb_erase(&gp->c_group_node, &head->c_group_root);
+ dp->g_group_dtr(gp);
+ kfree(gp);
+}
+
+static void ioband_group_destroy_all(struct ioband_group *gp)
+{
+ struct ioband_device *dp = gp->c_banddev;
+ struct ioband_group *group;
+ unsigned long flags;
+
+ spin_lock_irqsave(&dp->g_lock, flags);
+ while ((group = ioband_group_find(gp, IOBAND_ID_ANY)))
+ ioband_group_release(gp, group);
+ ioband_group_release(NULL, gp);
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+}
+
+static void ioband_group_stop_all(struct ioband_group *head, int suspend)
+{
+ struct ioband_device *dp = head->c_banddev;
+ struct ioband_group *p;
+ struct rb_node *node;
+ unsigned long flags;

```

```

+
+ spin_lock_irqsave(&dp->g_lock, flags);
+ for (node = rb_first(&head->c_group_root); node; node = rb_next(node)) {
+ p = rb_entry(node, struct ioband_group, c_group_node);
+ set_group_down(p);
+ if (suspend) {
+ set_group_suspended(p);
+ dprintk(KERN_ERR "ioband suspend: gp(%p)\n", p);
+ }
+ }
+ set_group_down(head);
+ if (suspend) {
+ set_group_suspended(head);
+ dprintk(KERN_ERR "ioband suspend: gp(%p)\n", head);
+ }
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ queue_work(dp->g_ioband_wq, &dp->g_conductor);
+ flush_workqueue(dp->g_ioband_wq);
+}
+
+static void ioband_group_resume_all(struct ioband_group *head)
+{
+ struct ioband_device *dp = head->c_banddev;
+ struct ioband_group *p;
+ struct rb_node *node;
+ unsigned long flags;
+
+ spin_lock_irqsave(&dp->g_lock, flags);
+ for (node = rb_first(&head->c_group_root); node;
+ node = rb_next(node)) {
+ p = rb_entry(node, struct ioband_group, c_group_node);
+ clear_group_down(p);
+ clear_group_suspended(p);
+ dprintk(KERN_ERR "ioband resume: gp(%p)\n", p);
+ }
+ clear_group_down(head);
+ clear_group_suspended(head);
+ dprintk(KERN_ERR "ioband resume: gp(%p)\n", head);
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+}
+
+static int split_string(char *s, long *id, char **v)
+{
+ char *p, *q;
+ int r = 0;
+
+ *id = IOBAND_ID_ANY;
+ p = strsep(&s, POLICY_PARAM_DELIM);

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```

+ q = strsep(&s, POLICY_PARAM_DELIM);
+ if (!q) {
+ *v = p;
+ } else {
+ r = strict_strtol(p, 0, id);
+ *v = q;
+ }
+ return r;
+}
+
+/*
+ * Create a new band device:
+ * parameters: <device> <device-group-id> <io_throttle> <io_limit>
+ * <type> <policy> <policy-param...> <group-id:group-param...>
+ */
+static int ioband_ctr(struct dm_target *ti, unsigned int argc, char **argv)
+{
+ struct ioband_group *gp;
+ struct ioband_device *dp;
+ struct dm_dev *dev;
+ int io_throttle;
+ int io_limit;
+ int i, r, start;
+ long val, id;
+ char *param;
+
+ if (argc < POLICY_PARAM_START) {
+ ti->error = "Requires " __stringify(POLICY_PARAM_START)
+ " or more arguments";
+ return -EINVAL;
+ }
+
+ if (strlen(argv[1]) > IOBAND_NAME_MAX) {
+ ti->error = "ioband device name is too long";
+ return -EINVAL;
+ }
+ dprintk(KERN_ERR "ioband_ctr ioband device name:%s\n", argv[1]);
+
+ r = strict_strtol(argv[2], 0, &val);
+ if (r || val < 0) {
+ ti->error = "Invalid io_throttle";
+ return -EINVAL;
+ }
+ io_throttle = (val == 0) ? DEFAULT_IO_THROTTLE : val;
+
+ r = strict_strtol(argv[3], 0, &val);
+ if (r || val < 0) {
+ ti->error = "Invalid io_limit";

```

```

+ return -EINVAL;
+ }
+ io_limit = val;
+
+ r = dm_get_device(ti, argv[0], 0, ti->len,
+ dm_table_get_mode(ti->table), &dev);
+ if (r) {
+ ti->error = "Device lookup failed";
+ return r;
+ }
+
+ if (io_limit == 0) {
+ struct request_queue *q;
+
+ q = bdev_get_queue(dev->bdev);
+ if (!q) {
+ ti->error = "Can't get queue size";
+ r = -ENXIO;
+ goto release_dm_device;
+ }
+ dprintk(KERN_ERR "ioband_ctr nr_requests:%lu\n",
+ q->nr_requests);
+ io_limit = q->nr_requests;
+ }
+
+ if (io_limit < io_throttle)
+ io_limit = io_throttle;
+ dprintk(KERN_ERR "ioband_ctr io_throttle:%d io_limit:%d\n",
+ io_throttle, io_limit);
+
+ dp = alloc_ioband_device(argv[1], io_throttle, io_limit);
+ if (!dp) {
+ ti->error = "Cannot create ioband device";
+ r = -EINVAL;
+ goto release_dm_device;
+ }
+
+ mutex_lock(&dp->g_lock_device);
+ r = policy_init(dp, argv[POLICY_PARAM_START - 1],
+ argc - POLICY_PARAM_START, &argv[POLICY_PARAM_START]);
+ if (r) {
+ ti->error = "Invalid policy parameter";
+ goto release_ioband_device;
+ }
+
+ gp = kzalloc(sizeof(struct ioband_group), GFP_KERNEL);
+ if (!gp) {
+ ti->error = "Cannot allocate memory for ioband group";

```

```

+ r = -ENOMEM;
+ goto release_ioband_device;
+ }
+
+ ti->private = gp;
+ gp->c_target = ti;
+ gp->c_dev = dev;
+
+ /* Find a default group parameter */
+ for (start = POLICY_PARAM_START; start < argc; start++)
+ if (argv[start][0] == ':')
+ break;
+ param = (start < argc) ? &argv[start][1] : NULL;
+
+ /* Create a default ioband group */
+ r = ioband_group_init(gp, NULL, dp, IOBAND_ID_ANY, param);
+ if (r) {
+ kfree(gp);
+ ti->error = "Cannot create default ioband group";
+ goto release_ioband_device;
+ }
+
+ r = ioband_group_type_select(gp, argv[4]);
+ if (r) {
+ ti->error = "Cannot set ioband group type";
+ goto release_ioband_group;
+ }
+
+ /* Create sub ioband groups */
+ for (i = start + 1; i < argc; i++) {
+ r = split_string(argv[i], &id, &param);
+ if (r) {
+ ti->error = "Invalid ioband group parameter";
+ goto release_ioband_group;
+ }
+ r = ioband_group_attach(gp, id, param);
+ if (r) {
+ ti->error = "Cannot create ioband group";
+ goto release_ioband_group;
+ }
+ }
+ mutex_unlock(&dp->g_lock_device);
+ return 0;
+
+release_ioband_group:
+ ioband_group_destroy_all(gp);
+release_ioband_device:
+ mutex_unlock(&dp->g_lock_device);

```

```

+ release_ioband_device(dp);
+release_dm_device:
+ dm_put_device(ti, dev);
+ return r;
+}
+
+static void ioband_dtr(struct dm_target *ti)
+{
+ struct ioband_group *gp = ti->private;
+ struct ioband_device *dp = gp->c_banddev;
+
+ mutex_lock(&dp->g_lock_device);
+ ioband_group_stop_all(gp, 0);
+ dm_put_device(ti, gp->c_dev);
+ ioband_group_destroy_all(gp);
+ mutex_unlock(&dp->g_lock_device);
+ release_ioband_device(dp);
+}
+
+static void ioband_hold_bio(struct ioband_group *gp, struct bio *bio)
+{
+ /* Todo: The list should be split into a read list and a write list */
+ bio_list_add(&gp->c_blocked_bios, bio);
+}
+
+static struct bio *ioband_pop_bio(struct ioband_group *gp)
+{
+ return bio_list_pop(&gp->c_blocked_bios);
+}
+
+static int is_urgent_bio(struct bio *bio)
+{
+ struct page *page = bio_iovec_idx(bio, 0)->bv_page;
+ /*
+ * ToDo: A new flag should be added to struct bio, which indicates
+ * it contains urgent I/O requests.
+ */
+ if (!PageReclaim(page))
+ return 0;
+ if (PageSwapCache(page))
+ return 2;
+ return 1;
+}
+
+static inline void resume_to_accept_bios(struct ioband_group *gp)
+{
+ struct ioband_device *dp = gp->c_banddev;
+

```

```

+ if (is_device_blocked(dp)
+   && dp->g_blocked < dp->g_io_limit[0]+dp->g_io_limit[1]) {
+   clear_device_blocked(dp);
+   wake_up_all(&dp->g_waitq);
+ }
+ if (is_group_blocked(gp)) {
+   clear_group_blocked(gp);
+   wake_up_all(&gp->c_waitq);
+ }
+ }
+
+static inline int device_should_block(struct ioband_group *gp)
+{
+ struct ioband_device *dp = gp->c_banddev;
+
+ if (is_group_down(gp))
+   return 0;
+ if (is_device_blocked(dp))
+   return 1;
+ if (dp->g_blocked >= dp->g_io_limit[0] + dp->g_io_limit[1]) {
+   set_device_blocked(dp);
+   return 1;
+ }
+ return 0;
+ }
+
+static inline int group_should_block(struct ioband_group *gp, struct bio *bio)
+{
+ struct ioband_device *dp = gp->c_banddev;
+
+ if (is_group_down(gp))
+   return 0;
+ if (!is_urgent_bio(bio) && is_group_blocked(gp))
+   return 1;
+ if (dp->g_should_block(gp)) {
+   set_group_blocked(gp);
+   return 1;
+ }
+ return 0;
+ }
+
+static void prevent_burst_bios(struct ioband_group *gp, struct bio *bio)
+{
+ struct ioband_device *dp = gp->c_banddev;
+
+ if (current->flags & PF_KTHREAD) {
+ /*
+  * Kernel threads shouldn't be blocked easily since each of

```

```

+ * them may handle BIOs for several groups on several
+ * partitions.
+ */
+ wait_event_lock_irq(dp->g_waitq, !device_should_block(gp),
+ dp->g_lock, do_nothing());
+ } else {
+ wait_event_lock_irq(gp->c_waitq, !group_should_block(gp, bio),
+ dp->g_lock, do_nothing());
+ }
+ }
+
+static inline int should_pushback_bio(struct ioband_group *gp)
+{
+ return is_group_suspended(gp) && dm_noflush_suspending(gp->c_target);
+}
+
+static inline int prepare_to_issue(struct ioband_group *gp, struct bio *bio)
+{
+ struct ioband_device *dp = gp->c_banddev;
+
+ dp->g_issued[bio_data_dir(bio)]++;
+ return dp->g_prepare_bio(gp, bio, 0);
+}
+
+static inline int room_for_bio(struct ioband_device *dp)
+{
+ return dp->g_issued[0] < dp->g_io_limit[0]
+ || dp->g_issued[1] < dp->g_io_limit[1];
+}
+
+static void hold_bio(struct ioband_group *gp, struct bio *bio)
+{
+ struct ioband_device *dp = gp->c_banddev;
+
+ dp->g_blocked++;
+ if (is_urgent_bio(bio)) {
+ /*
+ * ToDo:
+ * When barrier mode is supported, write bios sharing the same
+ * file system with the currnt one would be all moved
+ * to g_urgent_bios list.
+ * You don't have to care about barrier handling if the bio
+ * is for swapping.
+ */
+ dp->g_prepare_bio(gp, bio, IOBAND_URGENT);
+ bio_list_add(&dp->g_urgent_bios, bio);
+ } else {
+ gp->c_blocked++;

```

```

+ dp->g_hold_bio(gp, bio);
+ }
+}
+
+static inline int room_for_bio_rw(struct ioband_device *dp, int direct)
+{
+ return dp->g_issued[direct] < dp->g_io_limit[direct];
+}
+
+static void push_prio_bio(struct ioband_group *gp, struct bio *bio, int direct)
+{
+ if (bio_list_empty(&gp->c_prio_bios))
+ set_prio_queue(gp, direct);
+ bio_list_add(&gp->c_prio_bios, bio);
+ gp->c_prio_blocked++;
+}
+
+static struct bio *pop_prio_bio(struct ioband_group *gp)
+{
+ struct bio *bio = bio_list_pop(&gp->c_prio_bios);
+
+ if (bio_list_empty(&gp->c_prio_bios))
+ clear_prio_queue(gp);
+
+ if (bio)
+ gp->c_prio_blocked--;
+ return bio;
+}
+
+static void release_urgent_bios(struct ioband_device *dp,
+ struct bio_list *issue_list, struct bio_list *pushback_list)
+{
+ struct bio *bio;
+
+ if (bio_list_empty(&dp->g_urgent_bios))
+ return;
+ while (room_for_bio_rw(dp, 1)) {
+ bio = bio_list_pop(&dp->g_urgent_bios);
+ if (!bio)
+ return;
+ dp->g_blocked--;
+ dp->g_issued[1]++;
+ bio_list_add(issue_list, bio);
+ }
+}
+
+static int release_prio_bios(struct ioband_group *gp,
+ struct bio_list *issue_list, struct bio_list *pushback_list)

```

```

+{
+ struct ioband_device *dp = gp->c_banddev;
+ struct bio *bio;
+ int direct;
+ int ret;
+
+ if (bio_list_empty(&gp->c_prio_bios))
+ return 0;
+ direct = prio_queue_direct(gp);
+ while (gp->c_prio_blocked) {
+ if (!dp->g_can_submit(gp))
+ return 1;
+ if (!room_for_bio_rw(dp, direct))
+ return 0;
+ bio = pop_prio_bio(gp);
+ if (!bio)
+ return 0;
+ dp->g_blocked--;
+ gp->c_blocked--;
+ if (!gp->c_blocked)
+ resume_to_accept_bios(gp);
+ if (should_pushback_bio(gp))
+ bio_list_add(pushback_list, bio);
+ else
+ bio_list_add(issue_list, bio);
+ ret = prepare_to_issue(gp, bio);
+ if (ret)
+ return ret;
+ }
+ return 0;
+}
+
+static int release_norm_bios(struct ioband_group *gp,
+ struct bio_list *issue_list, struct bio_list *pushback_list)
+{
+ struct ioband_device *dp = gp->c_banddev;
+ struct bio *bio;
+ int direct;
+ int ret;
+
+ while (gp->c_blocked - gp->c_prio_blocked) {
+ if (!dp->g_can_submit(gp))
+ return 1;
+ if (!room_for_bio(dp))
+ return 0;
+ bio = dp->g_pop_bio(gp);
+ if (!bio)
+ return 0;

```

```

+
+ direct = bio_data_dir(bio);
+ if (!room_for_bio_rw(dp, direct)) {
+   push_prio_bio(gp, bio, direct);
+   continue;
+ }
+ dp->g_blocked--;
+ gp->c_blocked--;
+ if (!gp->c_blocked)
+   resume_to_accept_bios(gp);
+ if (should_pushback_bio(gp))
+   bio_list_add(pushback_list, bio);
+ else
+   bio_list_add(issue_list, bio);
+ ret = prepare_to_issue(gp, bio);
+ if (ret)
+   return ret;
+ }
+ return 0;
+}
+
+static inline void release_bios(struct ioband_group *gp,
+ struct bio_list *issue_list, struct bio_list *pushback_list)
+{
+ if (release_prio_bios(gp, issue_list, pushback_list))
+   return;
+ release_norm_bios(gp, issue_list, pushback_list);
+}
+
+static struct ioband_group *ioband_group_get(struct ioband_group *head,
+ struct bio *bio)
+{
+ struct ioband_group *gp;
+
+ if (!head->c_type->t_getid)
+   return head;
+
+ gp = ioband_group_find(head, head->c_type->t_getid(bio));
+
+ if (!gp)
+   gp = head;
+ return gp;
+}
+
+/*
+ * Start to control the bandwidth once the number of uncompleted BIODs
+ * exceeds the value of "io_throttle".
+ */

```

```

+static int ioband_map(struct dm_target *ti, struct bio *bio,
+ union map_info *map_context)
+{
+ struct ioband_group *gp = ti->private;
+ struct ioband_group_stat *bws;
+ struct ioband_device *dp = gp->c_banddev;
+ unsigned long flags;
+
+ #if 0 /* not supported yet */
+ if (bio_barrier(bio))
+ return -EOPNOTSUPP;
+ #endif
+
+ spin_lock_irqsave(&dp->g_lock, flags);
+
+ /*
+  * The device is suspended while some of the ioband device
+  * configurations are being changed.
+  */
+ if (is_device_suspended(dp))
+ wait_event_lock_irq(dp->g_waitq_suspend,
+ !is_device_suspended(dp), dp->g_lock, do_nothing());
+
+ gp = ioband_group_get(gp, bio);
+ prevent_burst_bios(gp, bio);
+ if (should_pushback_bio(gp)) {
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return DM_MAPIO_REQUEUE;
+ }
+
+ bio->bi_bdev = gp->c_dev->bdev;
+ bio->bi_sector -= ti->begin;
+ bws = &gp->c_stat[bio_data_dir(bio)];
+ bws->sectors += bio_sectors(bio);
+retry:
+ if (!gp->c_blocked && room_for_bio_rw(dp, bio_data_dir(bio))) {
+ if (dp->g_can_submit(gp)) {
+ prepare_to_issue(gp, bio);
+ bws->immediate++;
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return DM_MAPIO_REMAPPED;
+ } else if (dp->g_issued[0] + dp->g_issued[1] == 0) {
+ if (!dp->g_blocked && dp->g_restart_bios(dp)) {
+ dprintk(KERN_ERR "ioband_map: token refilled "
+ "gp:%p bio:%p\n", gp, bio);
+ goto retry;
+ }
+ }
+ }

```

```

+ }
+ hold_bio(gp, bio);
+ bws->deferred++;
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+
+ return DM_MAPIO_SUBMITTED;
+}
+
+/*
+ * Select the best group to resubmit its BIOs.
+ */
+static struct ioband_group *choose_best_group(struct ioband_device *dp)
+{
+ struct ioband_group *gp;
+ struct ioband_group *best = NULL;
+ int highest = 0;
+ int pri;
+
+ /* Todo: The algorithm should be optimized.
+ *      It would be better to use rbtree.
+ */
+ list_for_each_entry(gp, &dp->g_groups, c_list) {
+ if (!gp->c_blocked || !room_for_bio(dp))
+ continue;
+ if (gp->c_blocked == gp->c_prio_blocked
+ && !room_for_bio_rw(dp, prio_queue_direct(gp))) {
+ continue;
+ }
+ pri = dp->g_can_submit(gp);
+ if (pri > highest) {
+ highest = pri;
+ best = gp;
+ }
+ }
+
+ return best;
+}
+
+/*
+ * This function is called right after it becomes able to resubmit BIOs.
+ * It selects the best BIOs and passes them to the underlying layer.
+ */
+static void ioband_conduct(struct work_struct *work)
+{
+ struct ioband_device *dp =
+ container_of(work, struct ioband_device, g_conductor);
+ struct ioband_group *gp = NULL;
+ struct bio *bio;

```

```

+ unsigned long flags;
+ struct bio_list issue_list, pushback_list;
+
+ bio_list_init(&issue_list);
+ bio_list_init(&pushback_list);
+
+ spin_lock_irqsave(&dp->g_lock, flags);
+retry:
+ release_urgent_bios(dp, &issue_list, &pushback_list);
+ while (dp->g_blocked && (gp = choose_best_group(dp)))
+ release_bios(gp, &issue_list, &pushback_list);
+
+ if (dp->g_blocked
+ && dp->g_issued[0] + dp->g_issued[1] < dp->g_io_throttle) {
+ dprintk(KERN_ERR "ioband_conduct: token expired dp:%p "
+ "issued(%d,%d) g_blocked(%d)\n", dp,
+ dp->g_issued[0], dp->g_issued[1], dp->g_blocked);
+ if (dp->g_restart_bios(dp))
+ goto retry;
+ }
+
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+
+ while ((bio = bio_list_pop(&issue_list)))
+ generic_make_request(bio);
+ while ((bio = bio_list_pop(&pushback_list)))
+ bio_endio(bio, -EIO);
+}
+
+static int ioband_end_io(struct dm_target *ti, struct bio *bio,
+ int error, union map_info *map_context)
+{
+ struct ioband_group *gp = ti->private;
+ struct ioband_device *dp = gp->c_banddev;
+ unsigned long flags;
+ int r = error;
+
+ /*
+ * XXX: A new error code for device mapper devices should be used
+ * rather than EIO.
+ */
+ if (error == -EIO && should_pushback_bio(gp)) {
+ /* This ioband device is suspending */
+ r = DM_ENDIO_REQUEUE;
+ }
+ /*
+ * Todo: The algorithm should be optimized to eliminate the spinlock.
+ */

```

```

+ spin_lock_irqsave(&dp->g_lock, flags);
+ dp->g_issued[bio_data_dir(bio)]--;
+
+ /*
+  * Todo: It would be better to introduce high/low water marks here
+  * not to kick the workqueues so often.
+  */
+ if (dp->g_blocked)
+ queue_work(dp->g_ioband_wq, &dp->g_conductor);
+ else if (is_device_suspended(dp)
+ && dp->g_issued[0] + dp->g_issued[1] == 0)
+ wake_up_all(&dp->g_waitq_flush);
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return r;
+}
+
+static void ioband_presuspend(struct dm_target *ti)
+{
+ struct ioband_group *gp = ti->private;
+ struct ioband_device *dp = gp->c_bandddev;
+
+ mutex_lock(&dp->g_lock_device);
+ ioband_group_stop_all(gp, 1);
+ mutex_unlock(&dp->g_lock_device);
+}
+
+static void ioband_resume(struct dm_target *ti)
+{
+ struct ioband_group *gp = ti->private;
+ struct ioband_device *dp = gp->c_bandddev;
+
+ mutex_lock(&dp->g_lock_device);
+ ioband_group_resume_all(gp);
+ mutex_unlock(&dp->g_lock_device);
+}
+
+static void ioband_group_status(struct ioband_group *gp, int *szp,
+ char *result, unsigned int maxlen)
+{
+ struct ioband_group_stat *bws;
+ unsigned long reqs;
+ int i, sz = *szp; /* used in DMEMIT() */
+
+ DMEMIT(" %d", gp->c_id);
+ for (i = 0; i < 2; i++) {
+ bws = &gp->c_stat[i];
+ reqs = bws->immediate + bws->deferred;

```

```

+ DMEMIT(" %lu %lu %lu",
+ bws->immediate + bws->deferred, bws->deferred,
+ bws->sectors);
+ }
+ *szp = sz;
+}
+
+static int ioband_status(struct dm_target *ti, status_type_t type,
+ char *result, unsigned int maxlen)
+{
+ struct ioband_group *gp = ti->private, *p;
+ struct ioband_device *dp = gp->c_banddev;
+ struct rb_node *node;
+ int sz = 0; /* used in DMEMIT() */
+ unsigned long flags;
+
+ mutex_lock(&dp->g_lock_device);
+
+ switch (type) {
+ case STATUSTYPE_INFO:
+ spin_lock_irqsave(&dp->g_lock, flags);
+ DMEMIT("%s", dp->g_name);
+ ioband_group_status(gp, &sz, result, maxlen);
+ for (node = rb_first(&gp->c_group_root); node;
+ node = rb_next(node)) {
+ p = rb_entry(node, struct ioband_group, c_group_node);
+ ioband_group_status(p, &sz, result, maxlen);
+ }
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ break;
+
+ case STATUSTYPE_TABLE:
+ spin_lock_irqsave(&dp->g_lock, flags);
+ DMEMIT("%s %s %d %d %s %s",
+ gp->c_dev->name, dp->g_name,
+ dp->g_io_throttle, dp->g_io_limit[0],
+ gp->c_type->t_name, dp->g_policy->p_name);
+ dp->g_show(gp, &sz, result, maxlen);
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ break;
+ }
+
+ mutex_unlock(&dp->g_lock_device);
+ return 0;
+}
+
+static int ioband_group_type_select(struct ioband_group *gp, char *name)
+{

```

```

+ struct ioband_device *dp = gp->c_banddev;
+ struct group_type *t;
+ unsigned long flags;
+
+ for (t = dm_ioband_group_type; (t->t_name); t++) {
+ if (!strcmp(name, t->t_name))
+ break;
+ }
+ if (!t->t_name) {
+ DMWARN("ioband type select: %s isn't supported.", name);
+ return -EINVAL;
+ }
+ spin_lock_irqsave(&dp->g_lock, flags);
+ if (!RB_EMPTY_ROOT(&gp->c_group_root)) {
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return -EBUSY;
+ }
+ gp->c_type = t;
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+
+ return 0;
+}
+
+static int ioband_set_param(struct ioband_group *gp, char *cmd, char *value)
+{
+ struct ioband_device *dp = gp->c_banddev;
+ char *val_str;
+ long id;
+ unsigned long flags;
+ int r;
+
+
+ r = split_string(value, &id, &val_str);
+ if (r)
+ return r;
+
+ spin_lock_irqsave(&dp->g_lock, flags);
+ if (id != IOBAND_ID_ANY) {
+ gp = ioband_group_find(gp, id);
+ if (!gp) {
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ DMWARN("ioband_set_param: id=%ld not found.", id);
+ return -EINVAL;
+ }
+ }
+ r = dp->g_set_param(gp, cmd, val_str);
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return r;
+}

```

```

+
+static int ioband_group_attach(struct ioband_group *gp, int id, char *param)
+{
+ struct ioband_device *dp = gp->c_banddev;
+ struct ioband_group *sub_gp;
+ int r;
+
+
+ if (id < 0) {
+ DMWARN("ioband_group_attach: invalid id:%d", id);
+ return -EINVAL;
+ }
+ if (!gp->c_type->t_getid) {
+ DMWARN("ioband_group_attach: "
+ "no ioband group type is specified");
+ return -EINVAL;
+ }
+
+ sub_gp = kzalloc(sizeof(struct ioband_group), GFP_KERNEL);
+ if (!sub_gp)
+ return -ENOMEM;
+
+ r = ioband_group_init(sub_gp, gp, dp, id, param);
+ if (r < 0) {
+ kfree(sub_gp);
+ return r;
+ }
+ return 0;
+}
+
+static int ioband_group_detach(struct ioband_group *gp, int id)
+{
+ struct ioband_device *dp = gp->c_banddev;
+ struct ioband_group *sub_gp;
+ unsigned long flags;
+
+
+ if (id < 0) {
+ DMWARN("ioband_group_detach: invalid id:%d", id);
+ return -EINVAL;
+ }
+ spin_lock_irqsave(&dp->g_lock, flags);
+ sub_gp = ioband_group_find(gp, id);
+ if (!sub_gp) {
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ DMWARN("ioband_group_detach: invalid id:%d", id);
+ return -EINVAL;
+ }
+
+
+ /*

```

```

+ * Todo: Calling suspend_ioband_device() before releasing the
+ *   ioband group has a large overhead. Need improvement.
+ */
+ suspend_ioband_device(dp, flags, 0);
+ ioband_group_release(gp, sub_gp);
+ resume_ioband_device(dp);
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return 0;
+}
+
+/*
+ * Message parameters:
+ * "policy" <name>
+ *   ex)
+ * "policy" "weight"
+ * "type" "none"|"pid"|"pgrp"|"node"|"cpuset"|"cgroup"|"user"|"gid"
+ * "io_throttle" <value>
+ * "io_limit" <value>
+ * "attach" <group id>
+ * "detach" <group id>
+ * "any-command" <group id>:<value>
+ *   ex)
+ * "weight" 0:<value>
+ * "token" 24:<value>
+ */
+static int __ioband_message(struct dm_target *ti,
+ unsigned int argc, char **argv)
+{
+ struct ioband_group *gp = ti->private, *p;
+ struct ioband_device *dp = gp->c_banddev;
+ struct rb_node *node;
+ long val;
+ int r = 0;
+ unsigned long flags;
+
+ if (argc == 1 && !strcmp(argv[0], "reset")) {
+ spin_lock_irqsave(&dp->g_lock, flags);
+ memset(gp->c_stat, 0, sizeof(gp->c_stat));
+ for (node = rb_first(&gp->c_group_root); node;
+ node = rb_next(node)) {
+ p = rb_entry(node, struct ioband_group, c_group_node);
+ memset(p->c_stat, 0, sizeof(p->c_stat));
+ }
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return 0;
+ }
+
+ if (argc != 2) {

```

```

+ DMWARN("Unrecognised band message received.");
+ return -EINVAL;
+ }
+ if (!strcmp(argv[0], "debug")) {
+ r = strict_strtol(argv[1], 0, &val);
+ if (r || val < 0)
+ return -EINVAL;
+ ioband_debug = val;
+ return 0;
+ } else if (!strcmp(argv[0], "io_throttle")) {
+ r = strict_strtol(argv[1], 0, &val);
+ spin_lock_irqsave(&dp->g_lock, flags);
+ if (r || val < 0 ||
+ val > dp->g_io_limit[0] || val > dp->g_io_limit[1]) {
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return -EINVAL;
+ }
+ dp->g_io_throttle = (val == 0) ? DEFAULT_IO_THROTTLE : val;
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ ioband_set_param(gp, argv[0], argv[1]);
+ return 0;
+ } else if (!strcmp(argv[0], "io_limit")) {
+ r = strict_strtol(argv[1], 0, &val);
+ if (r || val < 0)
+ return -EINVAL;
+ spin_lock_irqsave(&dp->g_lock, flags);
+ if (val == 0) {
+ struct request_queue *q;
+
+ q = bdev_get_queue(gp->c_dev->bdev);
+ if (!q) {
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return -ENXIO;
+ }
+ val = q->nr_requests;
+ }
+ if (val < dp->g_io_throttle) {
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ return -EINVAL;
+ }
+ dp->g_io_limit[0] = dp->g_io_limit[1] = val;
+ spin_unlock_irqrestore(&dp->g_lock, flags);
+ ioband_set_param(gp, argv[0], argv[1]);
+ return 0;
+ } else if (!strcmp(argv[0], "type")) {
+ return ioband_group_type_select(gp, argv[1]);
+ } else if (!strcmp(argv[0], "attach")) {
+ r = strict_strtol(argv[1], 0, &val);

```

```

+ if (r)
+ return r;
+ return ioband_group_attach(gp, val, NULL);
+ } else if (!strcmp(argv[0], "detach")) {
+ r = strict_strtol(argv[1], 0, &val);
+ if (r)
+ return r;
+ return ioband_group_detach(gp, val);
+ } else if (!strcmp(argv[0], "policy")) {
+ r = policy_init(dp, argv[1], 0, &argv[2]);
+ return r;
+ } else {
+ /* message anycommand <group-id>:<value> */
+ r = ioband_set_param(gp, argv[0], argv[1]);
+ if (r < 0)
+ DMWARN("Unrecognised band message received.");
+ return r;
+ }
+ return 0;
+}
+
+static int ioband_message(struct dm_target *ti, unsigned int argc, char **argv)
+{
+ struct ioband_group *gp = ti->private;
+ struct ioband_device *dp = gp->c_banddev;
+ int r;
+
+ mutex_lock(&dp->g_lock_device);
+ r = __ioband_message(ti, argc, argv);
+ mutex_unlock(&dp->g_lock_device);
+ return r;
+}
+
+static struct target_type ioband_target = {
+ .name = "ioband",
+ .module = THIS_MODULE,
+ .version = {1, 2, 0},
+ .ctr = ioband_ctr,
+ .dtr = ioband_dtr,
+ .map = ioband_map,
+ .end_io = ioband_end_io,
+ .presuspend = ioband_presuspend,
+ .resume = ioband_resume,
+ .status = ioband_status,
+ .message = ioband_message,
+};
+
+static int __init dm_ioband_init(void)

```

```

+{
+ int r;
+
+ r = dm_register_target(&ioband_target);
+ if (r < 0) {
+ DMERR("register failed %d", r);
+ return r;
+ }
+ return r;
+}
+
+static void __exit dm_ioband_exit(void)
+{
+ int r;
+
+ r = dm_unregister_target(&ioband_target);
+ if (r < 0)
+ DMERR("unregister failed %d", r);
+}
+
+module_init(dm_ioband_init);
+module_exit(dm_ioband_exit);
+
+MODULE_DESCRIPTION(DM_NAME " I/O bandwidth control");
+MODULE_AUTHOR("Hirokazu Takahashi <taka@valinux.co.jp>, "
+ "Ryo Tsuruta <ryov@valinux.co.jp>");
+MODULE_LICENSE("GPL");
diff -uprN linux-2.6.26-rc5-mm3.orig/drivers/md/dm-ioband-policy.c
linux-2.6.26-rc5-mm3/drivers/md/dm-ioband-policy.c
--- linux-2.6.26-rc5-mm3.orig/drivers/md/dm-ioband-policy.c 1970-01-01 09:00:00.000000000
+0900
+++ linux-2.6.26-rc5-mm3/drivers/md/dm-ioband-policy.c 2008-07-04 12:21:10.000000000 +0900
@@ -0,0 +1,306 @@
+/*
+ * Copyright (C) 2008 VA Linux Systems Japan K.K.
+ *
+ * I/O bandwidth control
+ *
+ * This file is released under the GPL.
+ */
+#include <linux/bio.h>
+#include <linux/workqueue.h>
+#include <linux/rbtree.h>
+#include "dm.h"
+#include "dm-bio-list.h"
+#include "dm-ioband.h"
+
+/*

```

```

+ * The following functions determine when and which BIOs should
+ * be submitted to control the I/O flow.
+ * It is possible to add a new BIO scheduling policy with it.
+ */
+
+
+/*
+ * Functions for weight balancing policy based on the number of I/Os.
+ */
+#define DEFAULT_WEIGHT 100
+#define DEFAULT_TOKENBASE 8192
+#define IOBAND_IOPRIO_BASE 100
+#define TOKEN_BATCH_RATIO 10
+
+static int make_global_epoch(struct ioband_device *dp)
+{
+ dp->g_epoch++;
+ dprintk(KERN_ERR "make_epoch %d --> %d\n",
+ dp->g_epoch-1, dp->g_epoch);
+ return 1;
+}
+
+static inline int make_epoch(struct ioband_group *gp)
+{
+ struct ioband_device *dp = gp->c_banddev;
+
+ if (gp->c_my_epoch != dp->g_epoch) {
+ gp->c_my_epoch = dp->g_epoch;
+ return 1;
+ }
+ return 0;
+}
+
+static inline int iopriority(struct ioband_group *gp)
+{
+ struct ioband_device *dp = gp->c_banddev;
+ int iopri;
+
+ iopri = gp->c_token*IOBAND_IOPRIO_BASE/gp->c_token_init_value + 1;
+ if (gp->c_my_epoch != dp->g_epoch)
+ iopri += IOBAND_IOPRIO_BASE;
+ if (is_group_down(gp))
+ iopri += IOBAND_IOPRIO_BASE*2;
+
+ return iopri;
+}
+
+static int is_token_left(struct ioband_group *gp)

```

```

+{
+ struct ioband_device *dp = gp->c_banddev;
+
+ if (gp->c_token > 0)
+ return iopriority(gp);
+
+ if (is_group_down(gp)) {
+ gp->c_token = gp->c_token_init_value;
+ return iopriority(gp);
+ }
+ if (make_epoch(gp)) {
+ gp->c_token += gp->c_token_init_value;
+ if (gp == dp->g_current)
+ dp->g_token_mark += gp->c_token_init_value;
+ dprintk(KERN_ERR "refill token: gp:%p token:%d->%d\n",
+ gp, gp->c_token - gp->c_token_init_value, gp->c_token);
+ if (gp->c_token > 0)
+ return iopriority(gp);
+ dprintk(KERN_ERR "refill token: yet empty gp:%p token:%d\n",
+ gp, gp->c_token);
+ }
+ return 0;
+}
+
+static int consume_token(struct ioband_group *gp, struct bio *bio,
+ int count, int flag, int batch)
+{
+ struct ioband_device *dp = gp->c_banddev;
+ if (gp != dp->g_current) {
+ dp->g_current = gp;
+ dp->g_token_mark = gp->c_token - batch;
+ }
+ gp->c_token -= count;
+ if (gp->c_token <= dp->g_token_mark && !(flag & IOBAND_URGENT)) {
+ dp->g_current = NULL;
+ return 0;
+ }
+ return 1;
+}
+
+static int prepare_token(struct ioband_group *gp, struct bio *bio, int flag)
+{
+ return consume_token(gp, bio, 1, flag, TOKEN_BATCH_RATIO);
+}
+
+static void set_weight(struct ioband_group *gp, int new)
+{
+ struct ioband_device *dp = gp->c_banddev;

```

```

+ struct ioband_group *p;
+ uint64_t tmp;
+
+ dp->g_weight_total += (new - gp->c_weight);
+ gp->c_weight = new;
+
+ list_for_each_entry(p, &dp->g_groups, c_list) {
+ if (dp->g_weight_total == 0)
+ p->c_token = p->c_token_init_value = p->c_limit = 1;
+ else {
+ tmp = dp->g_token_base * (uint64_t)p->c_weight;
+ do_div(tmp, dp->g_weight_total);
+ p->c_token = p->c_token_init_value = tmp + 1;
+
+ tmp = (dp->g_io_limit[0] + dp->g_io_limit[1]) *
+ (uint64_t)p->c_weight;
+ do_div(tmp, dp->g_weight_total);
+ p->c_limit = tmp + 1;
+ }
+ }
+ }
+
+static int policy_weight_param(struct ioband_group *gp, char *cmd, char *value)
+{
+ struct ioband_device *dp = gp->c_banddev;
+ long val;
+ int r = 0, err;
+
+ err = strict_strtol(value, 0, &val);
+ if (!strcmp(cmd, "weight")) {
+ if (!err && 0 < val && val <= SHORT_MAX)
+ set_weight(gp, val);
+ else
+ r = -EINVAL;
+ } else if (!strcmp(cmd, "token")) {
+ if (!err && val > 0) {
+ dp->g_token_base = val;
+ set_weight(gp, gp->c_weight);
+ } else
+ r = -EINVAL;
+ } else if (!strcmp(cmd, "io_limit")) {
+ set_weight(gp, gp->c_weight);
+ } else {
+ r = -EINVAL;
+ }
+ return r;
+ }
+
+

```

```

+static int policy_weight_ctr(struct ioband_group *gp, char *arg)
+{
+ struct ioband_device *dp = gp->c_banddev;
+
+ if (!arg)
+ arg = __stringify(DEFAULT_WEIGHT);
+ gp->c_my_epoch = dp->g_epoch;
+ gp->c_weight = 0;
+ return policy_weight_param(gp, "weight", arg);
+}
+
+static void policy_weight_dtr(struct ioband_group *gp)
+{
+ set_weight(gp, 0);
+}
+
+static void policy_weight_show(struct ioband_group *gp, int *szp,
+ char *result, unsigned int maxlen)
+{
+ struct ioband_group *p;
+ struct ioband_device *dp = gp->c_banddev;
+ struct rb_node *node;
+ int sz = *szp; /* used in DMEMIT() */
+
+ DMEMIT(" %d :%d", dp->g_token_base, gp->c_weight);
+
+ for (node = rb_first(&gp->c_group_root); node; node = rb_next(node)) {
+ p = rb_entry(node, struct ioband_group, c_group_node);
+ DMEMIT(" %d:%d", p->c_id, p->c_weight);
+ }
+ *szp = sz;
+}
+
+static int is_queue_full(struct ioband_group *gp)
+{
+ return gp->c_blocked >= gp->c_limit;
+}
+
+/*
+ * <Method>    <description>
+ * g_can_submit : To determine whether a given group has the right to
+ *                submit BIOs. The larger the return value the higher the
+ *                priority to submit. Zero means it has no right.
+ * g_prepare_bio : Called right before submitting each BIO.
+ * g_restart_bios : Called if this ioband device has some BIOs blocked but none
+ *                  of them can be submitted now. This method has to
+ *                  reinitialize the data to restart to submit BIOs and return

```

```

+ *      0 or 1.
+ *      The return value 0 means that it has become able to submit
+ *      them now so that this ioband device will continue its work.
+ *      The return value 1 means that it is still unable to submit
+ *      them so that this device will stop its work. And this
+ *      policy module has to reactivate the device when it gets
+ *      to be able to submit BIOS.
+ * g_hold_bio   : To hold a given BIO until it is submitted.
+ *      The default function is used when this method is undefined.
+ * g_pop_bio    : To select and get the best BIO to submit.
+ * g_group_ctr  : To initialize the policy own members of struct ioband_group.
+ * g_group_dtr  : Called when struct ioband_group is removed.
+ * g_set_param  : To update the policy own data.
+ *      The parameters can be passed through "dmsetup message"
+ *      command.
+ * g_should_block : Called every time this ioband device receive a BIO.
+ *      Return 1 if a given group can't receive any more BIOS,
+ *      otherwise return 0.
+ * g_show       : Show the configuration.
+ */
+static int policy_weight_init(struct ioband_device *dp, int argc, char **argv)
+{
+ long val;
+ int r = 0;
+
+ if (argc < 1)
+ val = 0;
+ else {
+ r = strict_strtol(argv[0], 0, &val);
+ if (r || val < 0)
+ return -EINVAL;
+ }
+
+ dp->g_can_submit = is_token_left;
+ dp->g_prepare_bio = prepare_token;
+ dp->g_restart_bios = make_global_epoch;
+ dp->g_group_ctr = policy_weight_ctr;
+ dp->g_group_dtr = policy_weight_dtr;
+ dp->g_set_param = policy_weight_param;
+ dp->g_should_block = is_queue_full;
+ dp->g_show = policy_weight_show;
+
+ dp->g_token_base = (val == 0) ? DEFAULT_TOKENBASE : val;
+ dp->g_epoch = 0;
+ dp->g_weight_total = 0;
+ dp->g_current = NULL;
+ return 0;
+}

```

```

+/* weight balancing policy based on the number of I/Os. --- End --- */
+
+
+/*
+ * Functions for weight balancing policy based on I/O size.
+ * It just borrows a lot of functions from the regular weight balancing policy.
+ */
+static int w2_prepare_token(struct ioband_group *gp, struct bio *bio, int flag)
+{
+ return consume_token(gp, bio, bio_sectors(bio), flag,
+   TOKEN_BATCH_RATIO<<3);
+}
+
+static int w2_policy_weight_init(struct ioband_device *dp,
+  int argc, char **argv)
+{
+ long val;
+ int r = 0;
+
+ if (argc < 1)
+   val = 0;
+ else {
+   r = strict_strtol(argv[0], 0, &val);
+   if (r || val < 0)
+     return -EINVAL;
+ }
+
+ r = policy_weight_init(dp, argc, argv);
+ if (r < 0)
+   return r;
+
+ dp->g_prepare_bio = w2_prepare_token;
+ dp->g_token_base = (val == 0) ?
+   DEFAULT_TOKENBASE << (PAGE_SHIFT - 9) : val;
+ return 0;
+}
+/* weight balancing policy based on I/O size. --- End --- */
+
+
+static int policy_default_init(struct ioband_device *dp,
+  int argc, char **argv)
+{
+ return policy_weight_init(dp, argc, argv);
+}
+
+struct policy_type dm_ioband_policy_type[] = {
+ {"default", policy_default_init},
+ {"weight", policy_weight_init},

```

```

+ {"weight-iosize", w2_policy_weight_init},
+ {NULL, policy_default_init}
+};
diff -uprN linux-2.6.26-rc5-mm3.orig/drivers/md/dm-ioband-type.c
linux-2.6.26-rc5-mm3/drivers/md/dm-ioband-type.c
--- linux-2.6.26-rc5-mm3.orig/drivers/md/dm-ioband-type.c 1970-01-01 09:00:00.000000000
+0900
+++ linux-2.6.26-rc5-mm3/drivers/md/dm-ioband-type.c 2008-07-04 12:21:10.000000000 +0900
@@ -0,0 +1,76 @@
+/*
+ * Copyright (C) 2008 VA Linux Systems Japan K.K.
+ *
+ * I/O bandwidth control
+ *
+ * This file is released under the GPL.
+ */
+#include <linux/bio.h>
+#include "dm.h"
+#include "dm-bio-list.h"
+#include "dm-ioband.h"
+
+/*
+ * Any I/O bandwidth can be divided into several bandwidth groups, each of which
+ * has its own unique ID. The following functions are called to determine
+ * which group a given BIO belongs to and return the ID of the group.
+ */
+
+/* ToDo: unsigned long value would be better for group ID */
+
+static int ioband_process_id(struct bio *bio)
+{
+ /*
+ * This function will work for KVM and Xen.
+ */
+ return (int)current->tgid;
+}
+
+static int ioband_process_group(struct bio *bio)
+{
+ return (int)task_pgrp_nr(current);
+}
+
+static int ioband_uid(struct bio *bio)
+{
+ return (int)current->uid;
+}
+
+static int ioband_gid(struct bio *bio)

```

```

+{
+ return (int)current->gid;
+}
+
+static int ioband_cpuset(struct bio *bio)
+{
+ return 0; /* not implemented yet */
+}
+
+static int ioband_node(struct bio *bio)
+{
+ return 0; /* not implemented yet */
+}
+
+static int ioband_cgroup(struct bio *bio)
+{
+ /*
+ * This function should return the ID of the cgroup which issued "bio".
+ * The ID of the cgroup which the current process belongs to won't be
+ * suitable ID for this purpose, since some BIOs will be handled by kernel
+ * threads like aio or pdflush on behalf of the process requesting the BIOs.
+ */
+ return 0; /* not implemented yet */
+}
+
+struct group_type dm_ioband_group_type[] = {
+ {"none", NULL},
+ {"pgrp", ioband_process_group},
+ {"pid", ioband_process_id},
+ {"node", ioband_node},
+ {"cpuset", ioband_cpuset},
+ {"cgroup", ioband_cgroup},
+ {"user", ioband_uid},
+ {"uid", ioband_uid},
+ {"gid", ioband_gid},
+ {NULL, NULL}
+};
diff -uprN linux-2.6.26-rc5-mm3.orig/drivers/md/dm-ioband.h
linux-2.6.26-rc5-mm3/drivers/md/dm-ioband.h
--- linux-2.6.26-rc5-mm3.orig/drivers/md/dm-ioband.h 1970-01-01 09:00:00.000000000 +0900
+++ linux-2.6.26-rc5-mm3/drivers/md/dm-ioband.h 2008-07-04 12:21:10.000000000 +0900
@@ -0,0 +1,169 @@
+/*
+ * Copyright (C) 2008 VA Linux Systems Japan K.K.
+ *
+ * I/O bandwidth control
+ *
+ * This file is released under the GPL.

```

```

+ */
+
+#include <linux/version.h>
+#include <linux/wait.h>
+
+#define DEFAULT_IO_THROTTLE 4
+#define DEFAULT_IO_LIMIT 128
+#define IOBAND_NAME_MAX 31
+#define IOBAND_ID_ANY (-1)
+
+struct ioband_group;
+
+struct ioband_device {
+ struct list_head g_groups;
+ struct work_struct g_conductor;
+ struct workqueue_struct *g_ioband_wq;
+ struct bio_list g_urgent_bios;
+ int g_io_throttle;
+ int g_io_limit[2];
+ int g_issued[2];
+ int g_blocked;
+ spinlock_t g_lock;
+ struct mutex g_lock_device;
+ wait_queue_head_t g_waitq;
+ wait_queue_head_t g_waitq_suspend;
+ wait_queue_head_t g_waitq_flush;
+
+ int g_ref;
+ struct list_head g_list;
+ int g_flags;
+ char g_name[IOBAND_NAME_MAX + 1];
+ struct policy_type *g_policy;
+
+ /* policy dependent */
+ int (*g_can_submit)(struct ioband_group *);
+ int (*g_prepare_bio)(struct ioband_group *, struct bio *, int);
+ int (*g_restart_bios)(struct ioband_device *);
+ void (*g_hold_bio)(struct ioband_group *, struct bio *);
+ struct bio * (*g_pop_bio)(struct ioband_group *);
+ int (*g_group_ctr)(struct ioband_group *, char *);
+ void (*g_group_dtr)(struct ioband_group *);
+ int (*g_set_param)(struct ioband_group *, char *cmd, char *value);
+ int (*g_should_block)(struct ioband_group *);
+ void (*g_show)(struct ioband_group *, int *, char *, unsigned int);
+
+ /* members for weight balancing policy */
+ int g_epoch;
+ int g_weight_total;

```

```

+ int g_token_base;
+ struct ioband_group *g_current; /* current group */
+ int g_token_mark;
+
+};
+
+struct ioband_group_stat {
+ unsigned long sectors;
+ unsigned long immediate;
+ unsigned long deferred;
+};
+
+struct ioband_group {
+ struct list_head c_list;
+ struct ioband_device *c_banddev;
+ struct dm_dev *c_dev;
+ struct dm_target *c_target;
+ struct bio_list c_blocked_bios;
+ struct bio_list c_prio_bios;
+ struct rb_root c_group_root;
+ struct rb_node c_group_node;
+ int c_id; /* should be unsigned long or unsigned long long */
+ char c_name[IOBAND_NAME_MAX + 1]; /* rfu */
+ int c_blocked;
+ int c_prio_blocked;
+ wait_queue_head_t c_waitq;
+ int c_flags;
+ struct ioband_group_stat c_stat[2]; /* hold rd/wr status */
+ struct group_type *c_type;
+
+ /* members for weight balancing policy */
+ int c_weight;
+ int c_my_epoch;
+ int c_token;
+ int c_token_init_value;
+ int c_limit;
+
+ /* rfu */
+ /* struct bio_list c_ordered_tag_bios; */
+};
+
+#define IOBAND_URGENT 1
+
+#define DEV_BIO_BLOCKED 1
+#define DEV_SUSPENDED 2
+
+#define set_device_blocked(dp) ((dp)->g_flags |= DEV_BIO_BLOCKED)
+#define clear_device_blocked(dp) ((dp)->g_flags &= ~DEV_BIO_BLOCKED)

```

```

+#define is_device_blocked(dp) ((dp)->g_flags & DEV_BIO_BLOCKED)
+
+#define set_device_suspended(dp) ((dp)->g_flags |= DEV_SUSPENDED)
+#define clear_device_suspended(dp) ((dp)->g_flags &= ~DEV_SUSPENDED)
+#define is_device_suspended(dp) ((dp)->g_flags & DEV_SUSPENDED)
+
+#define IOG_PRIO_BIO_WRITE 1
+#define IOG_PRIO_QUEUE 2
+#define IOG_BIO_BLOCKED 4
+#define IOG_GOING_DOWN 8
+#define IOG_SUSPENDED 16
+#define IOG_NEED_UP 32
+
+#define set_group_blocked(gp) ((gp)->c_flags |= IOG_BIO_BLOCKED)
+#define clear_group_blocked(gp) ((gp)->c_flags &= ~IOG_BIO_BLOCKED)
+#define is_group_blocked(gp) ((gp)->c_flags & IOG_BIO_BLOCKED)
+
+#define set_group_down(gp) ((gp)->c_flags |= IOG_GOING_DOWN)
+#define clear_group_down(gp) ((gp)->c_flags &= ~IOG_GOING_DOWN)
+#define is_group_down(gp) ((gp)->c_flags & IOG_GOING_DOWN)
+
+#define set_group_suspended(gp) ((gp)->c_flags |= IOG_SUSPENDED)
+#define clear_group_suspended(gp) ((gp)->c_flags &= ~IOG_SUSPENDED)
+#define is_group_suspended(gp) ((gp)->c_flags & IOG_SUSPENDED)
+
+#define set_group_need_up(gp) ((gp)->c_flags |= IOG_NEED_UP)
+#define clear_group_need_up(gp) ((gp)->c_flags &= ~IOG_NEED_UP)
+#define group_need_up(gp) ((gp)->c_flags & IOG_NEED_UP)
+
+#define set_prio_read(gp) ((gp)->c_flags |= IOG_PRIO_QUEUE)
+#define clear_prio_read(gp) ((gp)->c_flags &= ~IOG_PRIO_QUEUE)
+#define is_prio_read(gp) \
+ ((gp)->c_flags & (IOG_PRIO_QUEUE|IOG_PRIO_BIO_WRITE) == IOG_PRIO_QUEUE)
+
+#define set_prio_write(gp) \
+ ((gp)->c_flags |= (IOG_PRIO_QUEUE|IOG_PRIO_BIO_WRITE))
+#define clear_prio_write(gp) \
+ ((gp)->c_flags &= ~(IOG_PRIO_QUEUE|IOG_PRIO_BIO_WRITE))
+#define is_prio_write(gp) \
+ ((gp)->c_flags & (IOG_PRIO_QUEUE|IOG_PRIO_BIO_WRITE) == \
+ (IOG_PRIO_QUEUE|IOG_PRIO_BIO_WRITE))
+
+#define set_prio_queue(gp, direct) \
+ ((gp)->c_flags |= (IOG_PRIO_QUEUE|direct))
+#define clear_prio_queue(gp) clear_prio_write(gp)
+#define is_prio_queue(gp) ((gp)->c_flags & IOG_PRIO_QUEUE)
+#define prio_queue_direct(gp) ((gp)->c_flags & IOG_PRIO_BIO_WRITE)
+

```

```
+
+struct policy_type {
+ const char *p_name;
+ int (*p_policy_init)(struct ioband_device *, int, char **);
+};
+
+extern struct policy_type dm_ioband_policy_type[];
+
+struct group_type {
+ const char *t_name;
+ int (*t_getid)(struct bio *);
+};
+
+extern struct group_type dm_ioband_group_type[];
+
+/* Just for debugging */
+extern long ioband_debug;
+#define dprintf(format, a...) \
+ if (ioband_debug > 0) ioband_debug--, printf(format, ##a)
```

---

Containers mailing list

Containers@lists.linux-foundation.org

<https://lists.linux-foundation.org/mailman/listinfo/containers>

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