

NAME

rsrc_m, rsrc_i – Resource Manager and Iterator Classes

SYNOPSIS

```

#include <rsrc.h>

template <class TYPE, class KEY>
class rsrc_m : public w_base_t {
    friend class rsrc_i<TYPE, KEY>;
public:
    NORET                                rsrc_m(
        TYPE*                            space,
        int                               n,
        char*                             descriptor=0);
    NORET                                ~rsrc_m();

    void                                mutex_acquire();
    void                                mutex_release();

    bool                                is_cached(const KEY& k);

    w_rc_t                               grab(
        TYPE*&                            ret,
        const KEY&                        k,
        bool&                             found,
        bool&                             is_new,
        latch_mode_t                      mode = LATCH_EX,
        int                               timeout = sthread_base_t::WAIT_FOREVER);

    w_rc_t                               find(
        TYPE*&                            ret,
        const KEY&                        k,
        latch_mode_t                      mode = LATCH_EX,
        int                               ref_bit = 1,
        int                               timeout = sthread_base_t::WAIT_FOREVER);

    void                                publish_partial(const TYPE* rsrc);
    void                                publish(
        const TYPE*                        rsrc,
        bool                               error_occurred = false);

    bool                                is_mine(const TYPE* rsrc);

    void                                pin(
        const TYPE*                        rsrc,
        latch_mode_t                      mode = LATCH_EX);

    void                                upgrade_latch_if_not_block(
        const TYPE*                        rsrc,
        bool&                             would_block);

    void                                unpin(
        const TYPE*&                      rsrc,
        int                               ref_bit = 1);

```

```

// number of times pinned
int                                pin_cnt(const TYPE* t);
w_rc_t                            remove(const TYPE*& t) {
    w_rc_t rc;
    bool get_mutex = ! _mutex.is_mine();
    if (get_mutex)    W_COERCE(_mutex.acquire());
    rc = _remove(t);
    if (get_mutex)    _mutex.release();
    return rc;
}

void                                dump(ostream &o, bool debugging=1) const;
int                                audit(bool prt= false) const;

void                                snapshot(u_int& npinned, u_int& nfree);

unsigned long                      ref_cnt, hit_cnt;

// iterator
template <class TYPE, class KEY>
class rsrc_i {
public:
    NORET                          rsrc_i(
        rsrc_m<TYPE, KEY>&          r,
        latch_mode_t                m = LATCH_EX,
        int                        start = 0)
        : _mode(m), _idx(start), _curr(0), _r(r) {};

    NORET                          ~rsrc_i();

    TYPE*                          next();
    TYPE*                          curr()    { return _curr ? _curr->ptr : 0; }
    w_rc_t                          discard_curr();

private: // disabled methods
    NORET                          rsrc_i(const rsrc_i&);
    rsrc_i&                        operator=(const rsrc_i&);
};

/*
 * rsrc_t
 *   control block (handle) to a resource
 */
template <class TYPE, class KEY>
struct rsrc_t {
public:
    NORET                          rsrc_t()    {};
    NORET                          ~rsrc_t()   {};
    w_link_t                       link;        // used in resource hash table
    latch_t                        latch;        // latch on the resource
    KEY                            key;          // key of the resource
    KEY                            old_key;
    bool                           old_key_valid;

```

```

    TYPE*                ptr;           // pointer to the resource
    w_base_t::uint4_t      waiters;      // # of waiters
    w_base_t::uint4_t      ref;          // ref count
    scond_t               exit_transit;  // signaled when
                                    // initialization is done

};

```

DESCRIPTION

The **rsrc_m** template class manages a fixed size pool of "resources" (of type T) in a multi-threaded environment. A structure, **rsrc_t**, is associated with each resource. Class **rsrc_t** contains a key, K, a pointer to the resource and a latch to protect access to the resource. The **rsrc_t** elements are stored in a hash table, **hash_t**. Because of the latches, each resource can be individually "pinned" for any desired length of time without restricting access to other resources.

The template class **rsrc_i** is the iterator for the **rsrc_m** class.

When a entry needs to be added and the table is full, an old entry is removed based on an LRU policy.

The **rsrc_m** is relatively expensive, so it is probably best used to manage large resources or where high concurrency is needed. A good example is managing access to pages in a buffer pool.

Requirements:

The **rsrc_m** template takes two class parameters:

- T the class type of the resources to be manages.
- K the unique key of the resource for lookup purposes. *Note:* that **K** must define **K::operator=()** for copying since **rsrc_m** saves a copy of **K u_long hash(const K&) hash** function for **K** because **rsrc_m** is hash-table based.

A resource in **rsrc_m**
can be in one of three states:

- unused the resource is free; no key is associated with the resource.
- cached the resource is cached and is associated with a key.
- in-transit
 the resource is begin replaced; its key is being changed.

Rsrc_m Interface

rsrc_m(rsrc, cnt, desc)

The constructor creates a resource manager to manage the resources specified by the array *rsrc*. The number of resources (ie. the length of the array) is specified by *cnt*. The *desc* is an optional string used for naming the latches protecting the resources. It can be useful in debugging.

~rsrc_m()

The destructor destroys the resource manager. There should not be any resources pinned when the resource manager is destroyed.

grab(*ret*, *key*, *found*, *is_new*, *mode*, *timeout*)

The **grab** method pins the resource associated with *key* and sets a latch in mode *mode* on the resource. The calling thread should subsequently free *rsrc* by calling **unpin**.

If the resource is cached, **grab** simply returns it. Otherwise, **grab** will either allocate an unused resource or find another cached resource to replace using a pseudo-LRU (clock) algorithm. The calling thread could potentially block if *mode* causes a latch conflict (i.e., when there is contention to the resource). If **grab** is successful, a pointer to the cached/allocated/replacement resource is returned in *ret*. The *found* flag is set to indicate cache hit/miss. In the case of a cache miss, the resource returned is said to be **in-transit**, and the *is_new* flag indicates whether *ret* points to:

- (1) a previously unused resource (true), or
- (2) a previously cached resource of another key (false).

In case 1, the in-transit resource returned simply needs to be initialized with the new key. All other threads that ask for a resource with the new key will block. The caller should initialize the resource and subsequently call **publish**, which formally publishes the new key and resets the resource's in-transit status.

In case 2, the in-transit resource returned is temporarily associated with both the new key (as specified in **grab** and the old key. All other threads that ask for a resource with any of these keys will block. The caller should first clean up the resource (invalidate the old key) and call **publish_partial**, which informs **rsrc_m** that the old key is no longer valid. The caller should then proceed as in case 1.

In essence, the caller should proceed as follows:

```

grab the resource
if not found then
    if not is_new then
        clean up the resource (optional), e.g., flush the dirty page
        call publish_partial() (optional)
    initialize the resource (obligatory), e.g., read the new page
    call publish() (obligatory)
... use the resource ...
call unpin() to free the resource

```

find(*ret*, *key*, *mode*, *ref_bit*, *timeout*)

The **find** method looks up and pins a cached resource identified by *key*. It returns an error **fcNOTFOUND**

if the resource is not cached. If the resource is cached, a *mode*

latch is acquired on the resource and a pointer to the resource is returned in *ret*. The calling thread should subsequently free the resource by calling **unpin**. As in **grab**,

the calling thread could potentially block if *mode* causes a latch conflict (i.e., when there is contention to the resource). The *refbit* parameter is a hint to the **rsrc_m** replacement algorithm; *refbit* is directly proportional to the duration that a resource remained cached. Thus, a zero *refbit* implies that the **rsrc_m** should reuse the resource as soon as needed after it is unpinned.

pin(*rsrc*, *mode*)

The **pin** method pins the resource *rsrc*. The latch on the resource is acquired in mode *mode*. The calling thread should subsequently free *rsrc* by calling **unpin**.

publish(rsrc, error_flag)

The **publish** method makes the resource *rsrc*, that was previously obtained by a **grab** call with a cache miss, available. See the description of **grab** for more details. The *error_flag* parameter informs the **rsrc_m** that the resource has not been successfully initialized, and should be invalidated.

publish_partial(rsrc)

The **publish_partial** method partially publishes the resource *rsrc* that was previously obtained with a call to **grab**. See the description of **grab** for more details.

unpin(rsrc, refbit)

The **unpin** method releases the latch on the resource *rsrc*. The *refbit* parameter is a hint to the **rsrc_m** replacement algorithm; *refbit* is directly proportional to the duration that a resource remained cached. Thus, a zero *refbit* implies that the **rsrc_m** should reuse the resource as soon as needed.

Rsrc_i Interface

The **rsrc_i** template is used to iterate over all of the resources in an instance of **rsrc_m**.

rsrc_m(r, mode, start)

The constructor initializes an iterator for the **rsrc_m** instance indicated by parameter *r*. Each resource will be pinned (latched) in mode *mode*. The iterator starts at the *start*, element in the array of resources that *r* manages. The iterator will only return those resources actually in the hash table.

~rsrc_m()

The destructor ends the iterator by unpinning and currently pinned resource.

next()

The **next** method unpins the current resource, advances the iterator to the next resource, and pins it. **Next** returns a pointer to the resource after it has advanced. It will return 0 if there are no more resources. **Next** skips any resources not in the hash table.

curr()

The **curr** method returns a pointer to the currently pinned resource.

discard_curr()

The **discard_curr** method unpins the current resource and removes it from the hash table.

TODO

VERSION

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SEE ALSO

latch_t(common), intro(common).