Identification

Initial Load Control
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Purpose

Load Control allows the system to restrict the number
of users to some specified amount, and to regulate this
number during system operation. This paper describes
a straightforward implementation of Load Control for initial
Multics. A more sophisticated algorithm will be used
in later versions.

Discussion

It is desirable that the load on the system be such that
each interactive user is reasonably comfortable with the
rate at which he interacts with the system. When the
load gets "too heavy" (defined for a particular installation),
the interaction rate decreases and system overhead may
sharply increase. To prevent such an overloading, Load
Control is provided to maintain the number of users at
some "satisfactory" level. Load Control is called to
perform such functions as:

   a)   determine if a particular user may log in

   b)   reset the maximum number of users allowed on
         the system

   c)   automatically log out a particular user

   d)   automatically log out a number of users to
         forcibly decrease the load

Load Control Table

To aid in performing its functions, Load Control maintains
a system-wide data base in a segment with pathname:

   ">sys_process_reserved_storage>load_control>load_ctl_tbl"

```
dcl 1 load_ctl_tbl based (lp),      /* load control table */

      2 max_users fixed bin (17),   /* max no. of interactive
                                       users */

      2 cur_users fixed bin (17),   /* current no. of interactive
                                       users */
```

```
    2 lct_length fixed bin (17),    /* length of load control
                                        table */

    2 load_lock,                     /* lock structure */

      3 lock_bit bit (36),           /* lock word */

      3 lock_chnl bit (70),          /* event channel for locker */

    2 user_list (50),                /* list of interactive
                                        users */

      3 pr_grp_id,                   /* user's process group id */

        4 name char (24),            /* user's name */

        4 project char (24),         /* user's project id */

        4 tag char (2),              /* login instance tag-always
                                        "aa" */

      3 user_ctrl_pr bit (36),       /* user control process id */

      3 auto_out_chnl bit (70);      /* event channel for automatic
                                        logout */
```

The table contains a fixed length and a variable-length
portion. The fixed length portion contains the value
for the maximum number of interactive users, the value
for the current number of interactive users, and a lock
structure used by the Locker facility to lock the table
while it is in use. The variable length portion of the
table is a list containing one entry per interactive user.
Each entry contains the user's process-group id, the process
id of the user's User Control Process, and an event channel
id of the event channel to be used to signal an automatic
logout to this user's User Control Process.

<u>Entries to Load Control</u>

To inquire if a particular user may be allowed to log
in (and, if so, to insert an entry for this user into
the Load Control Table):

```
        load_control$try_to_insert (username, projid, login_id,
        reply, auto_logout_channel);
```

```
dcl   username char (24),
      projid char (24),
      login_id char (2),
      reply bit (1),
      auto_logout_channel bit (70);
```

username - user's name

projid - user's project identification

login_id - instance tag (always "aa" for initial Multics)
           returned if the user should be allowed to log
           in. The instance tag uniquely identifies each
           of the process-groups for a user-name-projid
           combination which is logged in more than once.

reply - (return argument)

        "1"b if the user should be allowed to log in
        "0"b if the user should not be allowed to log in

auto_logout_channel - event channel id of the wait-type
                      event channel which may be used to
                      signal an automatic logout to this
                      User Control Process.

To remove the entry for a user from the Load Control Table:

    load_control$remove_user (username, projid, login_id,
                             remove_status);

        Same declarations as in try_to_insert call except
        for:

        dcl remove_status bit (36),

        remove_status - "0"b if entry successfully removed
                            from Load Control Table

                        "1"b if entry not found in Load
                        Control Table

To reset the maximum number of users allowed:

    load_control$set_max_users (new_max_users);

        dcl new_max_users fixed bin (17);

    new_max_users - new value of the maximum number of
                    interactive users (max_users)

To automatically log out a specific user:

    load_control$force_out_user (username, projid, login_id,
                                  force_status);

        dcl force_status bit (36);

        force_status - "0"b if entry found in Load Control
                       Table
                       "1"b if entry not found in Load Control
                       Table

To trim the system load (by automatically logging out a number
of users):

    load_control$trim_load (n_users, trim_status);

        dcl n_users fixed bin (17),

            trim_status bit (36);

        n_users - number of users to be automatically logged
                  out.

        trim_status - "0"b if successful

                      "1"b if caller specified that more users
                      should be logged out than are currently
                      logged in. [Action taken: all users
                      are logged out except for the user
                      represented by the first entry in the
                      Load Control Table.]

Operation

AT LOGIN TIME

The user_in procedure in this user's User Control Process
calls Load Control to "try-to-insert" this user into the
system.

Load Control checks to see that cur_users is less than
max_users. If not, reply is set to "0"b and control is
returned to the user_in procedure. If cur_users is less
than max_users, Load Control searches the user_list to
see if this user is already logged in. If he is, then
reply is set to "0"b and control is returned to user_in.
If he is not already logged in, reply is set to "1"b,
an entry for this user is placed in user_list, cur_users
is incremented by 1, and control is returned to user_in.

AT LOGOUT TIME

The user_out procedure in this user's User Control Process calls Load Control to "remove_user" from the system.

Load Control deletes this user's entry from the user_list, decrements cur_users by 1, and returns to user_out.

Note: Load Control calls the Locker to lock the Load Control Table whenever it is in use. The table is unlocked after Load Control has finished referencing it.

DURING SYSTEM OPERATION:

A - resetting maximum system load (and trimming system load by attrition).

The value of max_users is initially determined by the value in the Load Control Table at system initialization time. Once the system is running, this value may be changed by "set_max_users". If the new value of max_users is less than cur_users, the system load is trimmed by attrition, i.e., no further interactive users are allowed to log in until enough users have logged out to make cur_users less than the new value of max_users.

B - forcing a particular user to log out:

System Control calls Load Control to "force_out_user".

Load Control locates this user's entry in the Load Control Table and sends an automatic logout signal over the event channel specified in this entry to this user's User Control Process.

C - trimming the system load (by force):

System Control calls Load Control to "trim_load" by automatically logging out a certain number of users.

Load Control sends automatic logout signals to the specified number of User Control Processes. Under no circumstances is an automatic logout signal sent to the first person who logged in *(presumably the system operator). First, users whose project id is not "sys_operator" or "operator" are logged out (until the specified number of users have been logged out). If more users must be logged out then, and only then, users with project id "sys_operator" or "operator" are logged out until enough users have been logged out to fulfill the request.

*Note: At least for the duration of Initial Multics, the
           system operator will, in fact, always be the first
           person to log in. Therefore his entry in the Load
           Control Table will be the first such entry, and he
           will not lose this place.

```
   ╭─────────────────╮          ╭─────────────────╮        ╭─────────────────╮
   │  try_to_insert  │          │   remove_user   │        │  set_max_users  │
   ╰────────┬────────╯          ╰────────┬────────╯        ╰────────┬────────╯
            │                            │                          │
            ▼                            ▼                          ▼
        ╱───────╲    no   ┌──────────┐ ┌──────────┐      ┌────────────────┐
       ╱ cur_users╲──────▶│ reply=0  │ │ delete   │      │ reset value of │
       ╲   <      ╱       └────┬─────┘ │ the user │      │ max_users in   │
       ╲max_users╱            │       │ from load_│      │ load_ctl_tbl   │
        ╲───────╱             │       │ ctl_tbl  │      └───────┬────────┘
            │ yes             │        └────┬─────┘              │
            ▼                 ▼             ▼                    ▼
      ┌──────────┐       ╭─────────╮   ┌──────────┐       ╭───────────╮
      │ reply=1  │       │ return to│   │decrement │       │ return  to│
      └────┬─────┘       │  caller  │   │cur_users │       │  caller   │
           │             ╰─────────╯    │  by 1    │       ╰───────────╯
           ▼                            └────┬─────┘
    ┌──────────────┐                         │
    │ place entry  │                         ▼
    │ for this     │                    ╭──────────╮
    │ user in      │                    │ return to│
    │ load_ctl_tbl │                    │  caller  │
    └──────┬───────┘                    ╰──────────╯
           │
           ▼
    ┌──────────────┐
    │ increment    │
    │ cur_users    │
    │   by 1       │
    └──────────────┘
```

```
   ╭─────────────────╮                ╭─────────────────╮
   │  force_out_user │                │    trim_load    │
   ╰────────┬────────╯                ╰────────┬────────╯
            │                                  │
            ▼                                  ▼
   ┌──────────────────┐            ┌────────────────────┐
   │  locate this     │            │ logout specified   │
   │ user's entry in  │            │ number of users    │
   │ load_ctl_tbl     │            │ whose projids      │
   └────────┬─────────┘            │ are not "sys_      │
            │                      │ operator" or       │
            ▼                      │ "operator"         │
   ┌──────────────────┐            └─────────┬──────────┘
   │ send automatic   │                      │
   │ logout over      │                      ▼
   │ specified event  │                 ╱─────────╲   yes   ┌────────────┐      ╭───────────╮
   │ channel to speci-│            ────╱  have     ╲───────▶│ decrement  │─────▶│ return to │
   │ fied User_Con-   │           │   ╱ we logged   ╲       │ max_users by│     │  caller   │
   │ trol_Process     │           │   ╲ out specified╱      │ number of  │     ╰───────────╯
   └────────┬─────────┘           │    ╲number of users     │ logged out │
            │                     │     ╲    ?    ╱          │ users      │
            ▼                     │      ╲───────╱           └────────────┘
     ╭───────────╮                │          │
     │ return to │                │          ▼
     │  caller   │                │   ┌────────────────────┐
     ╰───────────╯                │   │ log out additional │
                                  │   │ users regardless   │
                                  └───│ of project id      │
                                      │ (but don't log     │
                                      │ out first user).   │
                                      └────────────────────┘
```
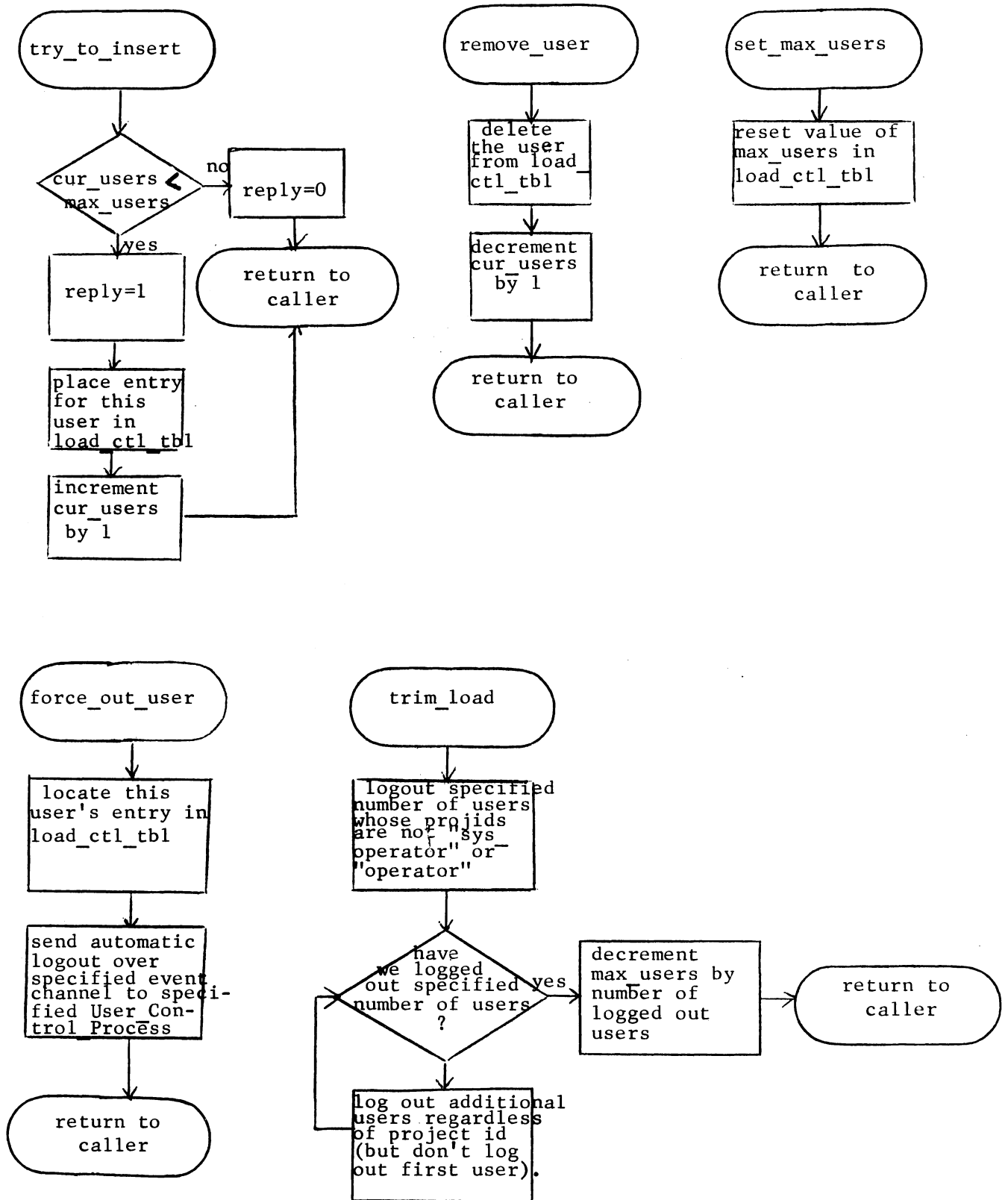
Fig. 1   Load Control Processing