April 26, 1966

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The attached is our first attempt to define an approach to the implementation of encapsulated GECOS. We would appreciate any comments you may have regarding the acceptability of this approach under MULTICS or any problems you may see in the method.

Emerson Seim and I will be in Cambridge on Friday, April 29 and would appreciate meeting with those of you who are in Cambridge on that day at 10:00 a.m. in the seventh floor conference room. We hope at that time to obtain your criticisms and answers to several questions which are outstanding in regard to this design.

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Problem

The execution of 635 batch processing jobs in a 645 MULTICS environment.

Approach

The package will take a customer, job oriented approach. That is, the GECOS operating system will not be incorporated entirely under MULTICS nor will any effort be made to reproduce GECOS logic in 645 language.

Functions like multi-programming and multi-processing are not a concern at the job level. The implementation of this type of function will be strictly the province of the MULTICS operating system.

The greatest effort will be made to retain present 635 system formats to minimize the task of converting a job to the 645. For example, an existing card file for a 635 multi-activity job should be accepted into the system with only preface identification to alert the MULTICS system.

635 Job Monitor

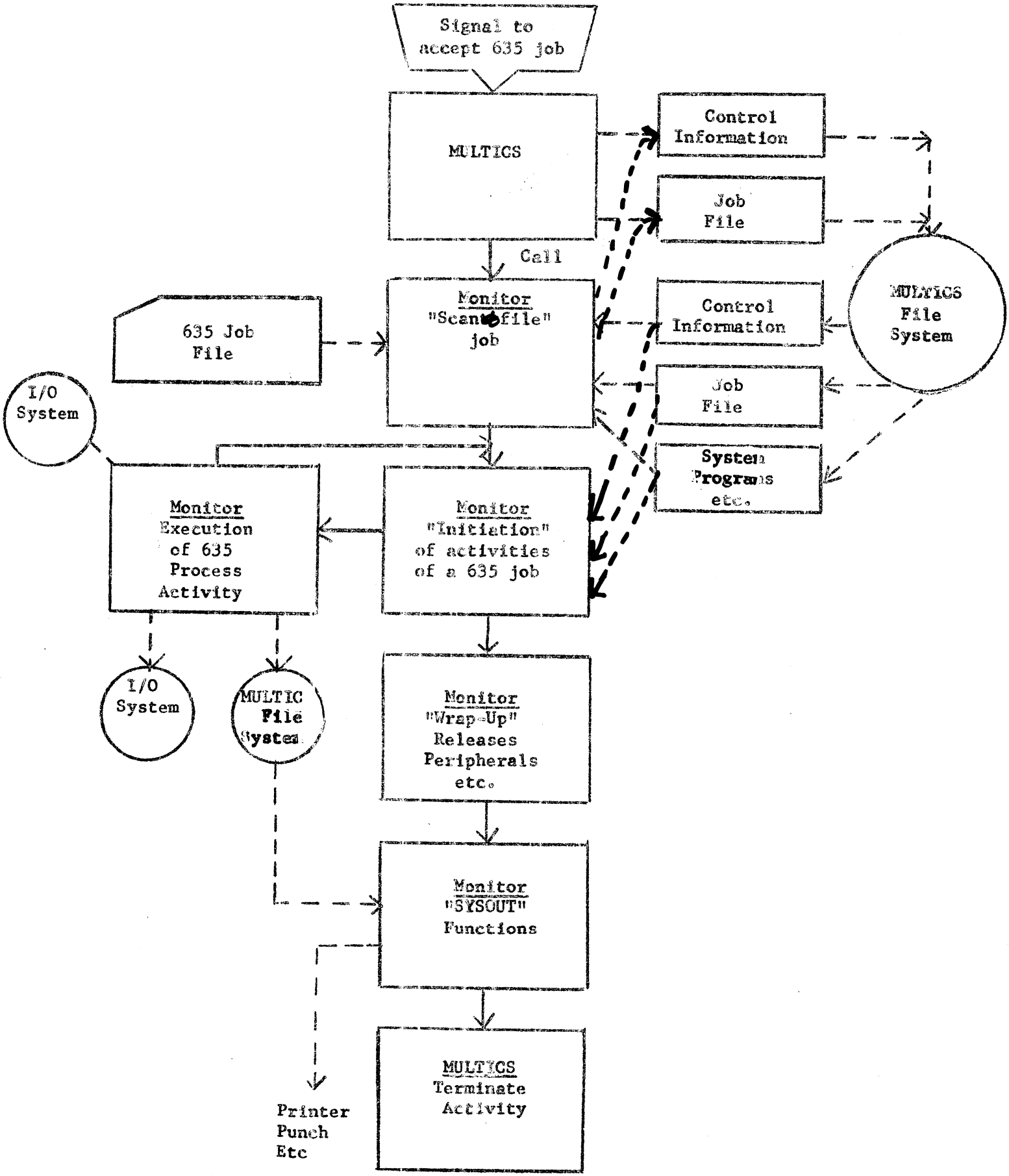
A Monitor file will be a pure procedure filed in the MULTICS file system. A separate MULTICS process will be initiated for each 635 job active in the system. It will consist of the Monitor plus the 635 programs loaded into 645 segments with associated linkage sections. These 645 segments created from 635 programs will be added to the Monitor in the sequence of execution of the 635 programs.

Accessable for incorporation into the Monitor from the MULTICS file system is the set of 635 Utility and System Programs which have been previously filed in 645 format. In this way, the Monitor might effect a compilation, an execution of compiled output, and perform system output in accordance with the activity descriptions of a 635 job.

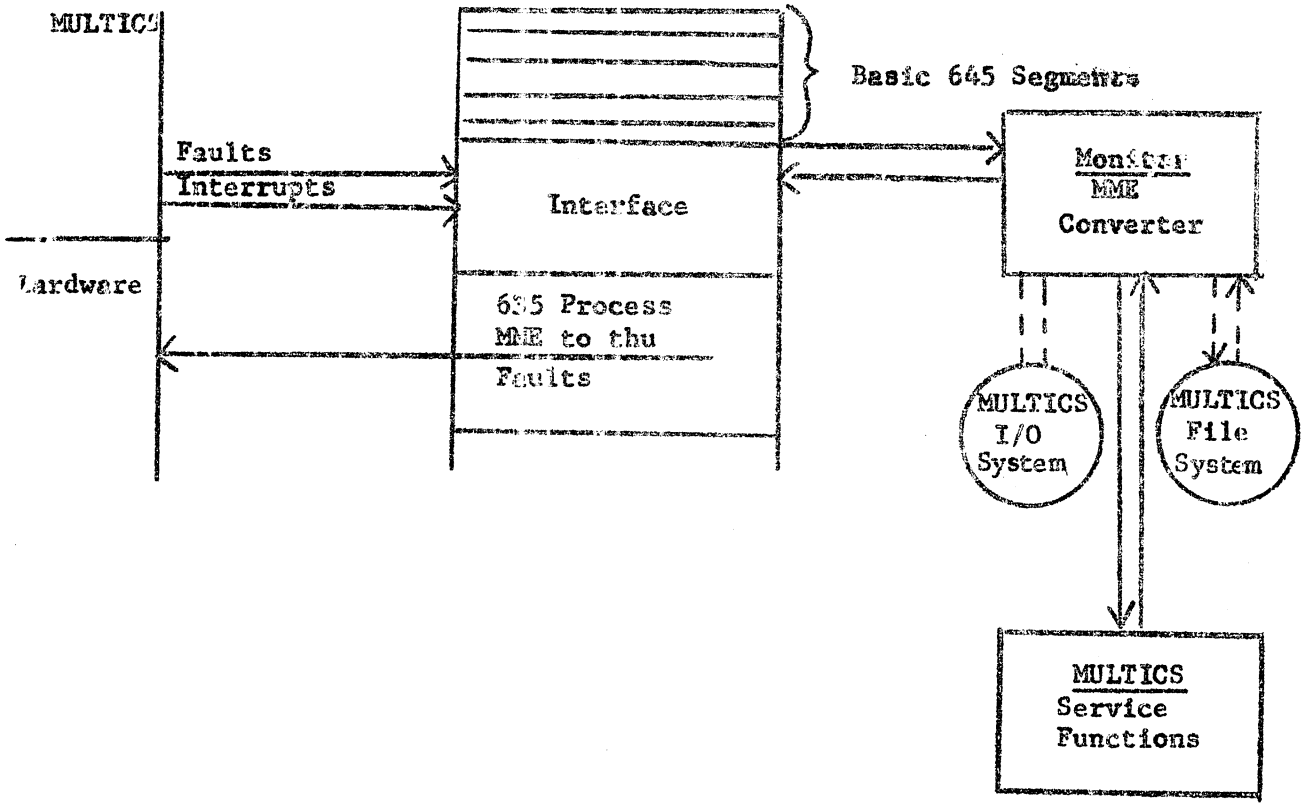
Also available in the Monitor are MME converters which perform GECOS MME service functions directly or generate appropriate calls for MULTICS services. During the execution phase of a 635 activity, an interface module is included to intercept faults and certain interrupts.

645 Direct Calls

After a 635 activity has been entered into the MULTICS file system by use of the Monitor, it can (hopefully) be called from a console for execution as a 645 process. The Monitor will adhere to MULTICS communication standards to facilitate this mode of operation.


Signal to accept 635 job
MULTICS
Control Information
Job File
Call
Monitor "Scan file" job
635 Job File
Control Information
MULTICS File System
Job File
I/O System
System Programs etc.
Monitor Execution of 635 Process Activity
Monitor "Initiation" of activities of a 635 job
I/O System
MULTIC File System
Monitor "Wrap-Up" Releases Peripherals etc.
Monitor "SYSOUT" Functions
MULTICS Terminate Activity
Printer Punch Etc

MONITOR ACTION,
EXECUTION PHASE



The Monitor - Typical phases

Basic This is those segments which are necessary to define a 645 process. The descriptor segment, stack segment, etc., comprise the basic set. A procedure segment of basic calls is included to start the generative processes.

Scan and File The additional functions of reading a 635 job file, scanning to extract control information and filing in the MULTICS file system are incorporated. This phase starts a 635 job into the MULTICS system.

Initiation The control parameters are recalled from File and interpreted to seek an allocation of resources from the MULTICS system. When the requirements have been satisfied, a 635 activity is called from File as a procedure segment of the 645 process.

The construction of the 635 activity segment will be done as the 635 loader would have done. Routines will be loaded and linked according to 635 GECOS rules.

An interface segment will be initialized with 635 file information, a switch word and activity information to control flow to the next activity. The interface segment will accept faults and interrupts, interpret them, and transfer to the appropriate MME converters during execution.

When the generation is complete, a transfer of control will be made into the 635 process segment to effect execution.

Execution The Monitor will now consist of a Basic set, an Interface set, and a 635 Procedure set which is in execution. MME converters are available as needed in the form of pure procedure in the Monitor File. Dump routines, SYSOUT routines, and the like will be used as a 635 procedure requests their functions.

When a 635 activity is concluded, the Initiation phase will be entered again. An Execution phase or a Wrap-up phase will follow as the activity information dictates.

Wrap-Up This phase of the Monitor would start releasing peripherals and file storage. The output of any system files (SYSOUT) would be initiated. The process as executed will still reside in the MULTICS file structure and can be dismissed or retained as an input option might specify.

General It is anticipated that the Monitor approach will provide a simple, efficient method of entering a 635 job into the MULTICS system and directing it through its various activities until it leaves the MULTICS file system.

By making the Monitor assume the identity and configuration of the 635 job file it is processing, the full MULTICS capabilities may be utilized for batch processing.

Functional Handling of MME 's

A MME is a program generated fault and will be intercepted by the interrupt system into a Monitor segment for interpretation. The fault will be classified and shunted to an appropriate routine which can interpret the related parameters. In many cases, these routines

will have to generate a call to MULTICS to satisfy the requests. Each MME must be considered individually according to its function.

GEINOS - I/O Handling

Extensive interpretation will be required and the following services may be expected from MULTICS.

1. Read, Write, and Space file or record.
2. Return of status information.
3. Signal when requested action has been completed. (Courtesy calls.)
4. Swap devices on a file.
5. Additional attempts at error recovery.
6. A block of mass storage for random accessing. (Does MULTICS file structure now provide this?)
7. Linking of requests e.g. SEEK/READ or WRITE.

GEROAD - Roadblock until all outstanding I/O has been serviced. To avoid wasteful looping, MULTICS must provide a form of delay or pause in dispatching.

GEFADD - Physical file address request. This is used to generate operator messages, etc. Operator messages are necessary - the functional need for a physical address may be questioned, but is desirable for continuity of operations.

GERELS - Releases a peripheral component. This will notify MULTICS that a device is free. Not necessary for the Monitors, perhaps, but desirable for MULTICS.

GESNAP - Snapshot dump. Status of processor registers must be available, and the MULTICS System File for output must be available.

GELAPS - Elapsed time request. An individual time clock must be available from MULTICS. (On 635 systems, one time pulse = 1/64 millisecond.)

GEFINI - Normal activity termination. This is a Monitor control request and does not directly involve MULTICS.

GEBORT - Abnormal activity termination. This is a Monitor control request and does not directly involve MULTICS.

GEMORE - Request for additional resource allocation. MULTICS will be asked to supply increments of 1024 core words, additional tape drives, or additional mass storage. GEMORE does provide a denial return, but an object program may suffer execution time penalties or be aborted if GEMORE can not be implemented through MULTICS calls.

GEFCON - File control block request. The request used by GEFRC ultimately results in a normal I/O request from MULTICS.

GEFILS - File switching request. This is provided for magnetic tape files and perhaps does not need reflection directly to MULTICS. If MULTICS does not provide multi-reel files, the Monitor can "fake" this.

GESETS - Set switch request. The switch word resides in the Monitor and does not directly involve MULTICS.

GERETS - Reset switch request. The switch word resides in the Monitor and does not directly involve MULTICS.

GEENDC - End courtesy call. This will be a part of the courtesy call procedure (See 3 under GEINOS). Does not affect MULTICS directly.

GERELC - Relinquish control. (See GEROAD) MULTICS will be asked to withold dispatching until an I/O action has been completed.

GESPEC - Special interrupt request. This provides for an I/O request to become effective when the device signals. This pertains to the card reader, card punch, printer, and remote terminals. The relationship of the Monitor to such devices through MULTICS is not clear. This type of "read or write when device is ready" function is anticipated in MULTICS.

GETIME - Date and time of day request. A date and time of day is expected to be available from MULTICS.

GECALL - System loader. This does not directly concern MULTICS. A normal call for retrieval from the MULTICS file system will be made by the Monitor.

GESAVE - Write file in system format. This will be translated by the Monitor into a normal MULTICS call to the file system.

GERSTR - Read file in system format. This will be translated by the Monitor into a normal MULTICS call to the file system.

GEMREL - Release memory. A multiple of 1024 words can be return to the MULTICS pool of resources. The Monitor will generate an appropriate call to MULTICS, if desired.

GESYOT - Write on SYSOUT. This is a call to transmit output to a collector for subsequent printing or punching. The Monitor will generate a normal call to the MULTICS file system.

GECHECK - Checkpoint. The Monitor will generate appropriate MULTICS file calls and safestore an image of the 635 activity and associated control parameters. If a convenient MULTICS checkpoint system is available, it will be used.

GEROLL - Reinitiate or rollback program. This is the correlate of GECHECK. The Monitor would retrieve files from the MULTICS file structure, or, if a MULTICS checkpoint is used, the status of the Monitor and its job would be recalled by MULTICS.

Assumptions and Questions Regarding MULTICS

1. There will be no restrictions on paging for a 635 process. Particularly, the MULTICS I/O System will process a scatter/gather list and adjust absolute addresses for lap-over between consecutive pages and will control locking and freezing of affected pages.
2. MULTICS can initiate multiple processes from a single copy of a segment in the MULTICS file system and treat them as separate, independent processes.
3. MULTICS can signal the completion of an I/O request or a request for file service. This is a courtesy call concept.
4. MULTICS will allocate a total time to a process which can not be exceeded. Further, the residual time can be determined at any time to by active process.
5. Fault and interrupt returns can be directed to a specified segment of a process other than the segment generating the fault. How is this done?