

Apple Computer Inc.

Inter-Office Memorandum

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Date: 07 June 1983

From: Michael *mk* Urquhart

Subj: Lisa 1.75 Firmware Project Plan: Preliminary

Attached in the preliminary project plan for the Lisa 1.75 ROM. I refer to the ROM in the plan as the System Firmware Module or SFM. The plan is tentative and can only be completed with your cooperation and approval. The size of the ROM and the role that the Lisa 1.75 CPU/Video board must play in Lisa 1.75 and the various servers requires a well planned approach. Please review the plan as soon as you can. I am arranging a meeting at the time and place indicated below so that open issues can be quickly resolved. Note that the most important issue is knowing who will be doing what! To help you in your review of the plan I am providing the following tidbits:

Meeting place: Sitting Bull
Meeting time: 1:30-4:00
Meeting date: Monday 13 June 1983

Lisa 1.75 Versatility

Lisa 1.75's CPU/Video board contains the processor, 128-256K bytes of ROM and 128K-256K bytes of RAM. It is to be designed to operate as a single board or as part of a two board set. The second board contains more RAM and the MMU. In the single board configuration, Lisa 1.75 is effectively a Macintosh with two to four times the firmware space. Even in the two board setup, no map mode (i.e. setup bit set) is effectively Macintosh mode.

From a marketing perspective, the ^{is} must be a reason for more firmware in Lisa 1.75 versus Macintosh's 64K bytes knowing that Mac provides a standard desktop capability using Quickdraw and the rest. Providing Lisa 1.75 with double or quadruple the amount of firmware space means that either

1. the equivalent functionality must be present in Lisa 1.75 firmware, or
2. there must be other aspects about the Lisa 1.75 firmware that demonstrates its worthiness as part of a higher cost product. For example, extensive diagnostics. Mac has virtually zero diagnostics in ROM.

From a manufacturing or service perspective, there should only be one type of CPU/Video board between 1.75 and servers. This reduces problems and costs associated with keeping track of different ROMs, different boards, installing wrong ROMs, wrong boards, inventories, different repair procedures, etc.

Increasing available memory

Designing a firmware module which thinks only 128K of RAM is always available and which provides most of the basic ingredients for desktop operation means that additional memory can be used more effectively. (Obviously, things in ROM should always be things that are always in RAM.)

Lisa/Mac Compatibility

An opportunity is available to explore the aspect of designing some degree of Mac compatibility. Since considerable effort has been made to move desktop functions into ROM and has in the process resulted in the design of a workable interface between ROM and RAM programs, capitalizing on that interface, if it can be done, may help us achieve some level of Mac compatibility while at the same time permit us to complete the key architectural aspects of the firmware in a much shorter time.

Lisa 1.75 System Firmware Module

Project Plan

7 June 1983

Preliminary

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I. Overview

A. Project Identification

This project has been assigned the name Lisa 1.75 System Firmware Module.

B. Definitions

System Firmware Module - The group of 8 ROM chips that resides on the Lisa 1.75 CPU/Video memory board and which can contain from 128K bytes using 27128 (16K by 8 bits) type ROMs to 256K bytes using 27256 (32K by 8 bit) type ROMS.

C. Scope of Project

The Lisa 1.75 System Firmware Module (SFM) is a 128K or 256K byte capacity ROM package which can bind together diagnostic, low to intermediate level software drivers and other frequently used system software such as Quickdraw, dynamic heap management code, MMU setting code, error logging code and a debugger. With careful (and clever) planning, diagnostics and operating system software can be made to operate within a single architecture.

By moving key system code to ROM, memory is free to be used for other purposes. In addition, the ability to provide superior operating ability in ROM can reduce the dependency on bootstrapping to achieve a comparable operating environment for troubleshooting and debugging.

Achieving the system firmware module capability noted above involves the cooperation and efforts of more than one software development group. This project plan hopes to establish the preliminary guidelines for the control, design, development and integration of firmware programs to be employed in the Lisa 1.75 hardware.

This project covers the following:

1. Startup in-line diagnostics.
2. Callable diagnostic subtests.
3. Primary level startup and alternate startup user interface.
4. Secondary level service and debug user interface.
5. The extensive modifications required to the Hardware interface drivers.
6. COPS ROM.
7. Drivers for Sony 3.5 floppy, 871 floppy, Profile, Priam, Profile Plus, RS-232, printers.
8. Modifications and incorporation of key LisaBug functions into the system firmware module.
9. Modifications and incorporation of Quickdraw into the system firmware module.
10. Modifications and incorporation of MMU setting code into the system firmware module.
11. Modifications and incorporation of dynamic heap management software into the system firmware module.
12. System firmware based error logging.
13. Assignments of data and video memory spaces for the video RAM.
14. Incorporation of a standard text and icon font into the system firmware module.
15. Modifications and incorporation of any other code into the system firmware module.

D. Objectives

By definition, Lisa 1.75 is a manufacturing cost reduced version of Lisa 1.0 which must be deliverable as a complete system no later than June of 1984. Reduced manufacturing cost as well as timeliness in delivering Lisa 1.75 to the market place will permit Apple to respond to marketing pressures with improved pricing leverage. To summarize these goals:

- a. Lisa 1.75 is a cost reduced Lisa 1.0.
- b. Lisa 1.75 must be completed at least six months prior to the planned ship date.

This project direction clearly mandates that as few code changes as possible can be made to existing software, except those code changes that are necessary to transport existing software to the new 1.75 environment, and that new software design must be limited to only those aspects of Lisa 1.75 hardware that have been changed. In addition, any redesigns that are necessary to improve performance or correct currently inadequate or undesirable features must seriously weigh the impact to the schedule. Finally, because scheduling is critical, learning curve time must be avoided or minimized to reduce schedule impact. To insure minimum learning curve impact, individuals that were formerly responsible for Lisa 1.0 key tasks must be assigned responsibility for the corresponding Lisa 1.75 task.

Objectives for the SFM take in account the above criteria. Key objectives are summarized as follows:

1. Move all frequently used drivers to the system firmware module and provide interface controls for these key drivers as necessary to support status and interrupt driven operation. This is to insure that diagnostics as well as normal system software can use the same low level drivers.
2. Offer the same or superior startup interface as Lisa 1.0 and provide the ability to boot from the 871 Floppy drive, a Sony 3.5 floppy drive, the integral hard disc, via Appletnet, *via the SCC interface* or from any expansion slot adhering to the expansion interface standard.
3. Offer improved selftest ability to isolate errors to the field replaceable unit and aid in manual troubleshooting using a minimum of diagnostic test controls.
4. Provide an error logging capability, primarily for memory errors, that is largely transparent to higher level software.
5. Provide complete standalone operation, including a basic desktop mode of operation which supports the primary startup interface of Lisa 1.0 or the like, as well as provides access to secondary level functions such as selection and invocation of self tests and debugger functions without the need to load in software from a storage device.
6. Design the system firmware module architecture so that sets of two ROMs can be replaced without affecting the functionality of other ROM sets.
7. Integrate part of Lisabug and all of Quickdraw into the firmware operating environment.
8. Maintain 100% compatibility between the SFM used with Lisa 1.75 and the SFM used with the Servant or File Server.

Always only use Video Memory for tests.
Boots Boot Block into Video Mem instead of main memory.
June 6, 1983

9. Insure that the SFM can operate properly without the main memory/memory management board. The SFM must permit single board operation.
10. Support dynamic heap management.
11. Support MMU initialization and management whenever the MMU/Memory board is installed.
12. Provide a reduced capability file system to support booting, keyboard tables, preferences and error logging.
13. Provide only one interface for entry to SFM functions from a RAM resident program.
14. Provide SFM operation override for all key traps and vectors preferably through an SFM controlled allocation scheme.
15. Provide SFM operation override for all other ROM resident routines.
16. Provide as much or greater firmware functionality than what is currently provided with Macintosh.
17. Support diagnostic functions in all drivers.
18. The SFM must be able to detect the difference between the Sony 3.5 inch and 871 floppy drives.
19. The SFM should support a standard communications protocol for remote diagnostics.

E. Assumptions

1. To insure that SFM project completion can meet the target schedule, or that at the least, availability of the SFM does not impact announcement of the Lisa 1.75 in the first quarter of 1984, management will insure that the individuals most familiar and therefore most likely to complete the key tasks in the shortest amount of time will be assigned responsibility for the corresponding Lisa 1.75 tasks.
2. All low level drivers must be changed or rewritten to support changes in hardware.
3. Correspondingly, all low level drivers will be modified to support error logging and provide diagnostic hooks.
4. Existing drivers transported to ROM will support their existing interfaces.
5. Memory error logging will be supported only by a SFM intercepted error handler.

5. Memory error logging will be supported only by a SFM intercepted error handler.
6. Error logic capability will not be diminished from Lisa 1.0. This implies that at the least the hardware design will sustain and/or improve error logging capability so that software overhead is reduced.
7. It is assumed that an SFM resident hard disc driver will be designed to handle the Profile, Profile Plus and PRAM hard discs.
8. Some effort will be made to understand Mac's firmware architecture and interfaces in order to determine if adoption of portions of Mac's architecture and/or interface is feasible and will help improve compatibility between Mac and Lisa.

F. Restrictions

1. There is a danger that insufficient time is available to implement the most desirable SFM functions.
2. Preoccupation with existing Lisa 1.0 commitments may delay involvement with the Lisa 1.75 SFM.
3. The inability to fit all necessary hardware onto the CPU/video RAM board may require a reduction in the number of ROM sockets that may be accommodated. This could effectively reduce available ROM space.

II. Phase Plan

A. Definition/Design

The following items have been identified as keys design issues requiring definition before efforts in other tasks can successfully be completed. Issues are listed in order of priority.

1. **Memory assignments for SFM and system software use.**
Because of the requirement to support standalone operation without the main memory board, all common data that was stored in low memory for Lisa 1.0 has to be moved to the video RAM. In addition, the appropriate video RAM segments expected to be used as the primary and alternate pages would need to be assigned.

It is believed that the following data is affected:

- a. Hardware Interface global data.
- b. Monitor Global Data.
- c. Self Test and Startup result data.
- d. Interrupt and trap vectors.
- e. Primary and alternate screen data.
- f. Quickdraw global data.
- g. Disc buffers/caches.
- h. debugger data area.
- i. Heap/system stack storage.

The below named groups or individuals are tentatively expected to resolve and document memory assignments.

Rick Meyers, Rich Page, Diagnostics&Firmware Group, OS Group

This task will produce a written Lisa 1.75 Video Memory Map description.

2. Identify and size all key components expected to be incorporated into the SFM. This task must calculate sizes of current components if they exist and then extrapolate the ultimate component sizes. /

The below named groups or individuals are tentatively expected to collect and publish code sizes.

TBDs

This task will produce a document listing planned key SFM components and current and estimated code sizes.

3. SFM Architecture has to be designed before any development efforts can proceed. SFM architecture should, among other issues:
 - a. design an orderly SFM theory of operation (after initial selftests fire up hardware interface then run certain diagnostic subroutines, etc) and then design a layered organization. Note that a certain amount of order is visibly supported in the Lisa 1.0 Boot ROM however its internal organization is not desirable.
 - b. resolve the interdependencies of the various SFM components (diagnostics needs hardware interface, boot code needs hardware interface, drivers, file system, Quickdraw needs hardware interface, heap management, etc).

- c. resolve the conflicts presented to SFM architecture by requiring that ROM sets be easily changed without affecting other ROM sets.
- d. establish a standard SFM interface and calling conventions which takes into account the need to minimize higher level software impact. Every effort should be made to evaluate Mac's firmware interface conventions.
- e. determine the effect of providing error logging at the firmware level and design the implementation steps.

The below named groups or individuals are tentatively expected to design and document the SFM architecture.

*Rick Meyers, Diagnostics&Firmware Group, OS Group,
Dan Smith, Rich Page*

This task will produce a written Lisa 1.75 SFM Architecture Specification.

- 3. **Primary Lisa User Interface Standard startup interface and graphic secondary service and debug interfaces must be designed and documented.**

Responsibility for user interface standard conformance:

Dan Smith

Responsibility for design and documentation:

TBD

This task should produce a Requirements Document to firmly establish what the detailed objectives are and a Interface Specification for primary and secondary level operations

5. The SFM based 871 driver will most likely be the sum of a low level 871 Floppy disc driver which is the logical replacement of the 6504 Floppy Controller ROM and the existing or appropriately modified OS floppy driver. The low level driver must be designed and documented taking into account the former ROM driver's functionality and the requirement, if any, to preserve a similar interface. The higher level driver may need to be slightly redesigned to accommodate SCC operations on the same interrupt level. Also, the higher level driver must support the Sony 3.5 inch floppy drive.

Responsibility for low level 6504 replacement: *Gary Phillips*

Responsibility for higher level floppy driver: *Dave Offen*

Participation or contributions are expected from:
Ron Hochsprung, MacIntosh Division

These tasks will produce a Low Level 871 Driver Specification and some form of higher level driver documentation or an updated specification if one exists already.

6. **Self tests and callable diagnostic routines** have to be redesigned and documented to take into account new hardware differences, SFM layout and added features offered by other likely SFM resident code such as Lisabug.

Group responsible: *Diagnostics&Firmware*

This task will produce a Requirements Document for SFM diagnostics and a SFM Diagnostic Specification.

7. A **new hard disk driver** for the internal hard disk must be designed and documented.

Group responsible: *OS Group*

Participation or contributions are expected from the following group:

Diagnostic&Firmware Group, Ron Hochsprung

This task should produce either a new driver specification or an updated version of an existing specification.

8. The Lisa 1.0 COPS is to be replaced in Lisa 1.75 by a different and improved version of the COPS. In addition, it is planned to change the specific interface protocol between the COPS and the Lisa host to improve performance and to reduce handshake problems. The cleanest approach to achieving new functionality may require COPS ROM redesign. To insure that sufficient time is available to address redesign, 100% resource allocation must be committed.

Individual responsible: *Todd MacMillan*

Participation or contributions are expected from the following group:

Gary Marten, Diagnostic&Firmware Group, Rick Meyers,

This task should produce a COPS ROM Requirements Document and a COPS ROM Specification.

9. Marketing requirements for the SFM that take in account Macintosh price/firmware size/firmware functionality as well as Lisa 1.75 price/firmware size/firmware functionality need to be determined. This task should produce a Marketing Requirements Document for the SFM.
10. International marketing requirements need to be defined. Specific requirements with respect to translating text must be documented. International Marketing is responsible. This task should produce an International Marketing Requirements Document.
11. Service Requirements for SFM diagnostics and service interface must be defined. DSSD is responsible. This task should produce a Service Requirements Document for the SFM.

B. Development/Modifications

1. Self tests and callable diagnostic routines will be developed by the Diagnostic&Firmware Group.

Primary choice: *George Cassey*

2. Primary startup interface and secondary service and debug interfaces will be developed by:

Primary choice: *TBD*

Alternate choice: *Rich Castro*

3. The OS group will be responsible for major driver development for the Floppy disk, SCC interface and Hard Disk. The Diagnostic&Firmware group will be responsible for low level 871 driver development.

Major Driver Development: *Dave Offen*
Low Level Driver: *Gary Phillips*

4. Hardware Design will be responsible for COPS firmware development.

Primary choice: *Todd MacMillan*

5. The Hardware Interface Driver module will be modified to work with new Lisa 1.75 hardware and to support an error logging capability:

Primary choice: *Rick Meyers*
Alternate choice: *Dave Offen*
Alternate choice: *George Cossey*

6. Lisabug will be modified for use in the SFM. Initially it will support its present interface. Ultimately it should be modified to conform to a secondary level service/debug graphic interface in the convention established by Lisa 1.0 service interface.

Primary choice: *Rich Page*
Alternate choice: *Rick Meyers*
Alternate choice: *Rich Castro*

7. Quickdraw must be modified as appropriate to run under the Lisa 1.75 environment.

Individual responsible: *TBD*

8. Heap management code must be modified as appropriate to run under the Lisa 1.75 environment.

Individual responsible: *TBD*

9. Low level printer driver code must be modified as appropriate to run under the Lisa 1.75 environment.

Group responsible: *OS Group*

10. Memory management unit handling code must be modified as appropriate to run under the Lisa 1.75 environment.

Group responsible *OS Group*

C. Integration

SFM components are expected to be integrated as follows:

1. Self Tests and startup result data processing with default interrupt and trap handling.
2. Hardware Interface.
3. LisaBug using present interface.
4. Profile external hard disc driver.
5. Low level startup (boot) driver.
6. Nonperipheral callable diagnostic subroutines.
7. Low level 871 driver.
8. Higher level hard disc drivers (replaces profile external hard disc driver).
9. Quickdraw, fonts and heap management.
10. User Interface.
11. Debugger using a graphics interface.
12. Miscellaneous functions as required.

D. Product Evaluation

1. Product Test

Once the release criteria for submission to product test has been met, NPR will validate that the products function according to specification.

2. User Testing

Marketing will coordinate and conduct user testing of the user interface concurrent with product testing. Included in user testing should be an evaluation of International Marketing's user interface requirements.

DSSD will conduct an evaluation of the SFM to verify that servicing needs have been satisfied.

3. Alpha Test

Alpha Testing will be coordinated by Marketing. Every effort should be made to separate alpha testing of the Lisa 1.75 with the final SFM into two phases.

Phase 1 Alpha Test should be conducted only with the SFM. Phase 2 Alpha test should be conducted together with any of the other software products.

4. Beta Test

Beta Testing will be coordinated by Marketing.

III. Dependencies

A. External Dependencies

1. Commencement of certain Lisa 1.75 tasks are dependent upon completion of Lisa 1.0 tasks.
2. Failure to assign individuals formally associated with a particular Lisa 1.0 project to the corresponding Lisa 1.75 project may delay SFM development.
3. Lack of sufficient new prototype machines will delay SFM debug and integration.
4. Lack of Widget documentation will delay disc driver design and development.
5. Lack of functional Widget hardware will delay disc driver debug.
6. Lack of a Lisa 1.75 compatible parallel interface card will delay startup code debug.
7. Lack of the appropriate adapter for the Data I/O equipment required to program SFM ROMs will delay the ability to provide ROMs for debug.
8. Porting of Monitor to 1.75 is dependent upon availability of SFM startup code.
9. Complete debug of the CPU/Video board is dependent upon availability of the COPS ROM.

B. Inter-Dependencies

1. Rick Meyers and Todd MacMillan must resolve the clock time format before the new COPS ROM can be developed.
2. Design and development of all major SFM components is dependent upon definition of CPU board RAM usage and design of SFM Architecture.
3. Completion of the new hardware interface COPS driver is dependent upon COPS ROM completion.
4. SFM startup (BOOT) code is dependent upon the debug and integration of floppy and hard disc driver code.
5. Incorporation of Quickdraw into the SFM is dependent upon the availability of the hardware interface.
6. Lisabug requires a working hardware interface.

7. Debug of the COPS ROM and the Hardware Interface COPS driver are mutually dependent.

IV. Schedule & Milestones

A. Schedule

- | | | | |
|----|---|----------|-----------------------------|
| 1. | Project Plan available | 06/07/83 | <i>Happened</i>
06/09/83 |
| | Project Plan approved | 06/15/83 | |
| 2. | Documents | | |
| | Lisa 1.75 Video Memory Map | 06/20/83 | |
| | Code Size Estimates For SFM | 06/20/83 | |
| | General SFM Requirements Document | 06/20/83 | |
| | SFM User Interface Requirements Document | 06/30/83 | |
| | SFM Architecture Specification | 07/15/83 | |
| | Low Level 871 Driver Specification | 06/20/83 | |
| | Hard Disc Driver Specification | 06/13/83 | |
| | COPS ROM Requirements Document | 06/15/83 | |
| | Hardware Interface Specification | 06/30/83 | |
| | SFM Diagnostic Requirements Document | 06/30/83 | |
| | SFM Diagnostics Specification | 07/15/83 | |
| 3. | Dependencies | | |
| | TBDs assigned by | 06/15/83 | |
| | Widget hard disc documentation received by | 06/30/83 | |
| | CPU Video memory use defined by | 06/30/83 | |
| | SFM Architecture defined by | 07/15/83 | |
| | Marketing Requirments for the SFM | 07/15/83 | |
| | Service Requirements for the SFM | 07/15/83 | |
| | International Marketing Requirements
for the SFM | 07/15/83 | |
| | Manufacturing Requirements for the SFM | 07/15/83 | |
| | Hardware: | | |
| | Data I/O Adapter for larger ROM available | 07/15/83 | |
| | Lisa 1.75 expansion compatible Parallel
Interface Card available | 08/01/83 | |
| | 1 Prototype Lisa 1.75s available for SFM only
development/debug | 07/15/83 | |
| | 2 Lisa 1.75s available for SFM only
development/debug | 09/22/83 | |
| 4. | Programming (complete) | | |
| | Selftest code/debugged | 09/15/83 | |
| | Startup code - external profile | 09/30/83 | |
| | Low level 871 driver coded/debugged | 08/30/83 | |
| | Startup code - widget | 09/30/83 | |

OS 871 driver changed/debugged	09/22/83
Startup code - 871	08/30/83
Startup code - Applenet	08/30/83
Lisa 1.75 only diagnostic subtests	09/30/83
Hardware Interface changed/debugged	09/30/83
Lisabug changed/debugged	08/30/83
MMU management code changed/debugged	TBS
Universal hard disc driver complete	10/30/83
Heap manager modified/debugged	TBS
Quickdraw modified/debugged	09/30/83
Primary user interface coded/debugged	11/30/83
Service/debug user interface coded/debugged	12/15/83

B. Major Milestones

Project Plan available	06/07/83
Project Plan approved	06/15/83
Release Memory Map Description	06/20/83
Release User Interface Specification	06/30/83
Release Architecture Specification	07/15/83
Major design tasks complete	07/15/83
Release SFM Diagnostic Specification	07/15/83
Selftests available in ROM	08/30/83
Hardware Interface available	08/30/83
SFM debugger available	08/30/83
Low level 871 driver available in ROM	08/30/83
Startup code all devices	10/01/83
Primary User Interface running	11/01/83
Secondary Level user interface	12/15/83
Code complete	01/15/84

V. Resources

1. Personnel	Shortest Duration	Longest Duration
Selftests	2 months	6 months
Hardware Interface	2 month	6 months
Low level 871 driver	2 months	4 months
OS 871 driver changes	1 month	2 months
Widget Hard disc driver	2 months	2 months
Startup code	1 month	1 month
Quickdraw changes	1 month	2 months
Heap management changes	1 month	1 month
Lisabug changes	1 month	2 months
Diagnostic subtests	3 months	6 months

Universal Hard Disc driver	2 months	4 months
User Interface primary startup	3 months	6 months
SCC Remote Communications	4 months	8 months
totals	25 months	50 months