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Proposal for Distributed System Framework Design Notebook

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The various elements of distributed systems research and development at L.C.S. fit together in a general framework that is carried in the heads of the various participants and has so far been described only in fragments. As work has proceeded, more aspects have become focused and problems thought through. By now, enough parts of the general plan are understood that it is possible to assemble a coherent framework from a systems perspective. As a vehicle for communicating that perspective, this note proposes that a framework document be evolved to record the technical design plan. The idea is to lay out a complete system structure in outline form, and then begin to fill in various parts of the outline to the extent that planning or careful thought has taken place. The result will be a notebook that grows to encompass all the design ideas currently envisioned. This notebook will be useful both for internal cross-communication and also to inform others about the nature of the system plan.

Since one of the underlying ground rules of the distributed system project is that autonomy is a fundamental force behind decentralization and distribution, the notebook must reflect this autonomy. To accomplish such a reflection, the highest levels of the outline should be considered to be a taxonomy of generic areas, under which one primary subsystem design may be initially described by other parallel, alternative, or competing approaches can also be fit. A way of mechanically accomodating any number of alternatives at any level is suggested in the example outline, using a basically numerical outline form with letters to identify alternative subsystems.

Although the notebook can reflect a wide range of alternative system components, alternatives including both interim facilities and facilities that might be the eventual outcome of research projects, it does not by

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itself say anything about the relative order in which various pieces might be implemented nor does it try to identify any minimal collection of subsystems that must be working in order to be useful. Its purpose is primarily to show how various existing and potential subsystems relate to one another. A separate planning document that distinguishes among already implemented production subsystems, development plans, and research projects is required to define those services needed for various stages of usefulness of a practical system.

It should be noted that this design framework is described from a particular perspective: it represents a particular view of how to organize a distributed system, yet it includes, at least by reference, several components being developed as independent research projects by other groups within L.C.S. This inclusion is not intended to be pre-emptive but rather complementary to the systems assumed by those research initiators. That is, it is our hope to be able to make use of other systems as if they were subsystems in the way suggested here, without corrupting their designers' intentions even though those subsystems were designed for other system environments or even with a complete, different, system view of their own. The success of this hope remains to be seen; it is another purpose of the proposed notebook to help explain to other system designers one way that their facilities might fit into this framework.

Following is a first cut at a highest level outline. For each entry the criterion of inclusion is that someone has thought about the area enough to be ready to document the next level of detail.

C. Distributed System Framework

1. Overview
2. Area network
3. Interactive catalog of services
4. Electronic message forwarding system
5. Authentication system
6. Data storage service
7. Desktop subsystem
8. Remote service debugging system
9. Distributed application language
10. Distributed application programming support system
11. Miscellaneous services
12. Far-out ideas

To illustrate an appropriate direction for the next two levels of detail, here is an expanded outline for the first few topics. Again, the criterion for inclusion of each topic is that enough thought has been given to the subject that a position paper or detailed plan could be written now.

2. Area network
    - .1 design requirements/environment/overview of plan
    - .2 local ring network (V2)
        - ..1 ring net philosophy
        - ..2 controller and modem design
            - ...1 controller interface specification
        - ..3 host interface design
            - ...1 UNIBUS programming specification
            - ...2 Nu-bus programming specification
            - ...3 Q-bus programming specification
            - ...4 S-100 bus programming specification
    - .2A Interim ring network (V1)
    - .3 Internetwork protocol IP forwarding strategy
        - ..1 Relation to DARPA/IP, Xerox PUP, CHAOS IP
        - ..2 IP-PUP-CHAOS interchange plan
        - ..3 IP forwarding software
        - ..4 Gateway hardware configuration
    - .4 Long distance bridge plan
        - ..1 Special version of ring controller/modem
        - ..2 Optical fibre version
    - .5 Topology plan
        - ..1 Masternet under central control
        - ..2 Private gateways under independent control
    - .6 Home computer interconnection
        - ..1 Packet radio interconnection system
    - .7 External network interconnection
        - ..1 ARPANET IP gateway
        - ..2 X.25 gateways to TELENET, TYMNET
        - ..3 X.25 hardware interface

.8 Area network services

..1 Routing/forwarding

..2 Service location

..3 Terminal concentrator

.9 Area network administration

..1 Traffic monitoring

..2 Network naming plan

.10 Widely-used higher-level protocols

..1 Telnet

..2 Trivial file transfer

..3 File transfer

..4 Object transfer

3. Interactive catalog of services

.0 Naming plan overview

.1 Mailbox location catalog

.2 Service catalog--"Yellow pages"

.3 Updating and operations

4. Electronic message forwarding system

.0 Overview of message system

.1 Message exchange protocol

.2 Message forwarding service

.3 Message exchange with outside services

.4 Desktop message system

.4A Alternate desktop message system

.4B Second alternate desktop message system

5. Message authentication system

.0 Authentication system overview

.1 Key distribution service

..1 Public key service

..2 DES key generation service

..3 Operation and management of key distribution services

.2 Identity authentication

..1 Password system

..2 Magnetic stripe reader

.3 Authentication protocols

..1 Mail

..2 Private connections

..3 Connectionless transactions

.4 Encryption hardware

..1 Alto encryption instructions

..2 Nu encryption card

6. Distributed data storage service

.0 Overview of data storage

..1 Object model

..2 Replication

...1 performance

...2 availability

.1 Atomic actions on data

..1 Synchronization

..2 Backward error recovery

..3 Multisite coordination

.2 Information protection

..1 Authentication

..2 Object encryption

..3 Physical security

.3 Long-term integrity

..1 Backup storage strategy

..2 Operational issues

..3 User interface

.4 Stable storage model

..1 Append-only model

..2 Magnetic disk strategy

..3 Optical disk strategy

..4 Tape strategy

.5 Broker function

..1 Interface

..2 Implementation

.6 Repository

..1 Interface

..2 Implementation

.7 Data storage service operation
..1 Utilities
..2 Operations interface
..3 Administration
.8 Performance techniques
.9 Special hardware
..1 Tape controller
..2 Large disk controller
..3 Optical disk controller

6A. Interim file storage service (Alto)
.1 Interim plan

7. Desktop subsystem
.1 Integrated user interface
..1 Uniform control language
..2 Word processing system (ETUDE)
..3 Drawing and illustration system
..4 Videotext interface
..5 Telephone control service
..6 CATV subpicture control
.2 Distributed runtime support system (CLUSYS)
.2A One-user operating system (TRIX)
.3 Hardware (nu)

8. Remote service debugging system

9. Distributed application language (XCLU)

9A. Application language (C)

10. Distributed application programming support system (XCLULIB)

11. Miscellaneous services
.0 List of all known services
.1 Dover printing service
.1A Canon printing service
.2 Printer queueing service
.3 ACSII-Press translation service
.4 Accounting service
.5 WWV time-of-day service
.6 Local weather sensor service

12. Far-out ideas