The I/O entity:

1. the medium
2. the transducer electronics
3. the device

Basic types:

1. interrupt-driven
2. polling
3. I/O controller (e.g. DMA)
4. I/O processor

Disk storage:

areal

1. Track, cylinder, aerial density
2. Rotation, seek
3. Disk block
4. I/O processor mechanism: e.g., elevator
5. Disk arrays -- RAID levels, performance vs. redundancy

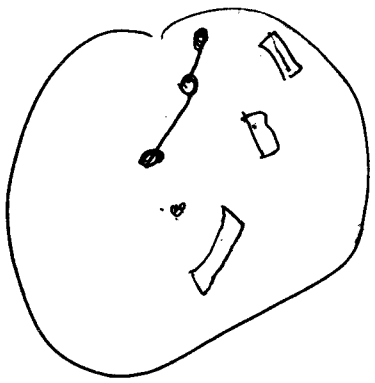
Cylinder track. across all platters

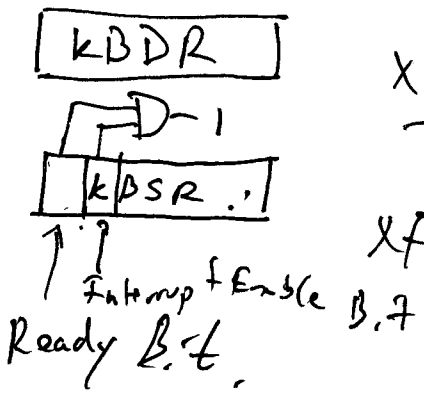
Ouch!

Buses:

1. Signals: A, D, C
2. Separate A,D lines vs. Multiplexed A,D lines
3. Pending bus vs. Split-transaction bus (tagging)
4. Asynch vs. Synch
5. Arbitration: Centralized vs. Distributed pipelined

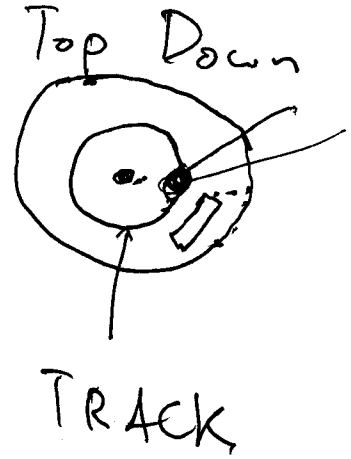
PAU Dinner table





XFE02

XFE04

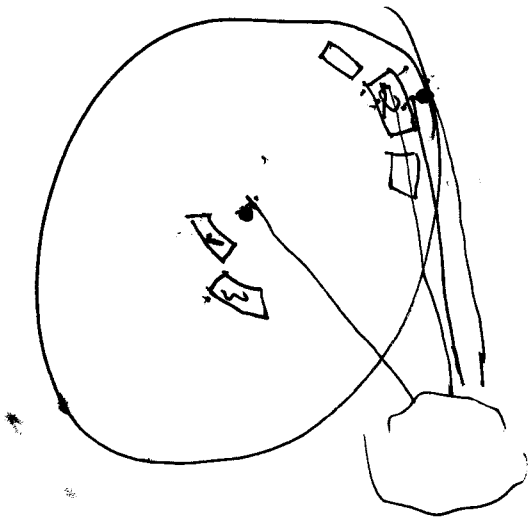


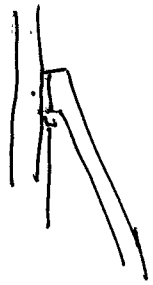
X sectional

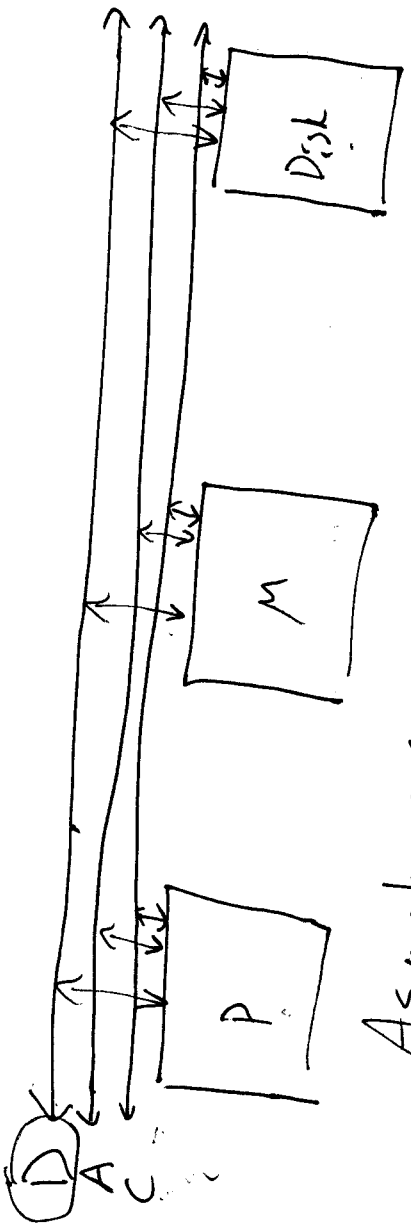
Area 1

FARUK / 1

FARUK/2



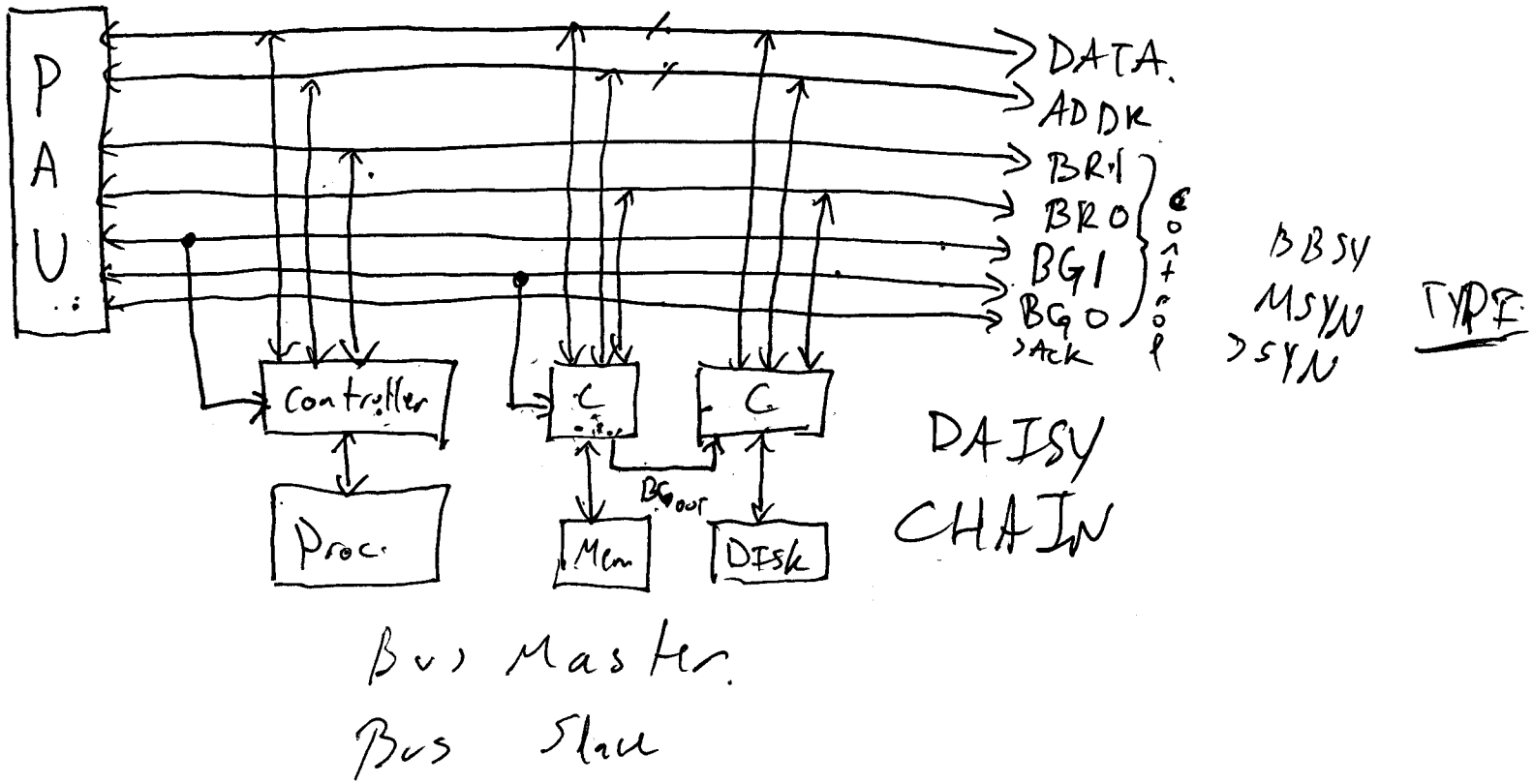




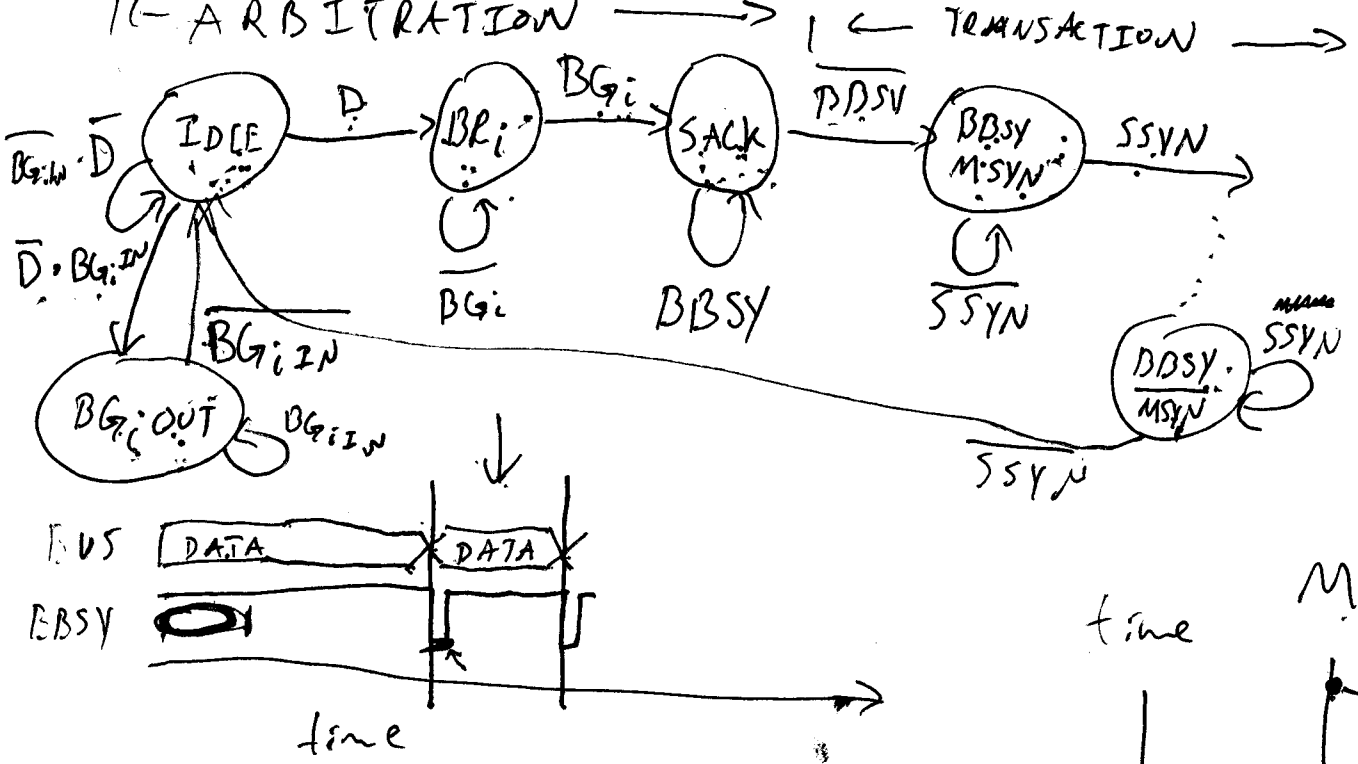
PAU

Asynchronous

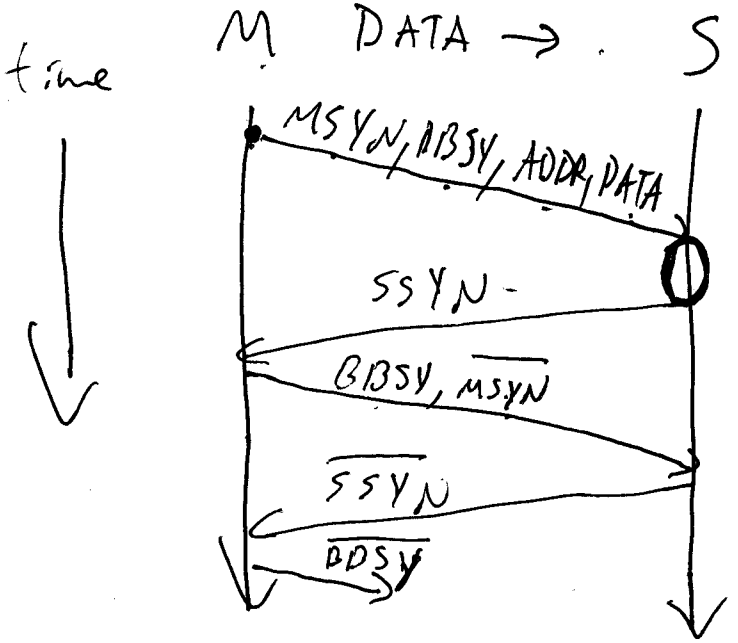
Synchronous

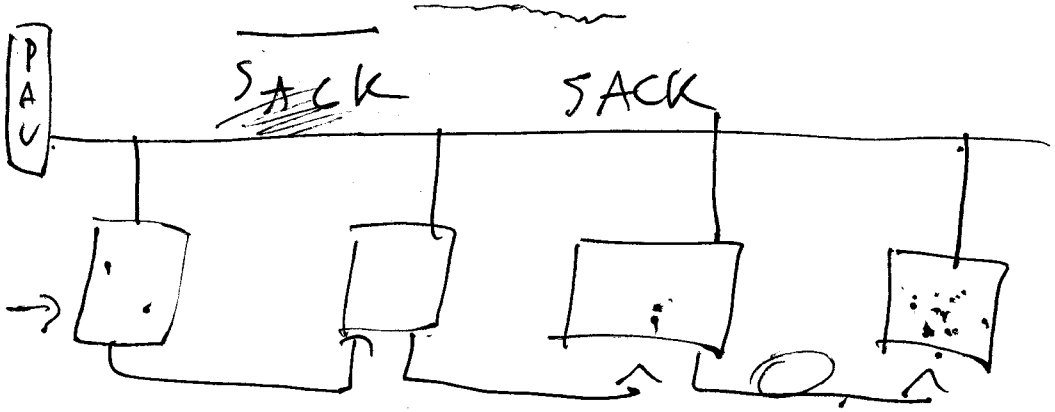

PAU
DATA
ADDR
BR1
BR0
BG1
BG0
Control
BBSY
MSYN
DSYN
TYPE
Controller
C
C
Proc
Mem
DISK
BGout
DAISY
CHAIN
Bus Master
Bus Slave

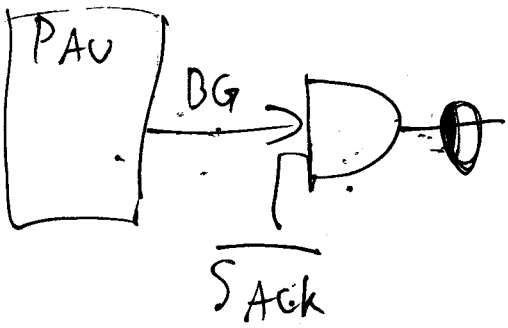
FARUK / 4

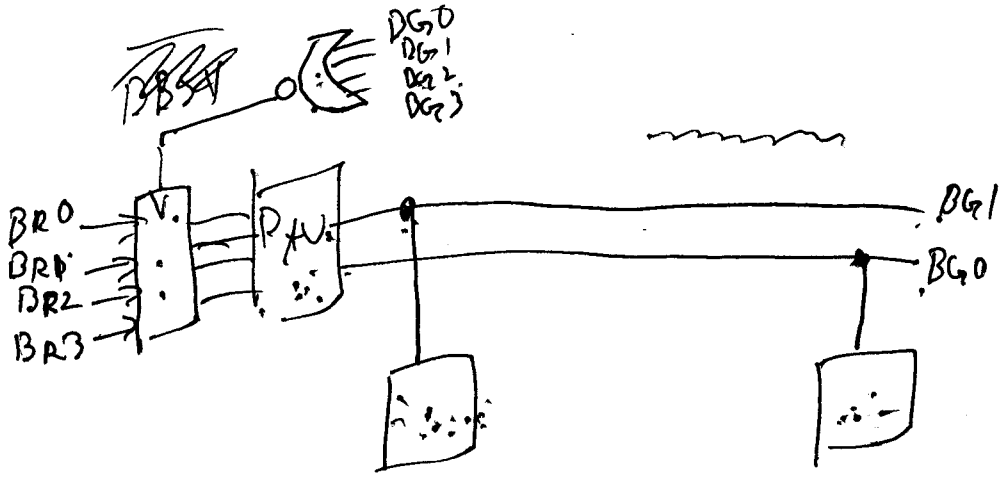

ARBITRATION
TRANSACTION
IDLE
BRi
SACK
BBSY
MSYN
SSYN
BGi
BGiIN
BGiOUT
D

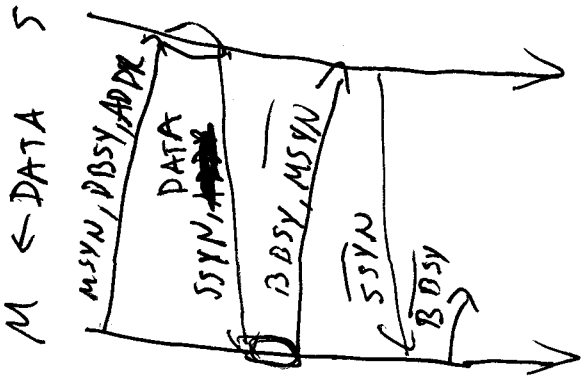
BUS
DATA
DATA
BBSY
time


time
M
DATA →
S
MSYN, BBSY, ADDR, DATA
SSYN
BBSY, MSYN
SSYN
BBSY

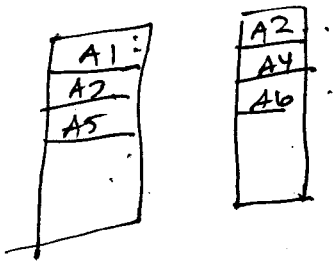

PAU
SACK
SACK


PAU
BG
SACK

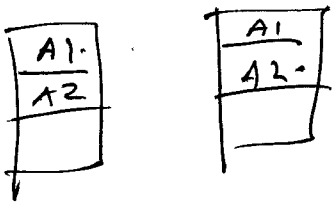

BBSY
DG0
DG1
DG2
DG3
BR0
BR1
BR2
BR3
V
PAU
BG1
BG0


M ← DATA
MSYN, BBSY, ADDR
DATA
SSYN
BBSY, MSYN
SSYN
BBSY

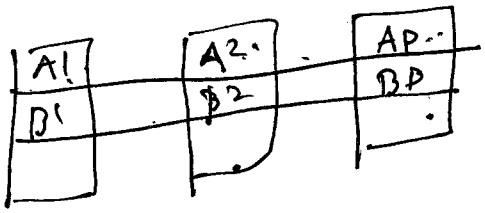
RAID 0 Striping



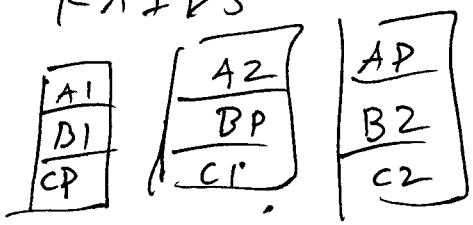
RAID 1 - mirroring



RAID 4



RAID5



2, 3, 6

Standard RAID levels

8 Data
4 bits

A1 A2 A3 A4 AP

SECDED

1 * ~~0~~ 0 1

0

Hamming

RAID2