On Configuring Hierarchical Storage Structures

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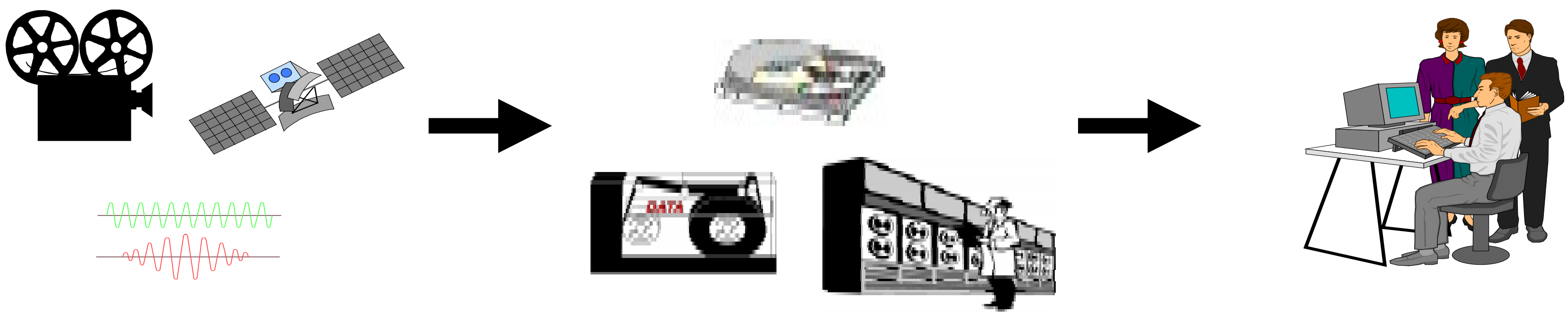
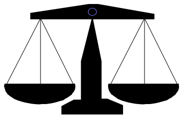
Configuration Problem



Growing Data Sets **Numerous Storage Alternatives** **User Requirements**

Challenges & Contributions

- Cost effective configuration (i.e., balanced-design):



  - Configuration planer to find cost effective HSS designs for a range of throughputs, DB sizes, and access distributions
- Continuous display using HSS's:
  - Display Caching (DC) technique to support continuous display from tape devices
  - Object Caching (OC) of hot objects at lower memory levels (e.g., on disks)

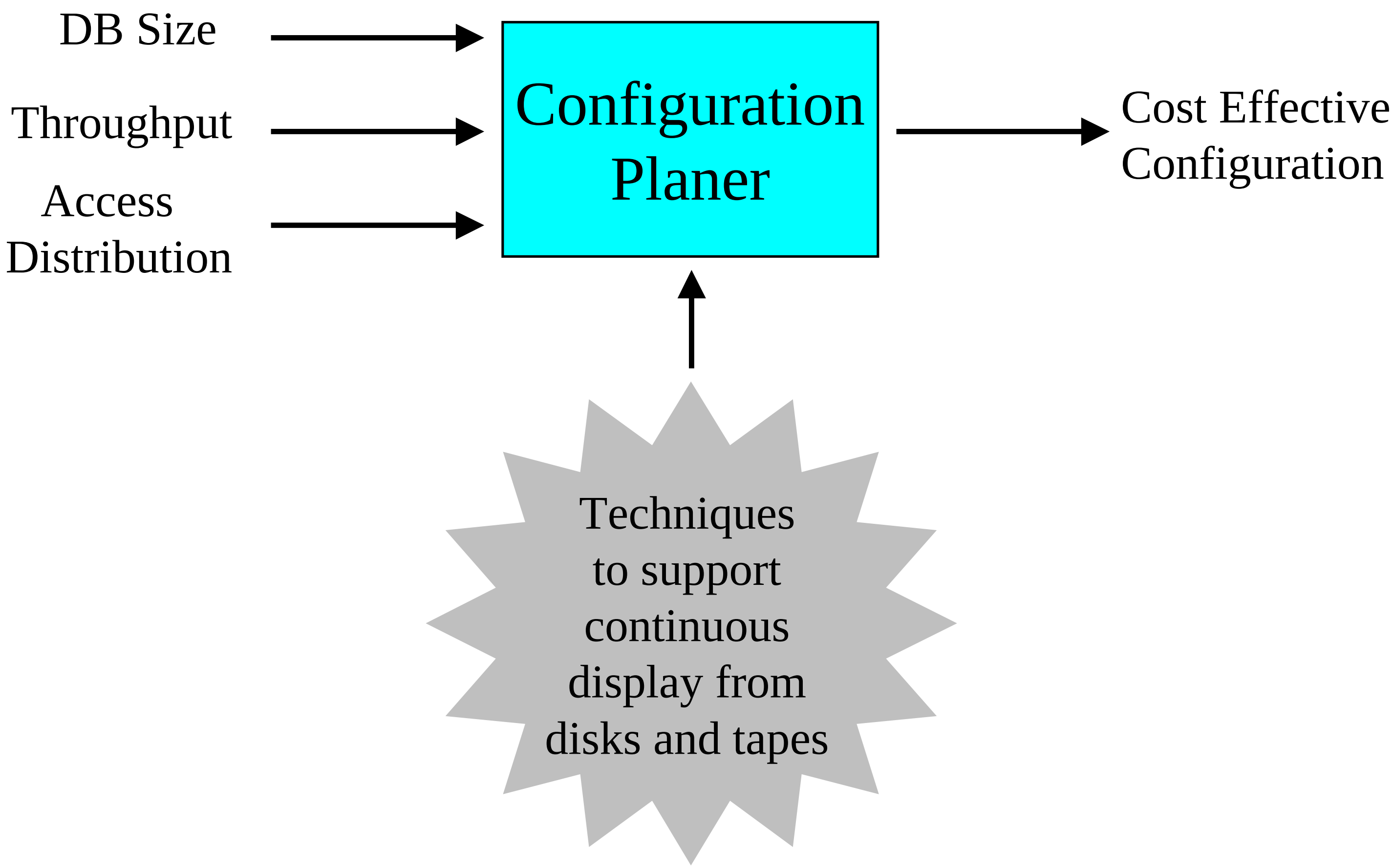
Configuration Categories

	DRAM	Disk	Tape
D-based	**DC**	**Complete DB**	**-**
M-based	**Complete DB***	**-**	**-**
T-based	**DC**	**DC**	**Complete DB**
MD-Hierarchy	**DC & OC**	**Complete DB**	**-**
MT-Hierarchy	**DC & OC**	**DC**	**Complete DB**
DT-Hierarchy	**DC**	**DC & OC**	**Complete DB**
MDT-Hierarchy	**DC & OC**	**DC & OC**	**Complete DB**

M: Memory
D: Magnetic Disk
T: Magnetic Tape

DC: Display-Caching
OC: Object-Caching

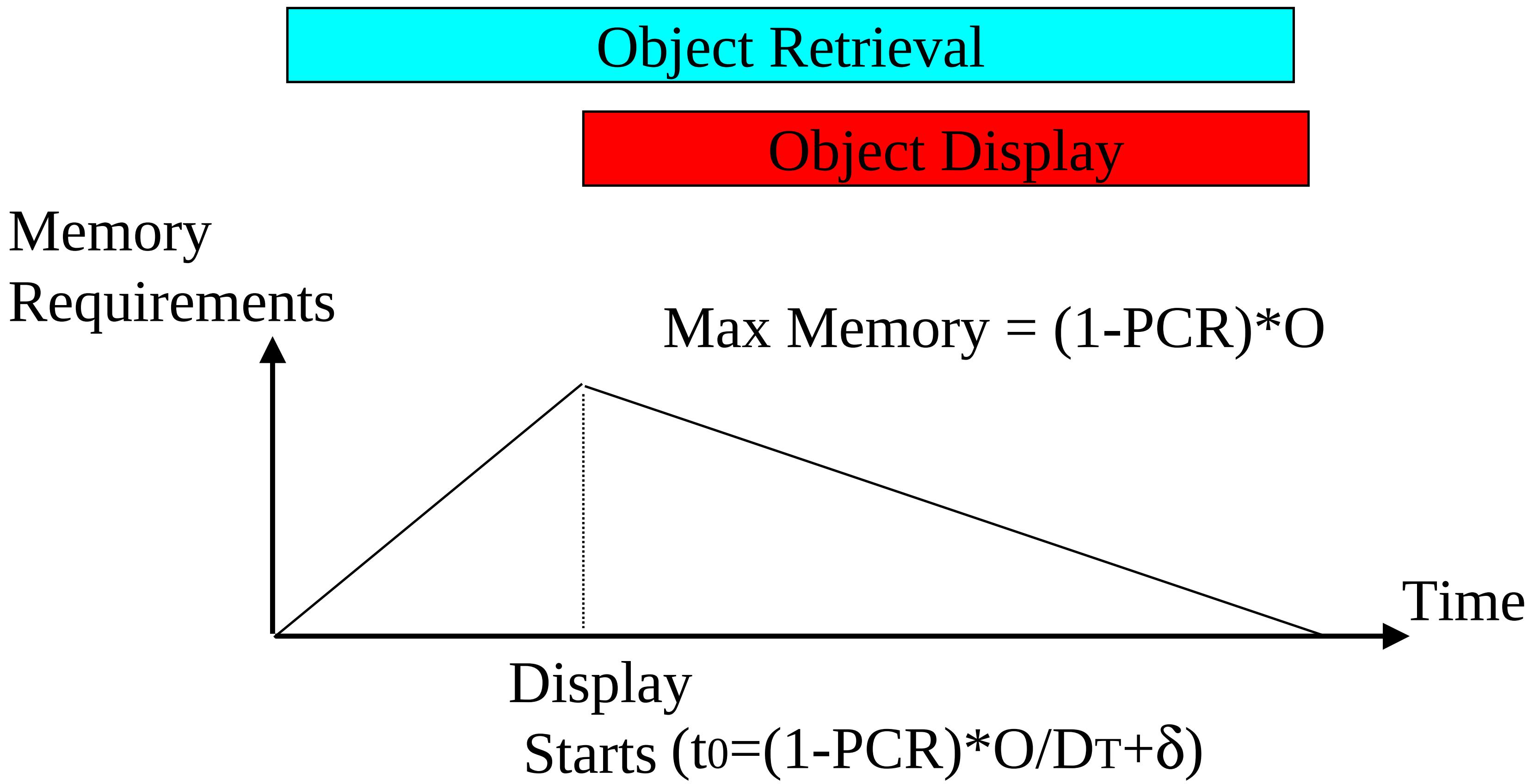
Configuration Planer



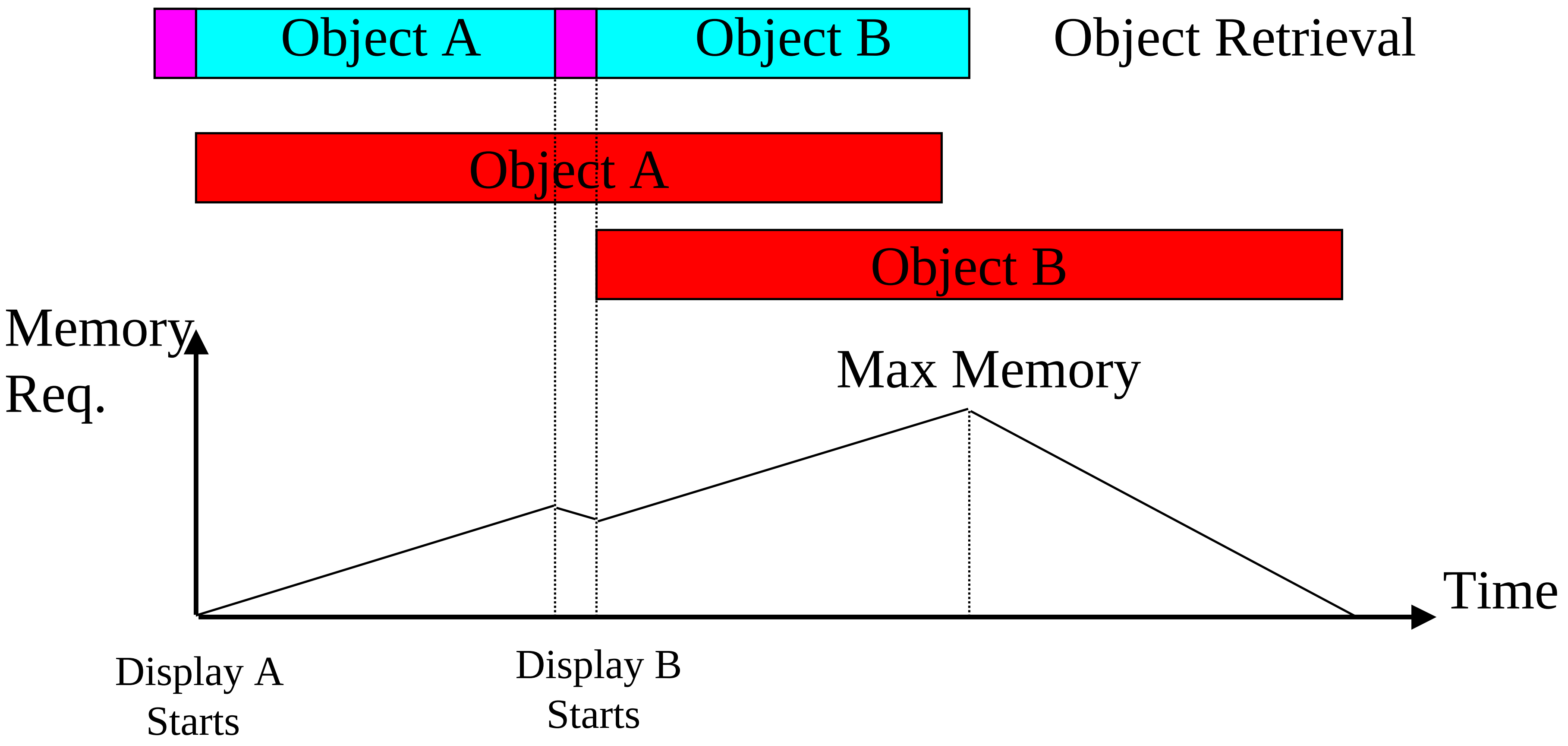
Display Caching

- Display Caching (DC) technique is used to bridge the gap between the retrieval behavior of the tape juke box (D_T) and the display requirement of objects (C):
  - How much data should be cached?
  - Where the data is cached?
  - When the display should start?
- Production Consumption Ratio ($PCR=D_T/C$)

Display Caching (2): PCR<1



Display Caching: PCR>1



Display Caching: PCR>1

- Number of simultaneous displays from the display cache is:
  - $N_T = \mathit{MAX}(1, \mathit{floor}(O/(T_{Access} + O/D_T)))$
- Maximum memory requirements:
  - Max Memory= $\Sigma\ ((1-1/PCR)*O-k(T_{Access}+O/D_T)*C)$, for all $k=0 \rightarrow N_{T-1}$

Results

	100 Gbytes	500 Gbytes	1 Tbytes	5 Tbytes	10 Tbytes
10	**M=1** **D=3** **T=1**	**M=1** **D=3** **T=1**	**M=1** **D=4** **T=2**	**M=1** **D=5** **T=6**	**M=1** **D=4** **T=11**
100	**M=4** **D=11**	**M=5** **D=38** **T=1**	**M=5** **D=44** **T=2**	**M=3** **D=20** **T=6**	**M=6** **D=30** **T=11**
1000	**M=33** **D=36**	**M=34** **D=56**	**M=39** **D=111**	**M=45** **D=420** **T=6**	**M=44** **D=198** **T=63**
5000	**M=163** **D=179**	**M=163** **D=179**	**M=163** **D=179**	**M=174** **D=556**	**M=190** **D=1022** **T=11**
10000	**M=1473** **D=11**	**M=325** **D=358**	**M=325** **D=358**	**M=331** **D=556**	**M=348** **D=1111**

M,D, & T represent number of modules