COT6930 – Video Communications

Workload Characterization of Video Applications

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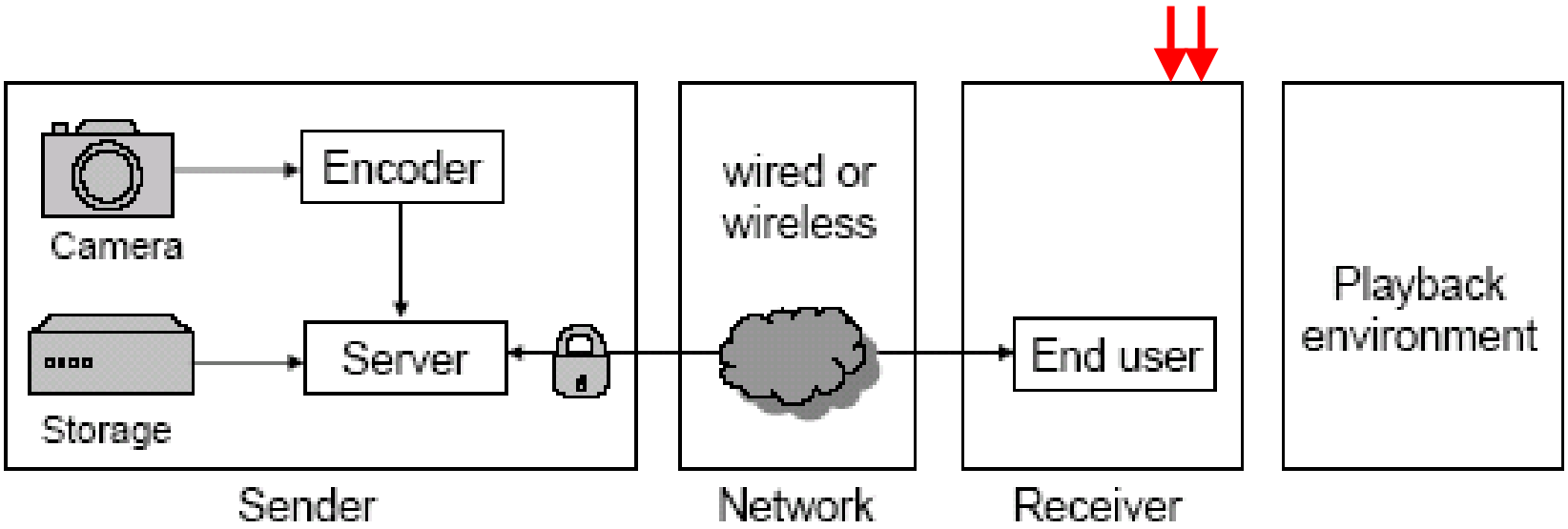
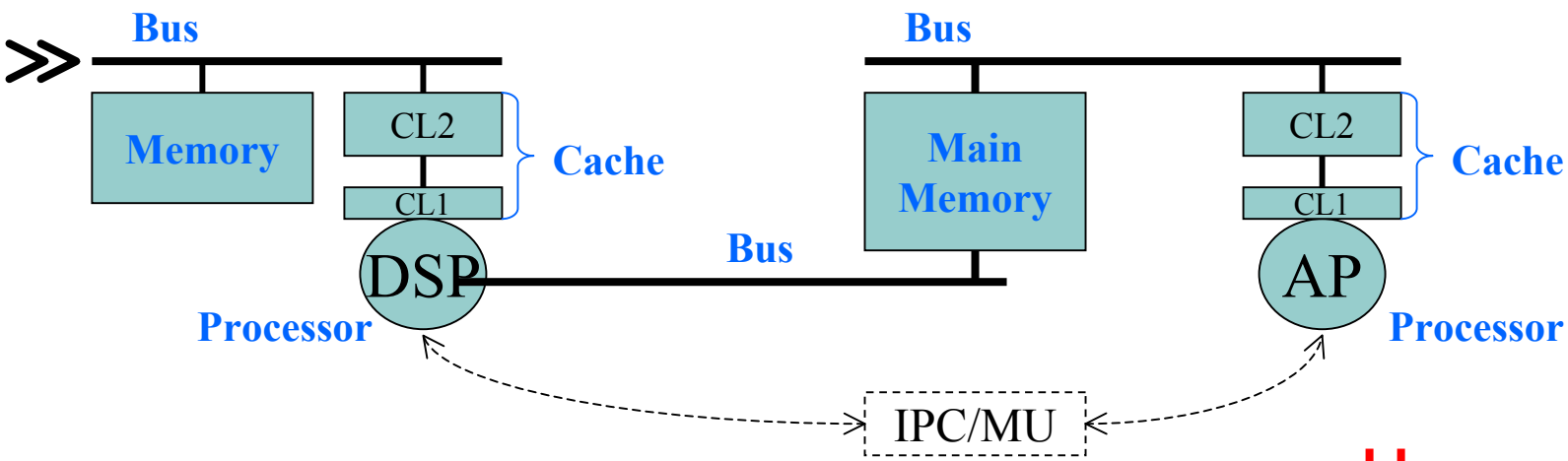
Video communications



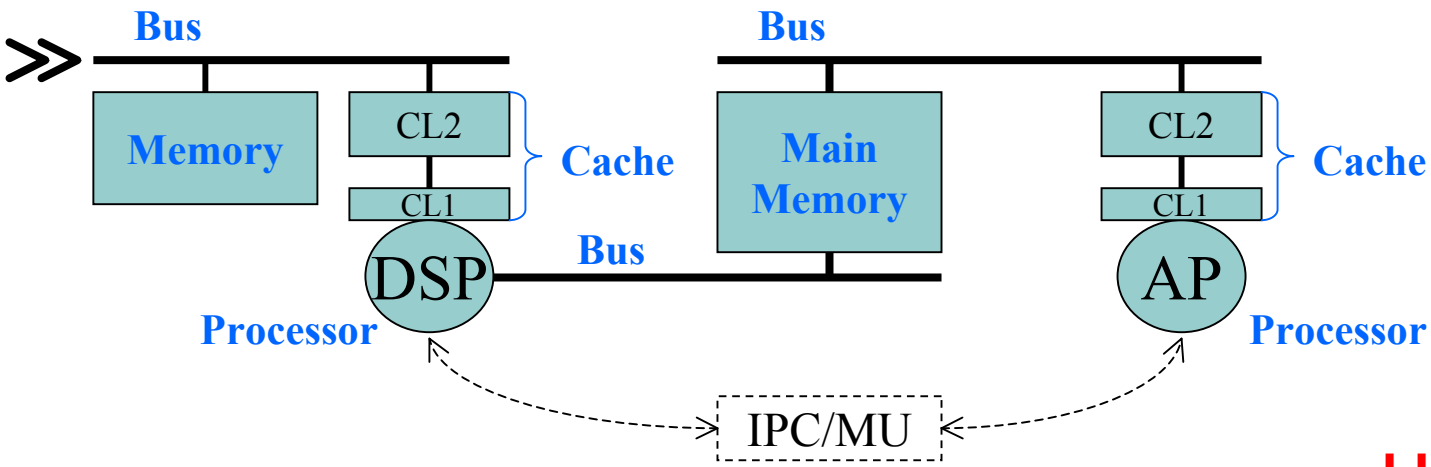
Reference architecture



DSP – Digital Signal Processor
AP – Application Processor
IPC/MU – Inter-Proc Comm./Messaging Unit

Performance metrics
- Utilization
- Latency
- Throughput

Reference architecture



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Performance metrics
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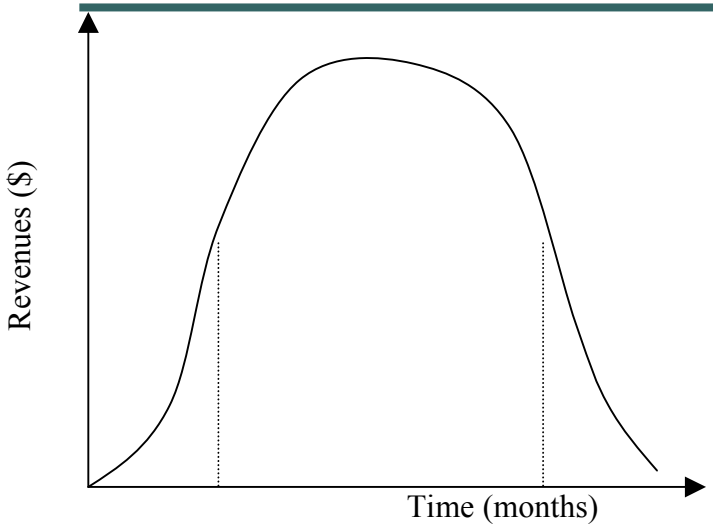
Evaluation methodology

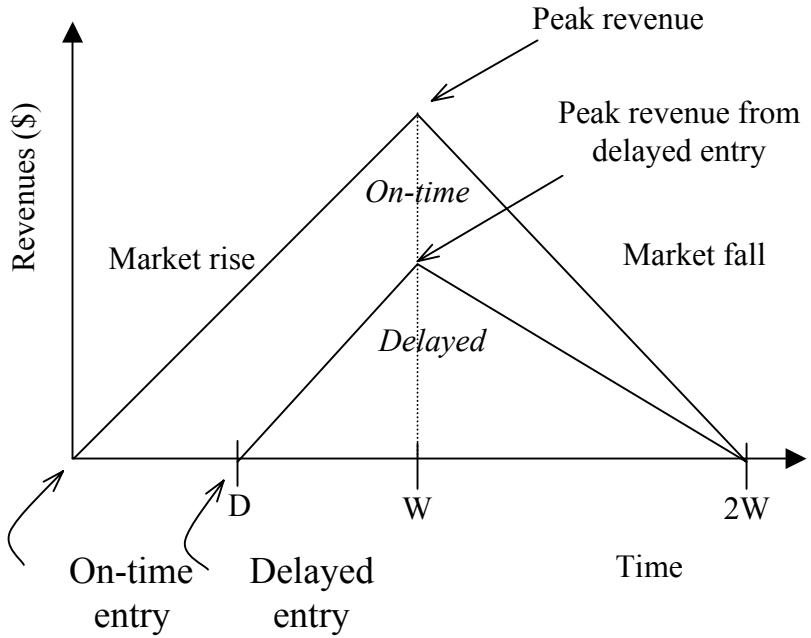
Measurement	Analytical	Simulation
System must exists	Math description	Computer programs
SW monitor in chip	Queuing model	Performance eval
Accurate	Less accurate	More accurate
-	Fast evaluation	Slow evaluation
Less flexible	Less flexible	More flexible
-	-	Finer levels of details

Time-to-market: a demanding design metric



Market window

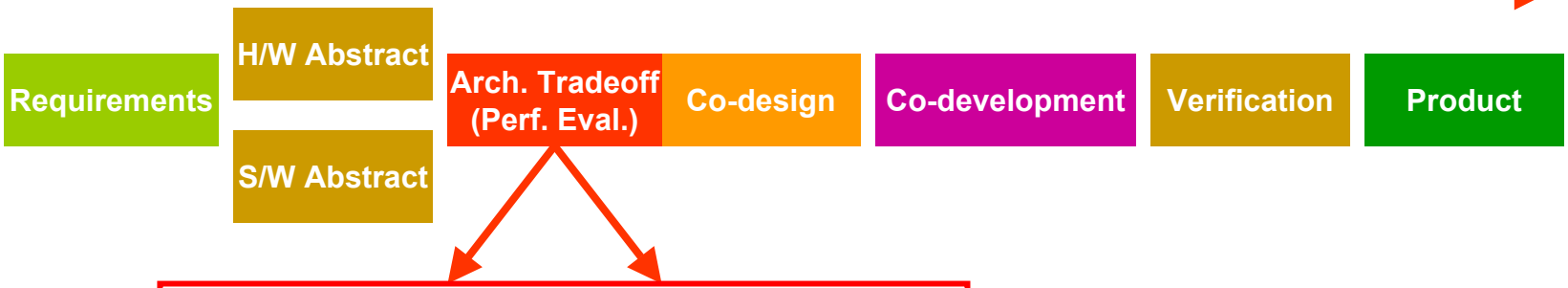
Avg. time-to-market = 8 months



- Lifetime 2W=52 wks, delay D=4 wks
- (4*(3*26 –4)/2*26^2) = 22%
- **Lifetime 2W=52 wks, delay D=10 wks**
- **(10*(3*26 –10)/2*26^2) = 50%**

HW-SW co-design steps

Major Co-design steps



Major Components

- Processor, memory, bus
  - Cache, pipeline
    - Cache size, block size

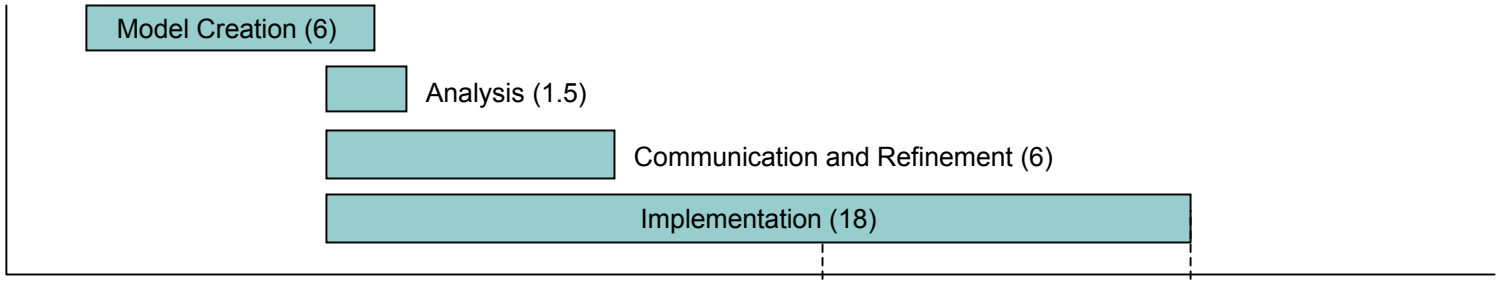
Performance metrics

- Utilization
- Latency
- Throughput

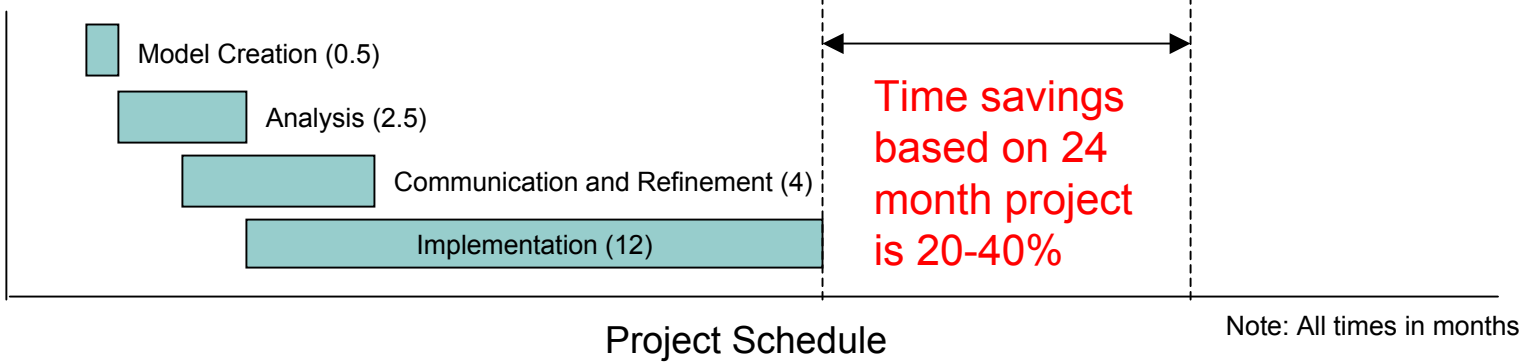
Methodologies	Simulation Analytical Measurement
Languages	C C++/SystemC Java
Tools	Mirabilisdesign, Ptolemy, MATLAB And SIMULINK

VisualSim Methodology Drives Efficiency and Productivity

Using Current Design Methodology

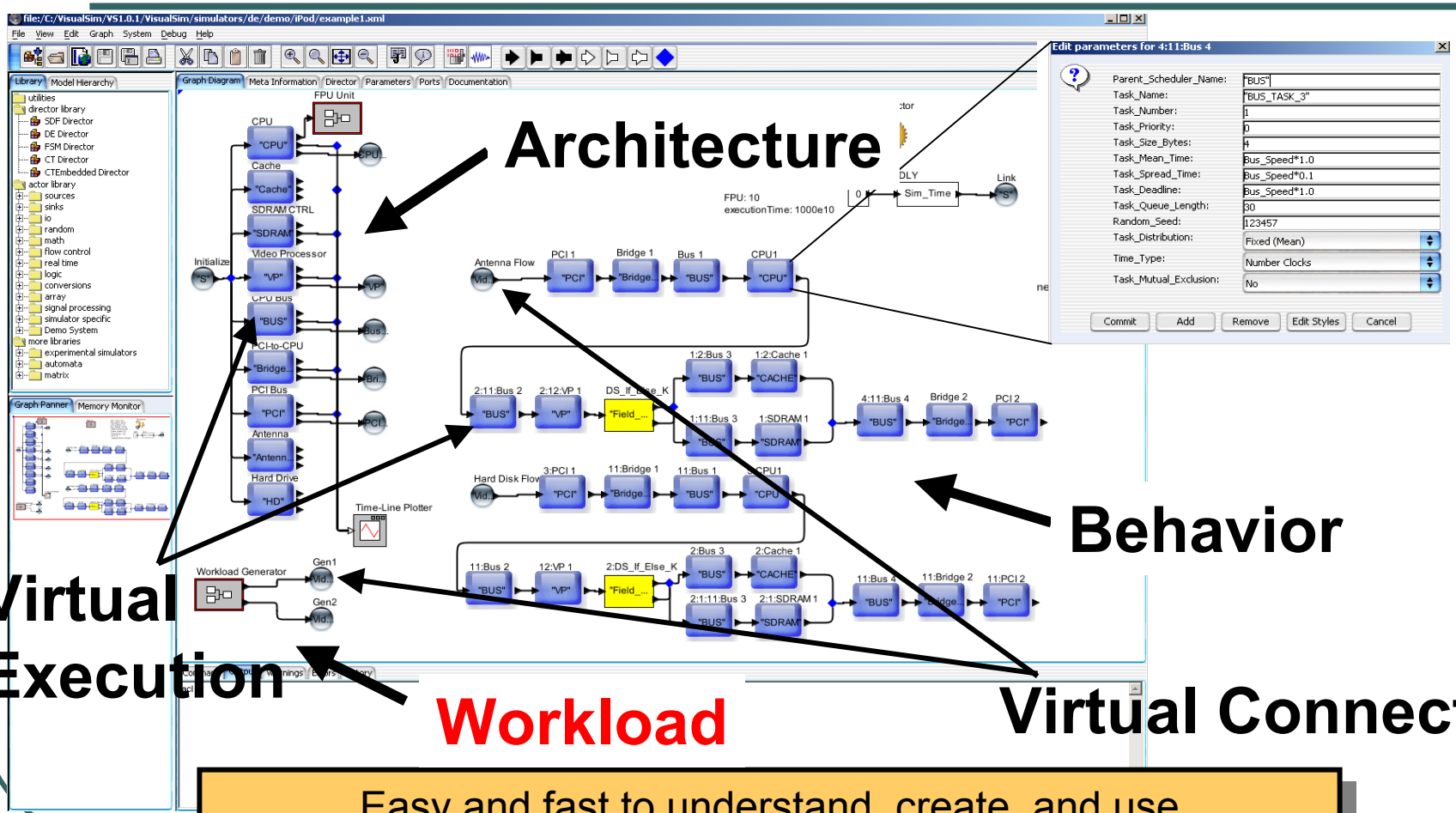


Using VisualSim© Design Methodology



Average increase in revenue per project = $??M

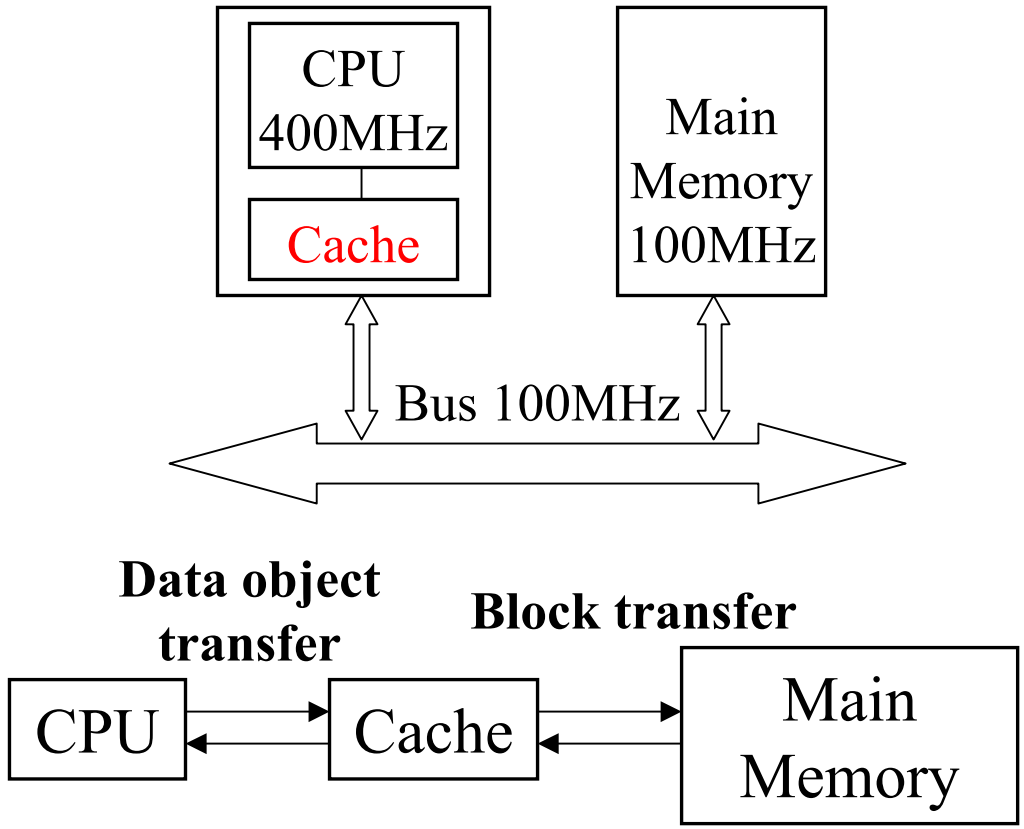
Block Diagram & Methodology



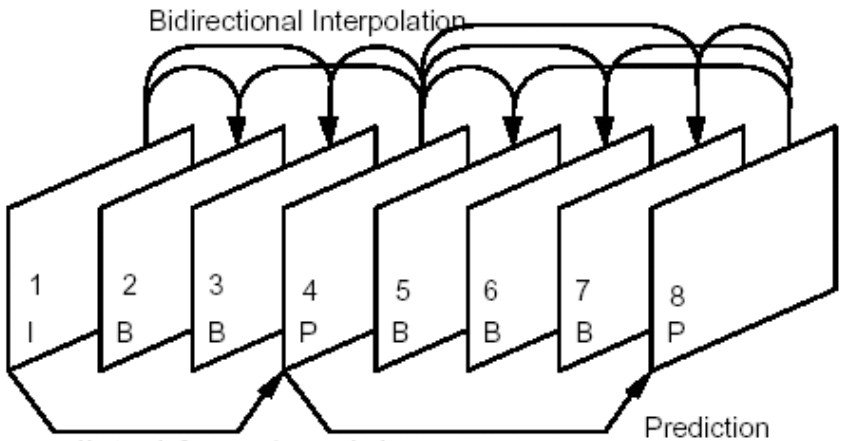
Easy and fast to understand, create, and use

Memory hierarchy

- Inboard memory
  - Registers
  - **Cache**
  - Main memory
- Outboard storage
  - Magnetic disks
- Off-line storage
  - Magnetic tapes



I, P, and B Frame structures



- 2 and 3 are predicted from 1 and 4
  - 4 is coded before 2 and 3
- 4 is predicted from 1and 8 is predicted from 4
- 5, 6, and 7 each are predicted from 4 and 8
- Encoding order = transmission order = decoding order = 1, 4, 2, 3, 8, 5, 6, 7
- Playback order = 1, 2, 3, 4, 5, 6, 7, 8
- Standard does not impose any particular I,P, and B structure
  - Structure (at the encoder) is usually specified using two parameters, M and N
    - An I picture is coded every N pictures and a P picture every M pictures, the rest are B pictures

Defining Workload

- Stochastic distributions
  - Standard: Poisson, Normal, Uniform & Fixed
  - Expression: Create custom distribution or feedback loops
- Trace-based
  - Use traces for enhanced modeling and accuracy
- File-based definitions
  - Define arrival rate, size, priority in .xls, .cvs or .xml
- Connect to hardware using datagram

Use predicted or leverage existing workload

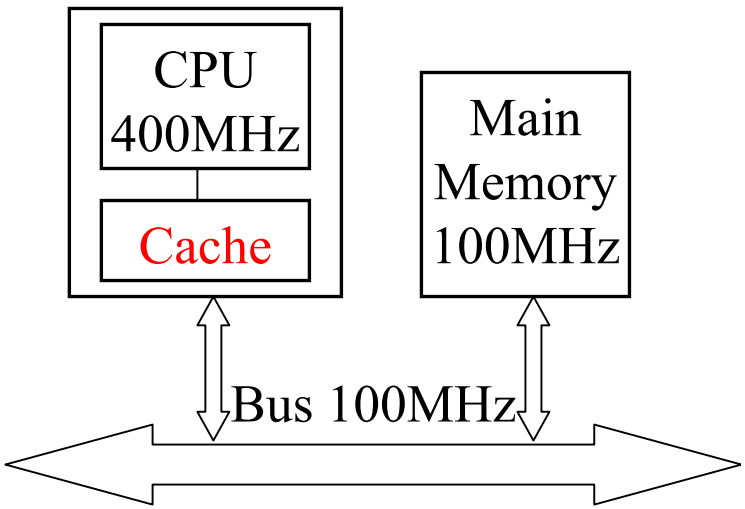
Workload characterization

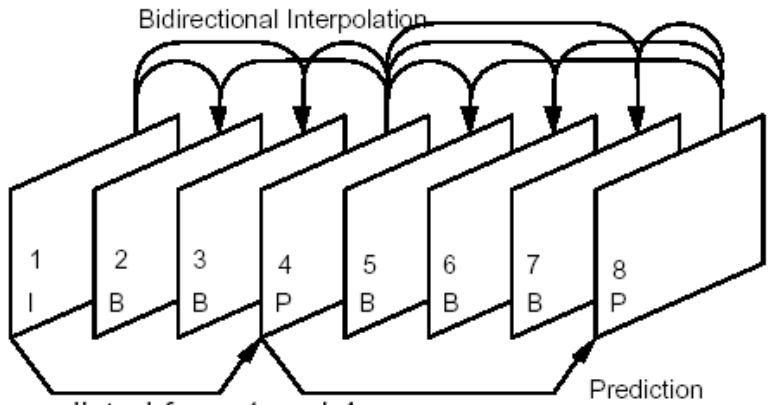
Probability distribution, operational profile, or operational distribution

A probability distribution associated with the input domain that describes how the system is used when it is operational in the field.

Derived by monitoring field usages

Workload characterization (cont'd)





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Steps in characterizing the workload

Encoder:

(Video comm is under progress)

- Get YUV file (Camera→DirectX)
- Encode the YUV file
  - MPEG-4 file (encoded)
  - Trace file from encoding
    - 00-I, 01-P, 10-B frames
    - Motion Vector
- MV for P and B frames
- Calculate number of operations
- Estimate mem ref for each block
  - Generate flat-file traces
    - Memory ref, operation type

Decoder:

(Live or stored)

- Get (pre-) encoded file
- Decode MPEG4 to YUV file
  - YUV file
  - Trace file from decoding
    - 00-I, 01-P, 10-B frames
    - Motion Vector
- MV for P and B frames
- Calculate number of operations
- Estimate mem ref for each block
  - Generate flat-file traces
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Encoder.trc

Encoder.trc

VOP_Start_Code: 10110110 @176
VOP_Pred_Type: 00 @184

...

VOP_Start_Code: 10110110 @73208
VOP_Pred_Type: 01 @73216

...

MV8= 83, 0
MV8= 73, 0
MV8= 78, 1
MV8= 73, -3

...

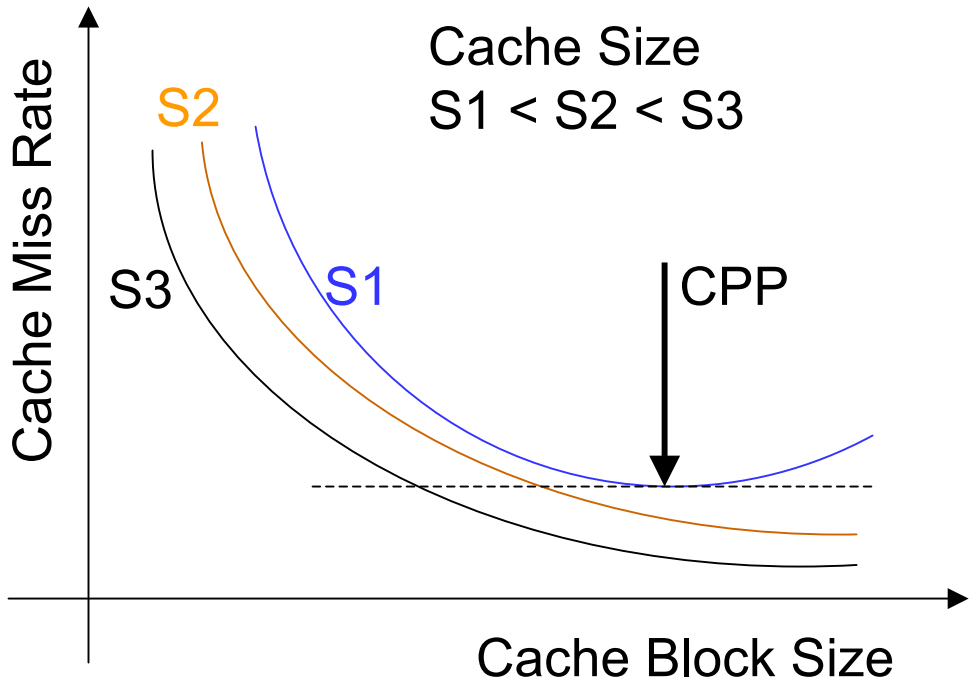
Flat-trace

MemRef OPType

Assumptions

Assumptions:

Picture size (W x H)
176 x 144
Block size (N x N)
8 x 8
Full search with $d_{max} = 3$
Calculate number of operations
$(176 * 144)(1 + 2*3)^2$
$= 1.24$ M



Cache pollution point

Simulation Results (Analytical workload)

	Utilization			Mean Task Delay			Throughput		
	tt*1.0!	tt*0.7	tt*0.5	tt*1.0	tt*0.7	tt*0.5	tt*1.0	tt*0.7	tt*0.5
Bus	6.72	8.48	?	1.60	1.60	?	42/42	53/53	?
MM	7.00	9.00	?	10.00	10.00	?	7/7	9/9	?
AP	15.56	21.32	?	6.20	4.00	?	26/25	33/33	?
DSP	66.92	93.64	?	6.90	6.69	?	98/97	141/141	?

!Task_Rate = TaskTime * 1.0

Thank you.

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