S.I.A. (Semiconductor Industry Association) ROADMAP (1995)					
	F.S. Preston		File = S.I.A. Data		Printed
			Data from 1996		
Year of first DRAM Shipment	1995	1998	2001	2004	2007
<---From S.I.A. *Calculated --->*					
Minimum Feature Size - micro mete	0.35	0.25	0.18	0.13	0.10
Inverse of Moore's Law Rate	1.00	0.25	0.06	0.02	0.00
Area ratio to 18 months before		0.51	0.52	0.52	0.59
Inverse of Area Ratio		1.96	1.93	1.92	1.69
Ratio for Memory to CPUs/sq.cm	8.42	13.06	18.32	25.00	33.33
Memory					
Bits per chip	6.40E+07	2.56E+08	1.00E+09	4.00E+09	1.60E+10
Bits per sq. cm	3.37E+07	9.14E+07	2.38E+08	6.25E+08	1.67E+09
Cost per bit @Volume -- millicents	0.0170	0.0070	0.0030	0.0010	0.0005
Memory Cost per chip	$10.88	$17.92	$30.00	$40.00	$80.00
Memory Cost per MegaByte	1.360	0.560	0.240	0.080	0.040
Cache (SRAM) bits/sq. cm	2.00E+06	6.00E+06	2.00E+07	5.00E+07	1.00E+08
Number ratio to 18 months before		3.00	3.33	2.50	2.00
Microprocessors					
Transistors (Logic) per sq. cm	4.00E+06	7.00E+06	1.30E+07	2.50E+07	5.00E+07
Transistors per chip	1.00E+07	2.10E+07	4.68E+07	1.08E+08	2.60E+08
Cost/transistor @Volume -- millicen	1.0000	0.5000	0.2000	0.1000	0.0500
CPU Cost per chip	$100	$105	$94	$108	$130
Number of I/O pads per chip	900	1,350	2,000	2,600	3,600
Package cost -- cents per pin	1.40	1.30	1.10	1.00	0.90
Package cost per unit	$12.60	$17.55	$22.00	$26.00	$32.40
Chip Frequency --MHz High Perform	300	450	600	800	1000
Relative CPU performance/chip	1.00	3.15	9.36	28.67	86.67
CPU chip speed (for 95 = 100 Mflops)	100	315	936	2,867	8,667
CPU (High) cost per Mflops	$1.126	$0.389	$0.124	$0.047	$0.019
Chip Frequency --MHz Cost Perform	150	200	250	300	375
Relative CPU performance/chip	1.00	2.80	7.80	21.50	65.00
CPU chip speed (for '95 = 100 Mflops)	100	280	780	2,150	6,500
CPU (Med.) cost per Mflops	$1.126	$0.438	$0.148	$0.062	$0.025
Chip Size (mm^2)					
DRAM	190	280	420	640	960
Microprocessor	250	300	360	430	520
ASIC	450	660	750	900	1100
Other Chip Data					
Max. number wiring levels (logic)	4.5	5	5.5	6	6.5
Minimum mask count	18	20	20	22	22
Cycle time (days)	9	10	10	11	11

Max. Substrate diameter (mm) for S	200	200	300	300	400
Power Supply Voltage					
Desktop	3.3	2.5	1.8	1.5	1.2
Battery	2.5	2.15	1.35	0.9	0.9
Maximum Power					
High performance with heatsink -- W	80	100	120	140	160
Logic without heatsink --W/sq.cm)	5	7	10	10	10
Battery - W	2.5	2.5	3	3.5	4
S.I.A. (Semiconductor Industry Association) ROADMAP (1995)					
ASSUMPTIONS					
1) Memory Bits/sq.cm = Bits/chip/Chip area					
2) CPUs transistors per chiip = Transistors/sq.cm * Chip area					
3) Cost of CPU per chip = Transistors *Cost/transistor					
4) Package cost = Pads*cost per pin					
5) CPU relative performance = Number of Trans.*High MHz / Corresponding Values for '95					
6) Chip cost per MFLOPS = (Chip cost + packaging)/Chip speed					
NOTES					
A) Cost per pin or pad for CPUs seems high					
B) Costs for memory and CPUs drop very far.					
C) A major problem will develop on power required					
D) Number of pads on microprocessors seems high					
SPECULATIVE PETAFLOPS CALCULATIONS					
Year of first DRAM Shipment	1995	1998	2001	2004	2007
Derived values for one petaflops					
Memory required (3/4 power) in MB	2.53E+08	2.53E+08	2.53E+08	2.53E+08	2.53E+08
Memory cost in millions	$344	$142	$61	$20	$10
Processor (High) cost in millions	$1,126	$389	$124	$47	$19
Processor (Med.) cost in millions	$1,126	$438	$148	$62	$25

SPECULATIVE WORKSTATION CALCULATIONS					
Year of first DRAM Shipment	1995	1998	2001	2004	2007
Derived costs for 100 MFLOPS and 8 MBytes for baseline in '95 ; Other years processor					
Parts cost for baseline chips	$123	$48	$17	$7	$3
Parts cost for 5 times baseline chips	$617	$241	$84	$34	$14
rts cost for 25 times baseline chips	$3,087	$1,206	$419	$171	$70
ts cost for 100 times baseline chips	$12,348	$4,825	$1,674	$685	$282
ts cost for 500 times baseline chips	$61,740	$24,124	$8,370	$3,425	$1,409
Year of first DRAM Shipment	1995	1998	2001	2004	2007
Derived speed and memory for $1,000 parts cost based upon $750 for processing chips					
CPU gigaFLOPS (for $750)	0.67	1.71	5.06	12.08	30.02
Memory in gigaBytes (for $250)	0.18	0.45	1.04	3.13	6.25

					S.I.A. (Semiconductor
Sheet 1A					
	THIS SHEET PROJECTIONS BY FSP				Moore's Law
Nov. 1997					Rate=1.5874
2010	2013	2016	2019		SIA Growth
					per year - avg.
0.07	0.07	0.07	0.07		0.898
0.00					0.630
0.49	1.00	1.00	1.00		
2.04	1.00	1.00	1.00		
50.79	50.79	50.79	50.79		1.127
6.40E+10	9.54E+10	1.42E+11	2.12E+11		1.585
4.57E+09	4.57E+09	4.57E+09	4.57E+09		1.387
0.0002	0.0003	0.0004	0.0007		0.744
$128.00	$285	$633	$1,406		1.179
0.016	0.024	0.036	0.053		0.744
3.00E+08	3.00E+08	3.00E+08	3.00E+08		1.397
3.00	1.00	1.00	1.00		
9.00E+07	9.00E+07	9.00E+07	9.00E+07		1.231
4.68E+08	5.42E+08	6.27E+08	7.26E+08		1.292
0.0200	0.0232	0.0268	0.0310		0.770
$94	$125	$168	$225		0.996
4,833	6,764	9,467	13,250		1.119
0.80	0.72	0.64	0.57		0.963
$38.66	$48.38	$60.55	$75.76		1.078
1100	1,202	1,313	1,435		1.090
171.60	217.09	274.64	347.45		1.409
17,160	21,709	27,464	34,745		1.409
$0.008	$0.008	$0.008	$0.009		0.717
475	534	601	676		1.080
148.20	193.00	251.35	327.33		1.395
14,820	19,300	25,135	32,733		1.395
$0.009	$0.009	$0.009	$0.009		0.724
1400	2087	3112	4640		1.142
520	602	697	807		1.050
1400	1757	2204	2766		1.079
7.5	8.3	9.2	10.2		1.035
24	25	27	29		1.019
12	13	13	14		1.019

400	459	528	606		1.047
0.9	0.7	0.5	0.4		0.917
0.9	0.7	0.6	0.5		0.934
180	212	249	293		1.056
10	11	13	15		1.047
4.5	5.1	5.7	6.4		1.040
					S.I.A. (Semiconductor
Sheet 2A					
	ASSUMPTIONS				
	1) Feature size does NOT improve after 2010 for Memo				
	2) Chip area continues to grow at same average rate (M				
	3) Memory cost per bit = cost in 2010 *Area/Area in 2				
	4) Memory cost per chip = Cost/bit* bits/chip				
	5) CPU frequency growth rate after 2010 = 50% of the				
	6) CPU cost per chip = cost in 2010 *Area/Area in 201				
	7) Cost of CPU per chip = Transistors *Cost/transistor				
	8) Pads per chip = No. in 2010 * growth rate				
	9) Packaging cost = Cost in 2010*Growth rate				
	10) Package cost = Number of pads*cost/pin				
	11) Chip frequency = Value in 2010*Growth rate				
	12) Other chip data = Value in 2010* Growth rate				
	13) Chip power data = Value in 2010* Growth rate				
2010	2013	2016	2019		SIA Growth
2.53E+08	2.53E+08	2.53E+08	2.53E+08		1.000
$4	$6	$9	$13		0.744
$8	$8	$8	$9		0.717
$9	$9	$9	$9		

2010	2013	2016	2019		SIA Growth
speed and memory directly proportional					
$1	$1	$1	$1		
$5	$5	$6	$7		
$26	$27	$30	$34		
$102	$109	$119	$134		
$510	$546	$597	$672		
2010	2013	2016	2019		SIA Growth
and $250 for Memory chips					
84.04	83.27	82.42	81.52		
15.63	10.48	7.03	4.71		

Industry Association) ROADMAP (1995)	
Sheet 1B	
Year of first DRAM Shipment	
<---From S.I.A. *Calculated --->*	
Minimum Feature Size - micro meters	
Inverse of Moore's Law Rate	
Area ratio to 18 months before	
Inverse of Area Ratio	
Ratio for Memory to CPUs/sq.cm	
Memory	
Bits per chip	
Bits per sq. cm	
Cost per bit @Volume -- millicents	
Memory Cost per chip	
Memory Cost per MegaByte	
Cache (SRAM) bits/sq. cm	
Number ratio to 18 months before	
Microprocessors	
Transistors (Logic) per sq. cm	
Transistors per chip	
Cost/transistor @Volume -- millicents	
CPU Cost per chip	
Number of I/O pads per chip	
Package cost -- cents per pin	
Package cost per unit	
Chip Frequency --MHz High Perform.	
Relative CPU performance/chip	
CPU chip speed (for 95 = 100 Mflops)	
CPU (High) cost per Mflops	
Chip Frequency --MHz Cost Perform.	
Relative CPU performance/chip	
CPU chip speed (for '95 = 100 Mflops)	
CPU (Med.) cost per Mflops	
Chip Size (mm^2)	
DRAM	
Microprocessor	
ASIC	
Other Chip Data	
Max. number wiring levels (logic)	
Minimum mask count	
Cycle time (days)	

Max. Substrate diameter (mm) for SOI	
Power Supply Voltage	
Desktop	
Battery	
Maximum Power	
High performance with heatsink -- W	
Logic without heatsink --W/sq.cm)	
Battery - W	
Industry Association) ROADMAP (1995)	
Sheet 2B	
ry and CPUs	
emory and CPUs)	
010	
prior rate for Medium and 33% for High	
0	
Year of first DRAM Shipment	
Derived values for one petaflops	
Memory required (3/4 power) in MB	
Memory cost in millions	
Processor (High) cost in millions	
Processor (Med.) cost in millions	

Year of first DRAM Shipment	
Year of first DRAM Shipment	