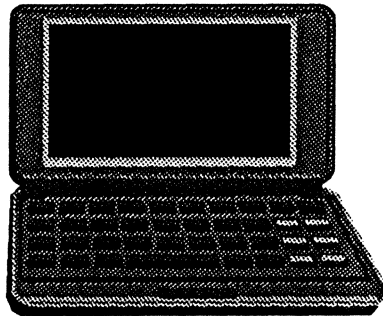


***Adaptive Battery
Life Extender™
for
Travelstar Products***

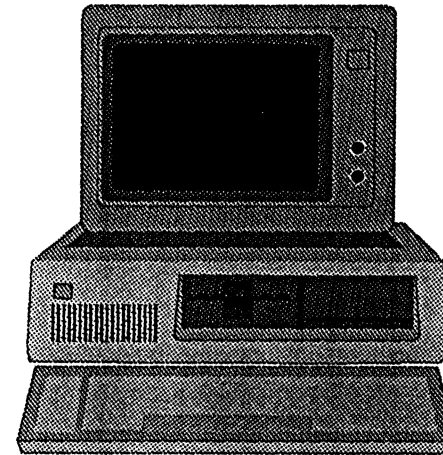
an IBM exclusive



Customer Priorities



Mobile

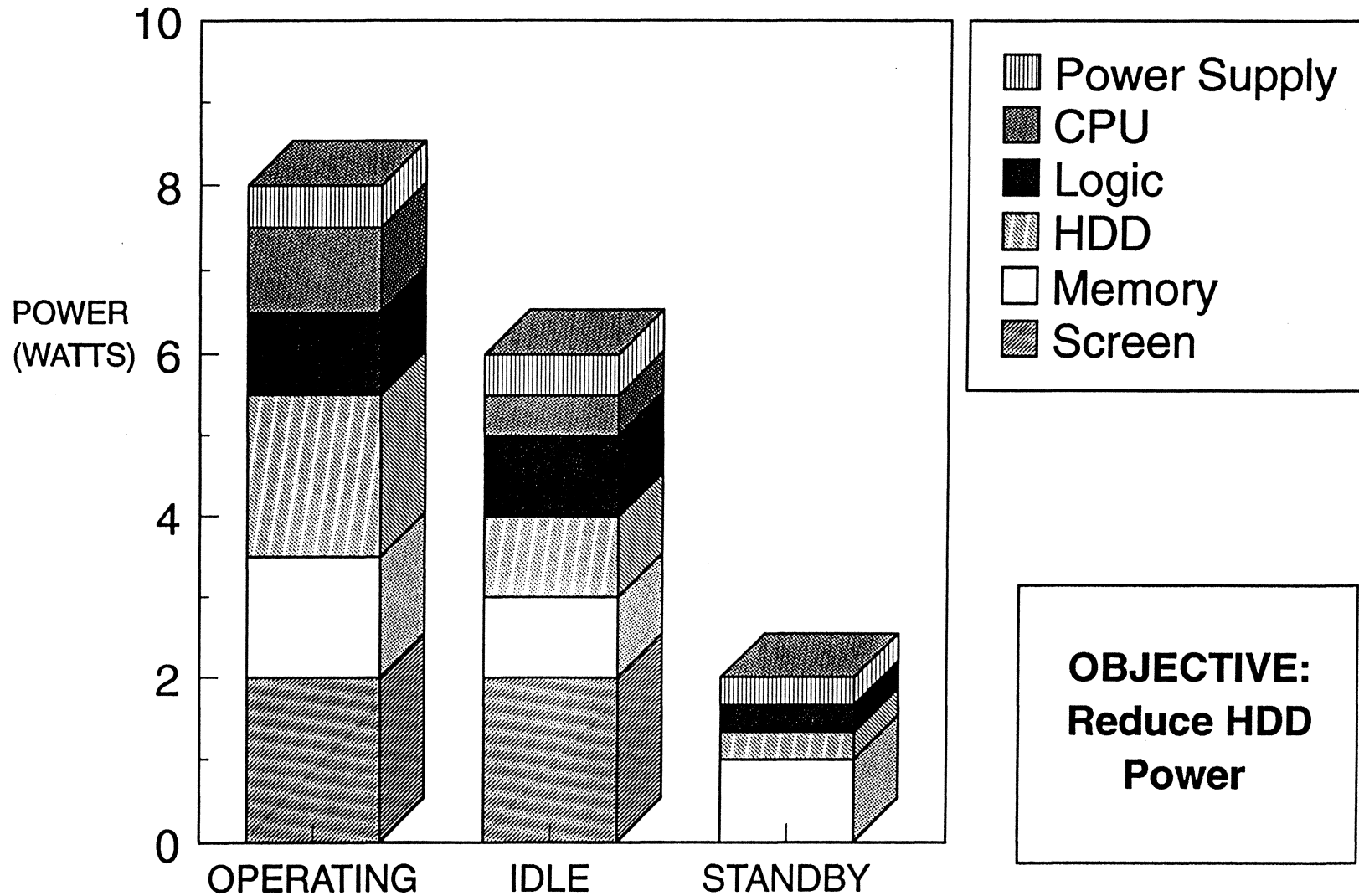


Desktop

- 1. Capacity**
- 2. Power - Battery Life**
- 3. Ruggedness**
- 4. Reliability**
- 5. Performance**
- 6. Price / Value**

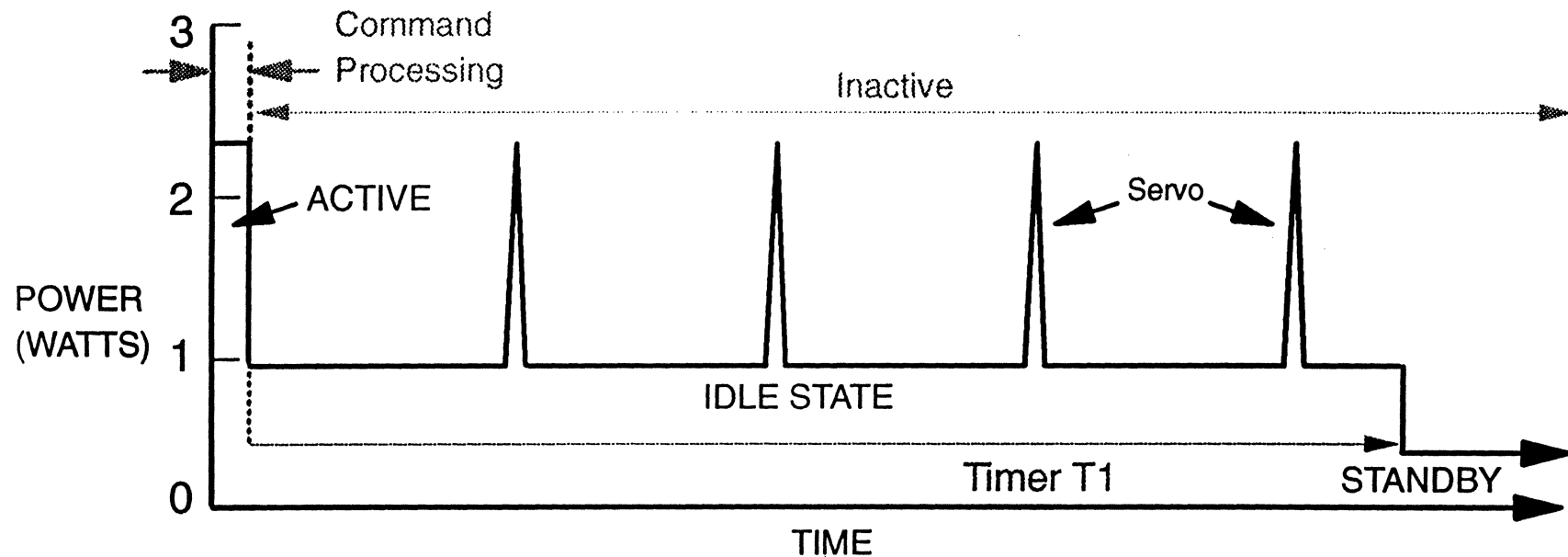
- 1. Reliability**
- 2. Price / Value**
- 3. Performance**
- 4. Capacity**
- 5. Technical Fit**
- 6. Customer Support**

Typical Mobile Power Budget



**OBJECTIVE:
Reduce HDD
Power**

Conventional Power Management



ACTIVE

- ▶ DURATION OF COMMAND PROCESSING

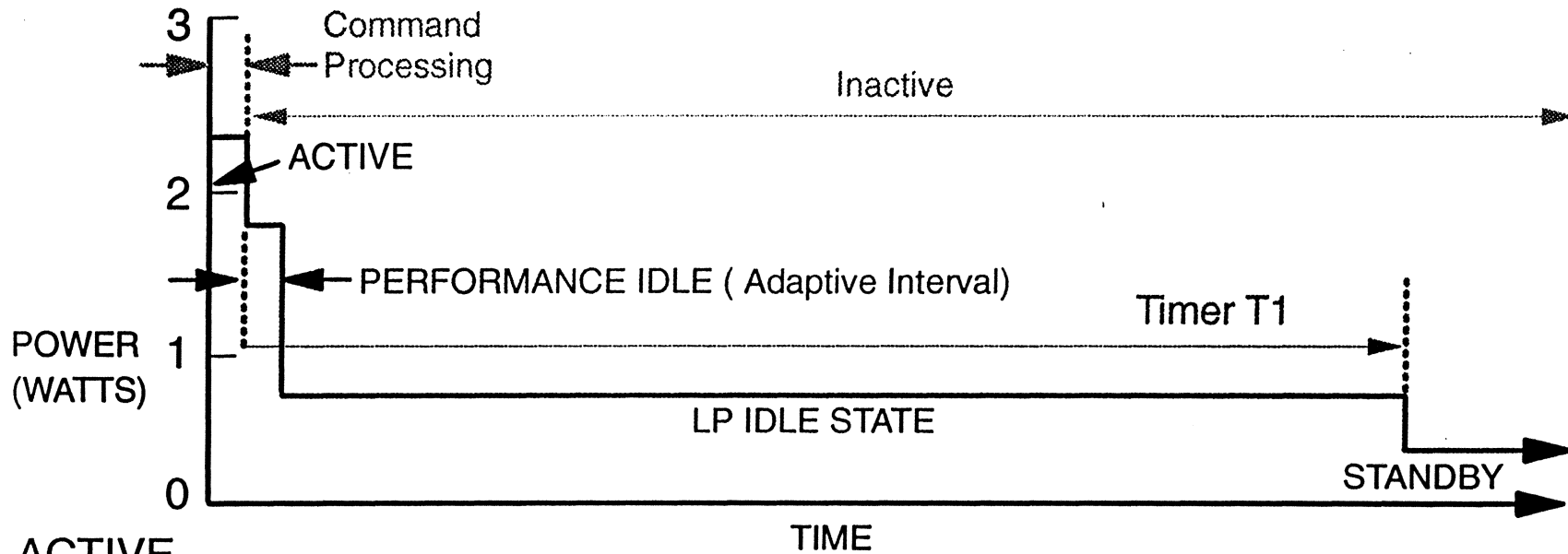
IDLE STATE

- ▶ SHORT RECOVERY (1 ms)
- ▶ SERVO PERIODICALLY

STANDBY

- ▶ SPINDLE MOTOR OFF
- ▶ STARTS AT USER-DEFINED T1 VALUE

New Travelstar Power Management



ACTIVE

- ▶ NO CHANGE

PERFORMANCE IDLE

- ▶ CHANNEL READY
- ▶ INSTANTANEOUS RESPONSE

LP IDLE STATE

- ▶ POWER SAVINGS
- ▶ START TIME ADAPTS TO END-USER

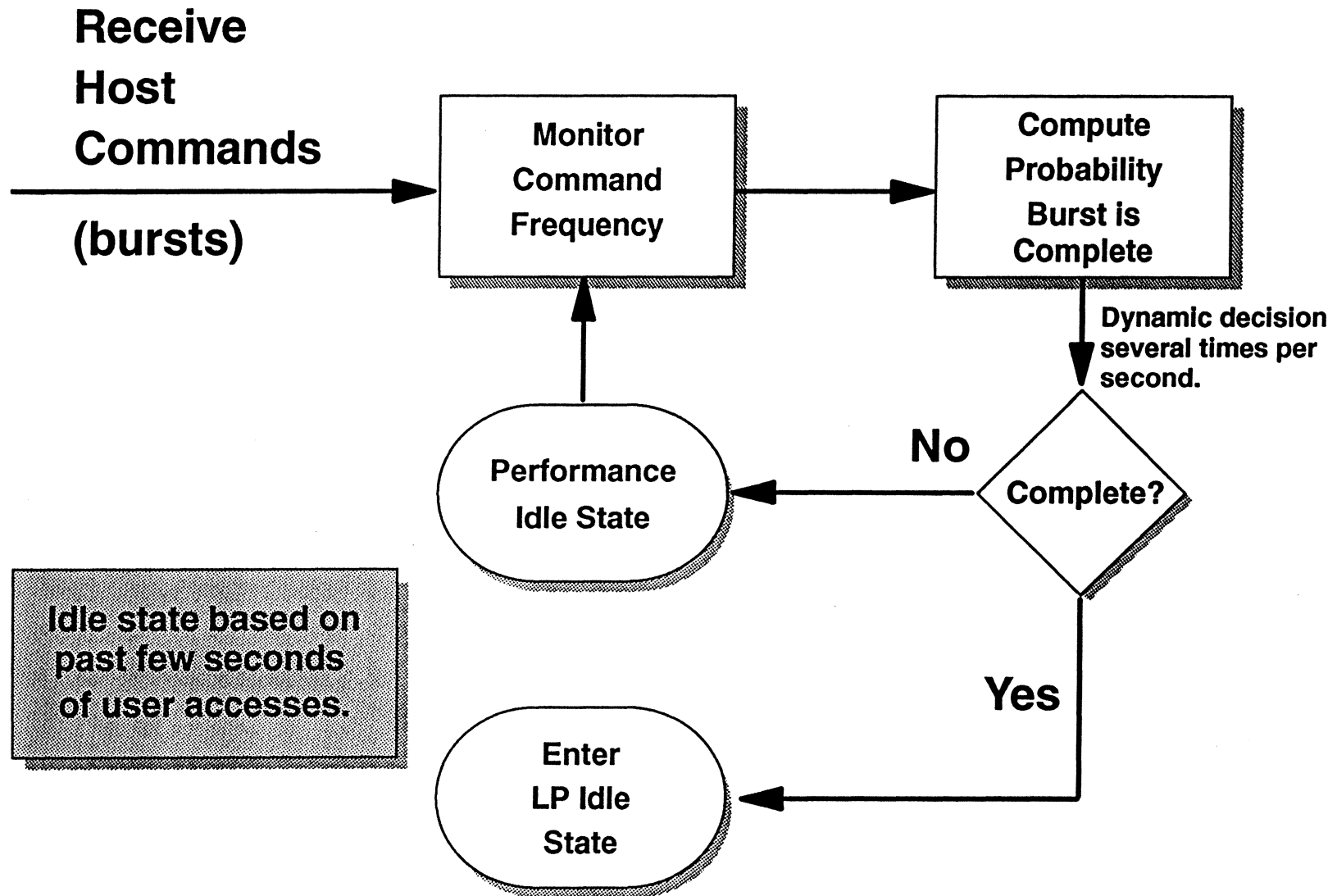
STANDBY

- ▶ NO CHANGE

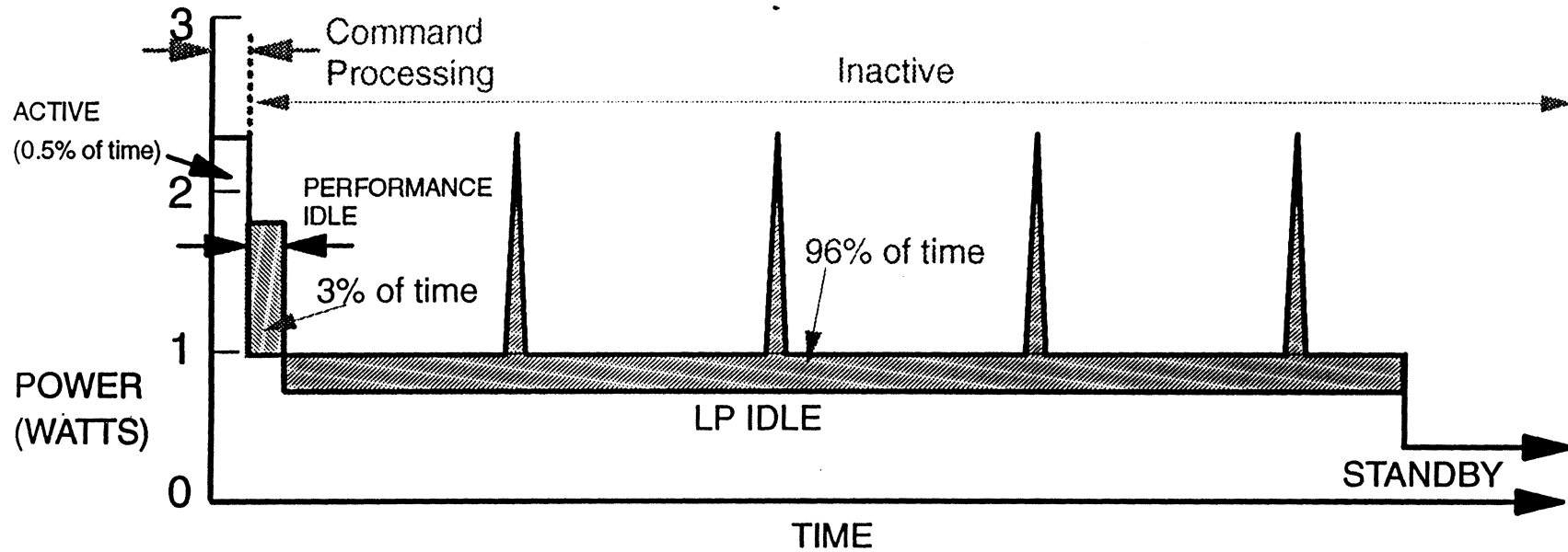
IDLE STATE POWER

	CURRENT IDLE	LP IDLE
TRAVELSTAR LP	0.95W	0.8W
TRAVELSTAR XP	1.3W	1.1W

How Does It Work?



Energy Savings of Adaptive Power Management



 Extended Period of High Performance (Adapts to User)

 Energy Savings

Thinkpad® Battery Benchmarks



THINKPAD 755CE	CURRENT (MIN.)	NEW (MIN.)	DELTA
PC BENCH 8.0	TRAVELSTAR LP	TRAVELSTAR LP	
8 RUNS AVG. (system 1)	390	427	9.5%
4 RUNS AVG. (system 2)	394	427	8.4%
	TRAVELSTAR XP	TRAVELSTAR XP	
3 RUNS AVG. (system 1)	366	401	9.6%
1 RUN (system 2)	381	398	4.5%

THINKPAD 755CX	CURRENT (MIN.)	NEW (MIN.)	DELTA
	TRAVELSTAR LP	TRAVELSTAR LP	
BENCHMARK A	215	217	1.0%
BENCHMARK B	509	557	9.4%
	TRAVELSTAR XP	TRAVELSTAR XP	
BENCHMARK A	206	211	2.4%
BENCHMARK B	501	587	17.2%

EXTENSION OF SYSTEM BATTERY LIFE
1.0% to 17.2%

THINKPAD 750C	CURRENT (MIN.)	NEW (MIN.)	DELTA
VERITEST	TRAVELSTAR LP	TRAVELSTAR LP	
BENCHMARK C	213	224	5.2%
	TRAVELSTAR XP	TRAVELSTAR XP	
BENCHMARK D	204	209	2.5%



Dell/Compaq/TI Battery Benchmarks

DELL LATITUDE XPI	CURRENT (min.)	NEW (min.)	DELTA
PC BENCH 8.0	TRAVELSTAR XP	TRAVELSTAR XP	
Run 1	190	197	3.7%
Run 2	188	203	8.0%
AVERAGE	189	200	5.8%

COMPAQ CONTURA AERO 4/33C	CURRENT (min.)	NEW (min.)	DELTA
PC BENCH 8.0	TRAVELSTAR LP	TRAVELSTAR LP	
Run 1	141	153	8.5%
Run 2	146	150	2.7%
AVERAGE	144	152	5.6%

TI TRAVELMATE 5000	CURRENT (min.)	NEW (min.)	DELTA
PC BENCH 8.0*	TRAVELSTAR XP	TRAVELSTAR XP	
Run 1	229	276	20.5%
Run 2	229	261	14.0%
AVERAGE	229	269	17.5%

EXTENSION OF SYSTEM BATTERY LIFE

2.7% to 20.5%

(* SCREEN NOT OPERATING)

NOTE: COMPARISONS VALID ONLY WITHIN ONE TABLE

Gateway/NEC Battery Benchmarks



GATEWAY 2000 LIBERTY	CURRENT (min.)	NEW (min.)	DELTA
PC BENCH 8.0	TRAVELSTAR LP	TRAVELSTAR LP	
Run 1	133	132	-0.8%
Run 2	108	130	20.4%
AVERAGE	121	131	8.3%

NEC ULTRALITE VERSA	CURRENT (min.)	NEW (min.)	DELTA
PC BENCH 8.0	TRAVELSTAR XP	TRAVELSTAR XP	
Run 1	117	125	6.8%
Run 2	122	128	4.9%
AVERAGE	120	126	5.0%

**EXTENSION OF SYSTEM
BATTERY LIFE**

-0.8% to 20.4%

NOTE: COMPARISONS VALID ONLY WITHIN ONE TABLE.

Competitive Hard Drive Battery Benchmarks



<i>Thinkpad 755CE PC Bench 8.0</i>	<i>Travelstar XP 1.2 GB Current</i>	<i>Toshiba MK2628C 810 MB</i>	<i>DELTA</i>	<i>Toshiba MK2720C 1.3 GB</i>	<i>DELTA</i>
Run 1 (min)	382	316	-17%	319	-16%
Run 2 (min)	372	317	-15%	316	-15%
Average (min)	377	317	-16%	318	-16%

<i>Thinkpad 755CE PC Bench 8.0</i>	<i>Travelstar XP 1.2 GB New</i>	<i>Toshiba MK2628C 810 MB</i>	<i>DELTA</i>	<i>Toshiba MK2720C 1.3 GB</i>	<i>DELTA</i>
Run 1 (min)	403	316	-22%	319	-21%
Run 2 (min)	406	317	-22%	316	-22%
Average (min)	405	317	-22%	318	-22%

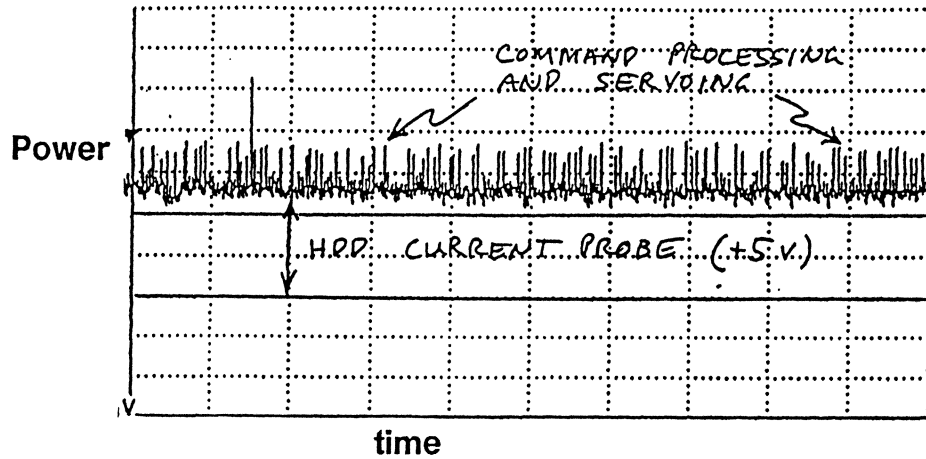
**Adaptive Battery Life Extender
 Increases Travelstar Advantage
 in System Battery Life
 from 16% to 22%**

TRAVELSTAR LP POWER MEASUREMENT

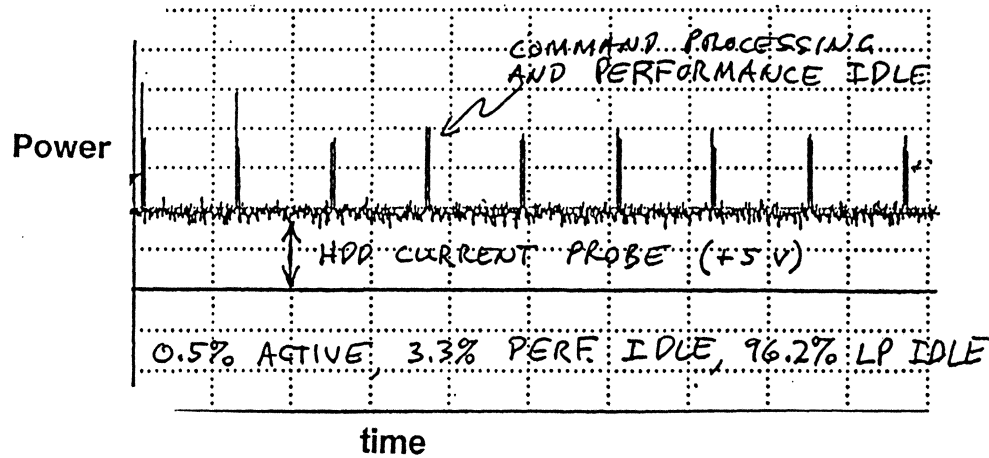


◆ PC BENCH 8.0 BATTERY RUNDOWN

Current Travelstar LP



New Travelstar LP



◆ DRIVE POWER

	Current	New	Delta
TRAVELSTAR LP	1.0 w	0.797 w	-20.3%



Thinkpad 755CE Performance

PC BENCH 9.0			
	<i>CURRENT</i>	<i>NEW</i>	<i>DELTA</i>
TRAVELSTAR LP	471	471	0%
TRAVELSTAR XP	473	476	1%

WIN BENCH 95			
	<i>CURRENT</i>	<i>NEW</i>	<i>DELTA</i>
TRAVELSTAR LP	310	309	0%
TRAVELSTAR XP	325	325	0%

Q BENCH V1.3 access time (ms)			
	<i>CURRENT</i>	<i>NEW</i>	<i>DELTA</i>
TRAVELSTAR LP (system 1)	9.5	9.3	2%
TRAVELSTAR LP (system 2)	8.7	8.6	1%
TRAVELSTAR XP (system 1)	7.2	7.2	0%

Q BENCH V1.3 data transfer rate (KB/S)			
	<i>CURRENT</i>	<i>NEW</i>	<i>DELTA</i>
TRAVELSTAR LP (system 1)	1657	1877	12%
TRAVELSTAR LP (system 2)	2100	2247	7%
TRAVELSTAR XP (system 1)	2240	2257	1%

IMPROVEMENT IN SYSTEM
PERFORMANCE
0% to 12%

Competitive Hard Drive Performance



<i>Thinkpad 755CE PC Bench 9.0</i>	<i>IBM Travelstar XP 1.2 GB</i>	<i>Toshiba MK2628C 810 MB</i>	<i>DELTA</i>	<i>Toshiba MK2720C 1.3 GB</i>	<i>DELTA</i>
Smartdrv ON	494	416	-16%	438	-11%
Smartdrv OFF	195	137	-30%	135	-31%

**IBM Travelstar
Performance Advantage
11% to 31%**

Summary and Futures

New Approach to HDD Power Management

- **Adapts to User**
- **Same or Better Performance**

Saves Power

- **16% - 20% Lower HDD Power**
- **5% - 8% Longer Battery Life**

Extendible

- **Adaptive Control of Standby Mode**

Schedule

- | | |
|----------------------------|-------------|
| • Samples | Now |
| • Production | 4Q95 |
| • Advanced Function | 2Q96 |