

SATA

- **Parallel ATA**

- **Serial ATA**

Istorija SATA

History of serial ATA



Generation	Standard	Year	Speed	Key features
Serial ATA	ATA/ATAPI-7	2002	150 MB/sec	
Serial ATA II	ATA/ATAPI-8?	2003?	300 MB/sec	Enhanced queuing
Serial ATA III	ATA/ATAPI-9?	?	600 MB/sec	

Serial ATA

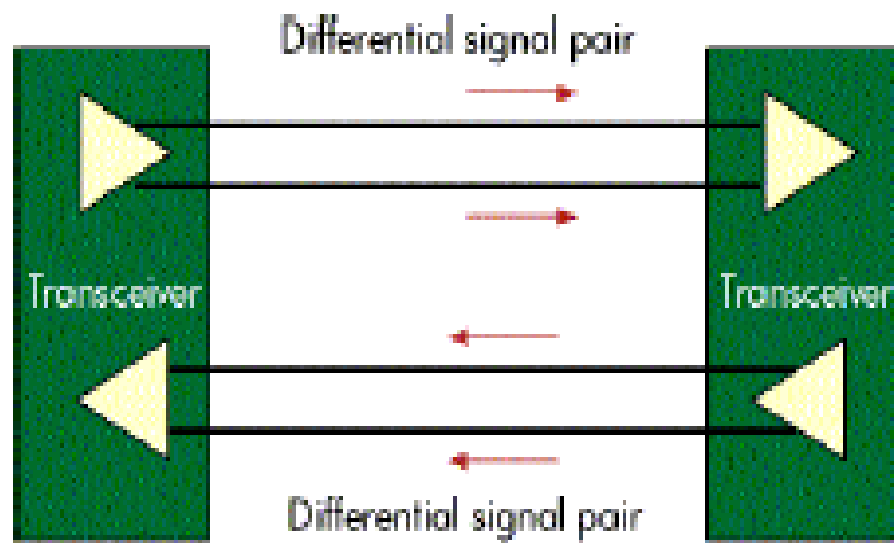
- Back to serial architecture
- LVD
- Point to Point topology

Table 1. Comparison of parallel ATA and SATA

	Parallel ATA	Serial ATA
Bandwidth	133 MB/s	150 MB/s
Volts	5V	250 mV
Number of pins	40	7
Cable length	18 in. (45.7 cm)	39 in. (100 cm)

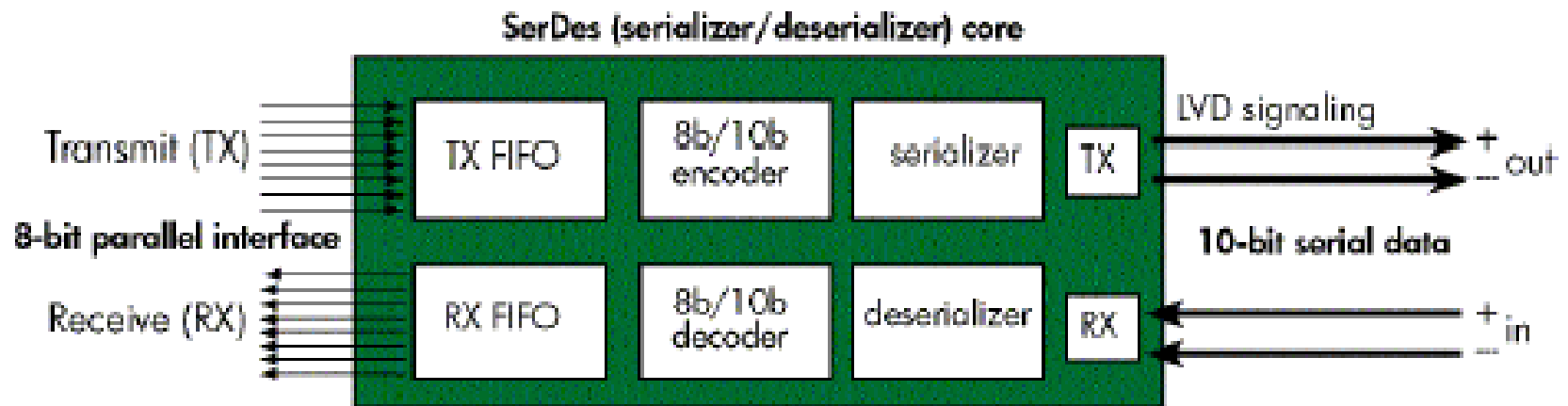
LVD

Figure 5. LVD signaling



Kodovanje 8b/10b

Figure 6. The SerDes core integrates 8b/10b coding and decoding logic.

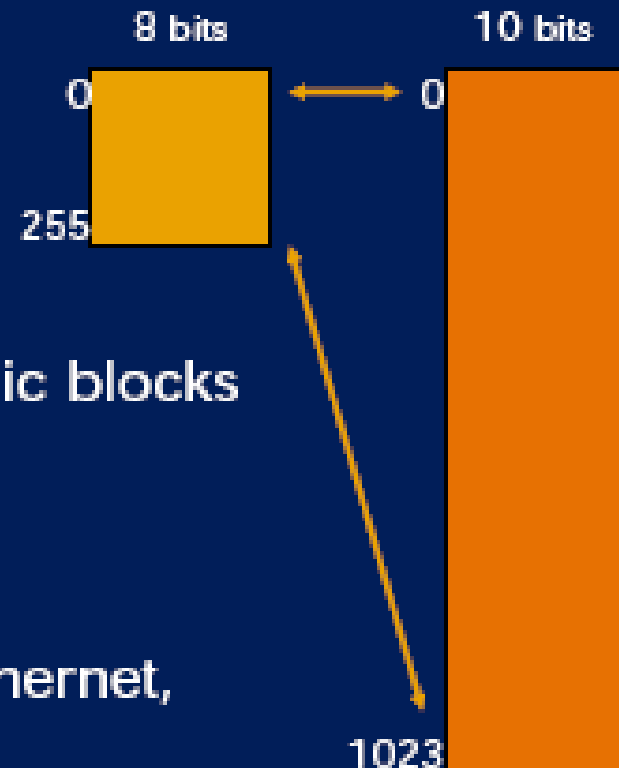


8b10b



Encoding

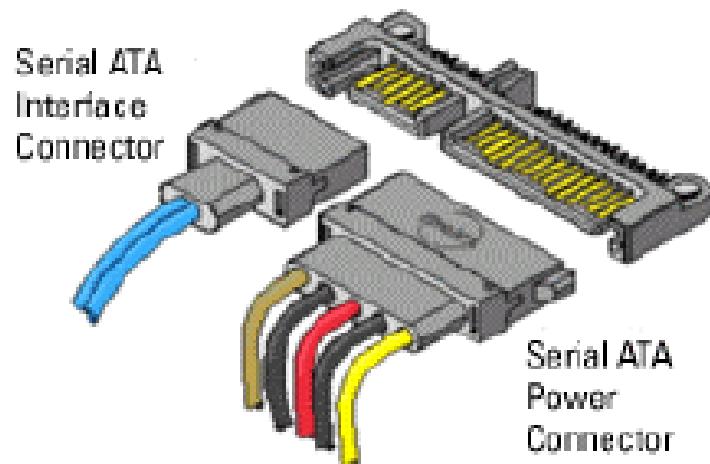
- 8b10b coding converts 8-bit bytes into 10-bit data characters for transmission on the wire
- Reasons
 - Clock recovery
 - DC balance
 - Special characters
 - Error detection
- Mapping done with two simple logic blocks
 - 5b6b and 3b4b
 - Full table in SAS and SATA
- Invented by IBM in 1983
- Used by Fibre Channel, Gigabit Ethernet, 1394b, and many other standards



Novi SATA konektor

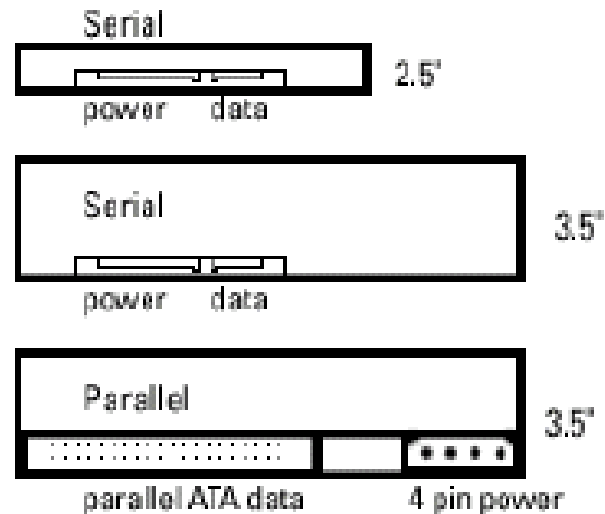
Connectors and Cables

Appearance of Serial ATA Connectors

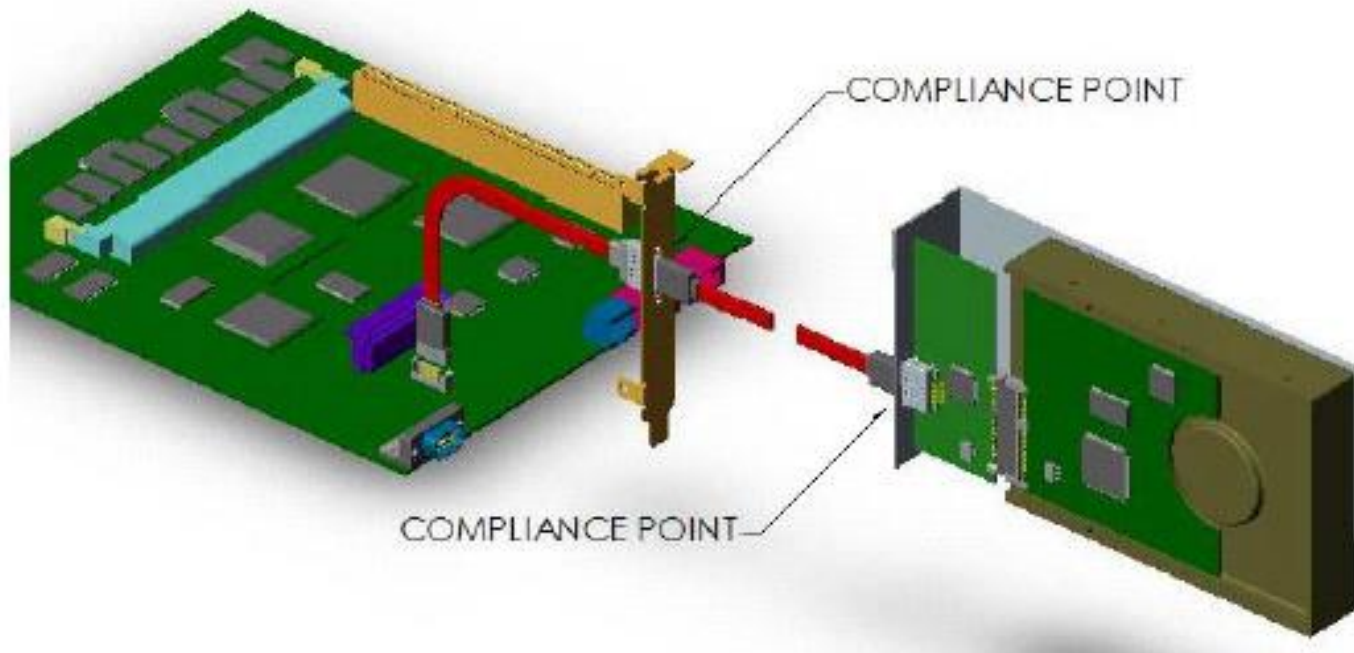


Drawing courtesy of Microlon

Device Connector Sizes and Locations



SATA controller and disk



Uprošćeno kabliranje

■
Figure 1:

Parallel ATA Cabling



Serial ATA Cabling

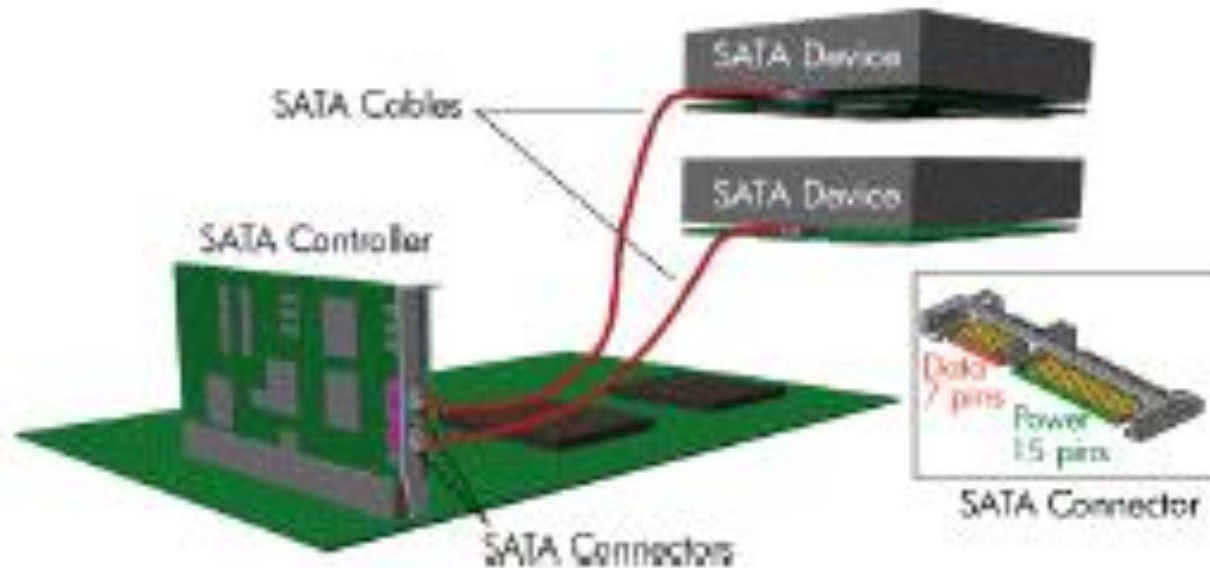


Serial ATA v parallel ATA

- **Serijska v paralelne magistrale**
- **LVD v SE(TTL)**
- **Brzina (Speed)**
- **Obrada komandi u redu (Command queuing)**
- **Point-to-point povezivanje v master/slave**
- **Uprošćeno kabliranje (Simpler/longer cabling)**
- **Hot-pluggability.**

SATA controller and 2 devices

Figure 8. The Serial ATA Controller will connect with one device on each port to create point-to-point connections.



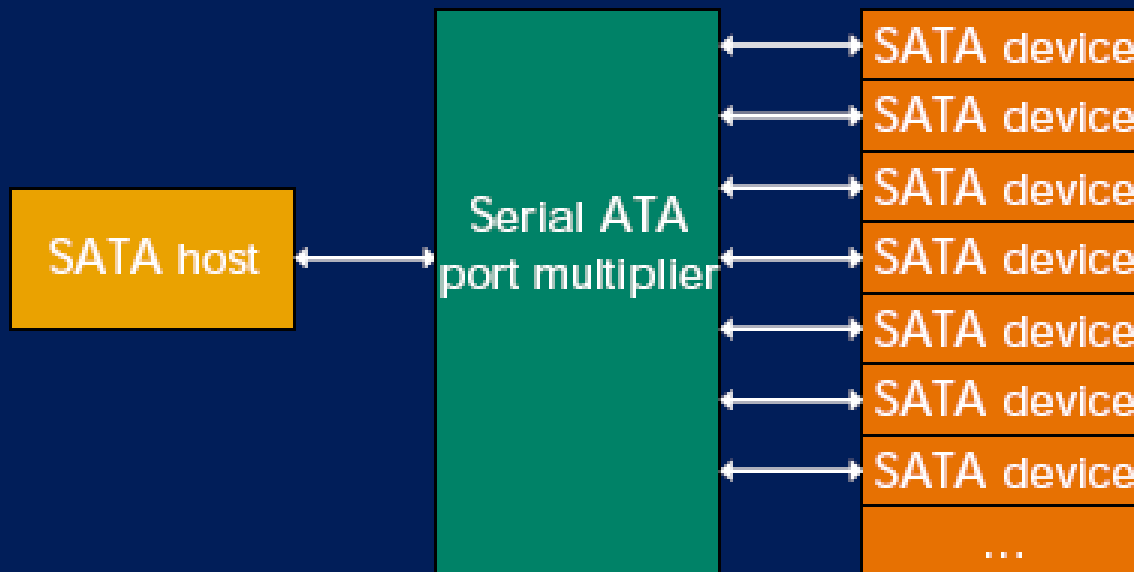
The SATA controller can use an expander (low-cost switch) to "fan out" to multiple target devices from a single port (Figure 9).

SATA II port multiplier

Serial ATA II port multiplier

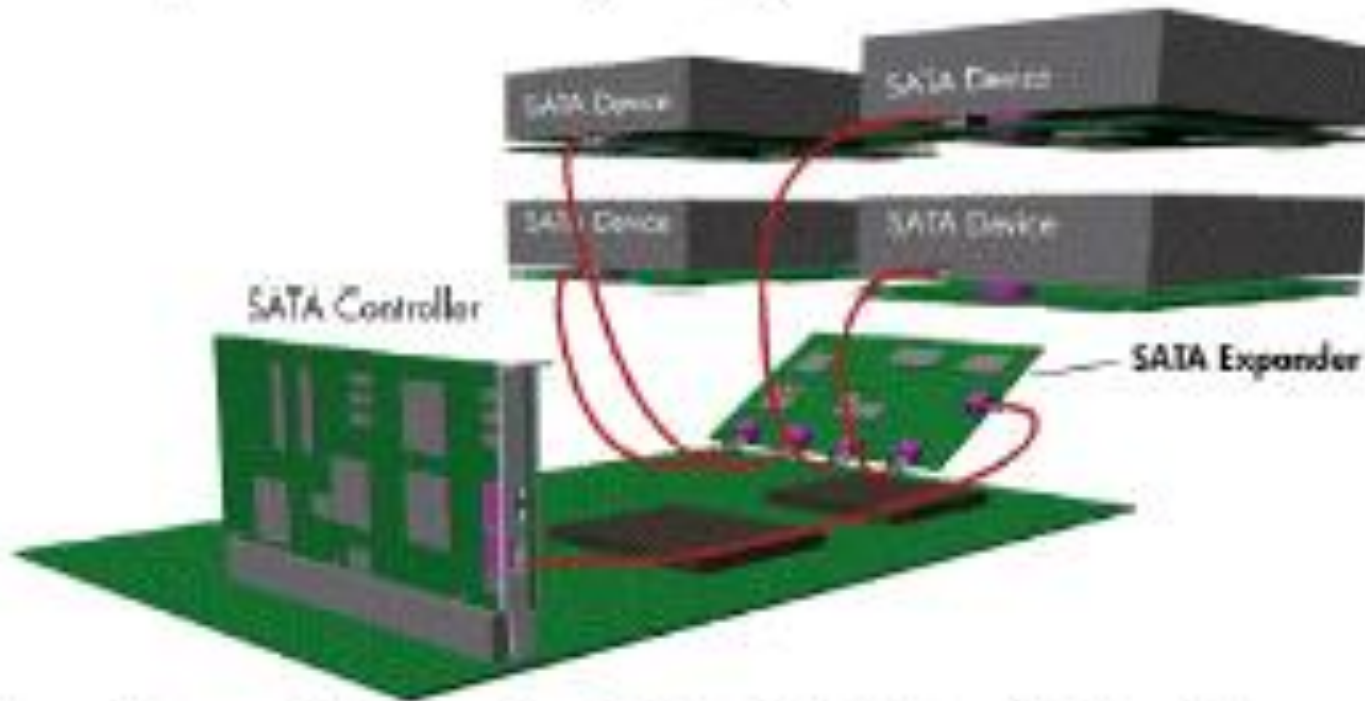


- Serial ATA II port multipliers attach up to 15 devices to a host
 - Stores and forwards frames from the host based on a field in the frame header
 - Fills in that field for frames from devices



Expander and larger number of devices

Figure 9. SATA expanders allow connectivity to a larger number of devices.



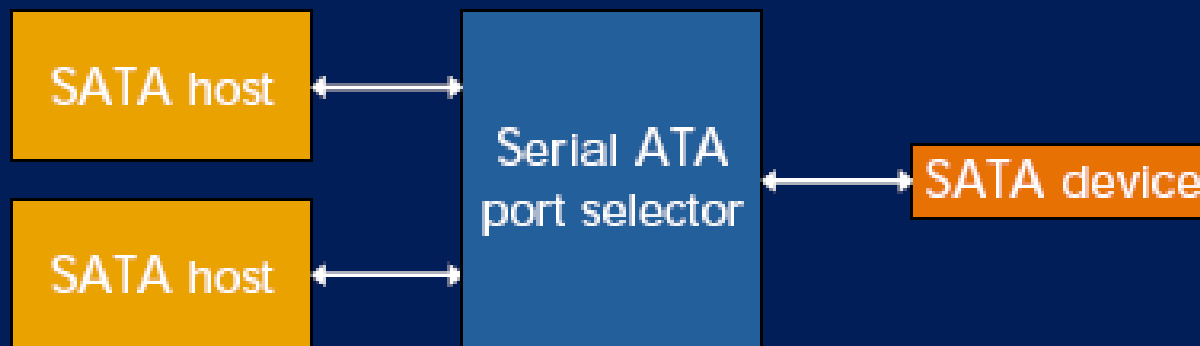
Regardless of these useful features for PCs, the SATA 1.0 specification lacks support for some advanced features required by some server and network storage applications.

SATA II port selector

Serial ATA II port selector



- Serial ATA II port selector let a device talk to two hosts
 - First host to run OOB is active; the latecomer is inactive
 - Switch over
 - Inactive host can take control by sending a particular sequence of COMINIT OOB signals
 - Sideband signals also allowed



Primer: brzine transfera

- **Ultra ATA/100**

- 25MHz strobe
- x 2 for double data rate clocking
- x 16 for bits per edge
- / 8 bits per byte
- = 100 Mbytes/sec

- **SATA 1.5Gb/s**

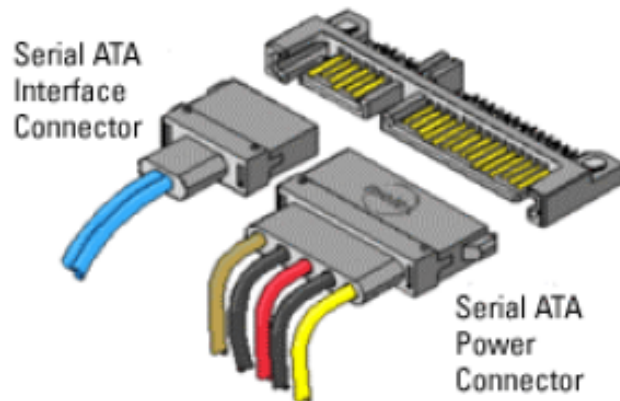
- 1500MHz embedded clock
- x 1 bit per clock
- x 80% for 8b10b encoding
- / 8 bits per byte
- = 150 Mbytes/sec

SATA kontroleri



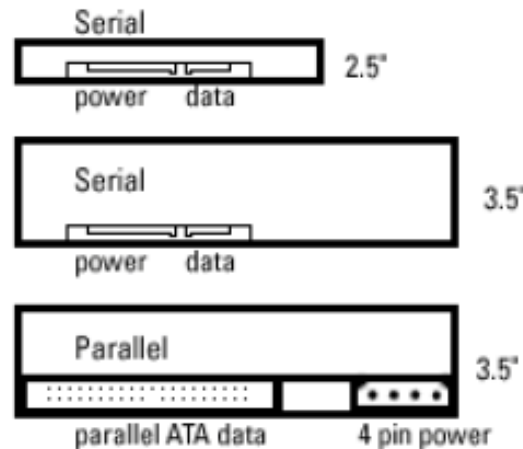
SATA kablovi

Appearance of Serial ATA Connectors



Drawing courtesy of Molex

Device Connector Sizes and Locations



Feature	Benefit
The interface cable consists of: • Transmit signal differential pair • Receive signal differential pair • Three ground connections	The use of differential signals improves tolerance to electrical noise.
The power cable consists of: • +12 V • +5 V • 3.3 V • Two ground connections	+3.3 V power enables this connector to be used for future low power systems, particularly in the mobile market.

Tipičan predstavnik SATA diskova



Specifications	2 TB ¹
Model Number	ST32000641AS
Interface Options	SATA 6Gb/s NCQ
Performance	
Transfer Rate, Max Ext (MB/s)	600
Sustained Data Rate OD (MB/s)	138
Cache (MB)	64
Average Latency (ms)	4.16
Spindle Speed (RPM)	7200
Configuration/Organization	
Heads/Disks	8/4
Bytes per Sector	512
Reliability/Data Integrity	
Load/Unload Cycles	300K
Nonrecoverable Read Errors per Bits Read, Max	1 per 10E14
Annualized Failure Rate	0.34%
Mean Time Between Failures (hours)	750,000
Limited Warranty (years)	5
Power Management	
Startup Current +12 Peak (A, $\pm 10\%$)	2.8
Seek, Average (W)	7.3
Operating, Average (W)	9.23
Idle, Average (W)	6.39

Primeri za razumevanje

■ PRIMER ZA VEŽBU BR. 1

☞ SATA diskovi

■ PRIMER ZA VEŽBU BR. 2

☞ SATA taktovi i brzine prenosa

PRIMER BR. 1

< SATA diskovi >

- Date su karakteristike jednog realnog SATA-1 diska.

DiamondMax® SATA 1.0	
maximum Capacity	80.0 GB
average seek time	10ms
rotational speed	7,200 rpm
media speed	42MB/s
disk interface	SATA 1
maximum disk buffer throughput	1.5 Gb/sec
disk buffer	4 MB

- U konfiguraciji računara imate 2 takva diska.
- Pristigla su 2 zahteva, za svaki disk po jedan
- **disk #1:** sa adrese (cilindar 15, head 0, sektor 13), pročitati 10 sektora
- **disk #2:** sa adrese (cilindar 940, head 2, sektor 1), pročitati 40 sektora

PRIMER BR. 1

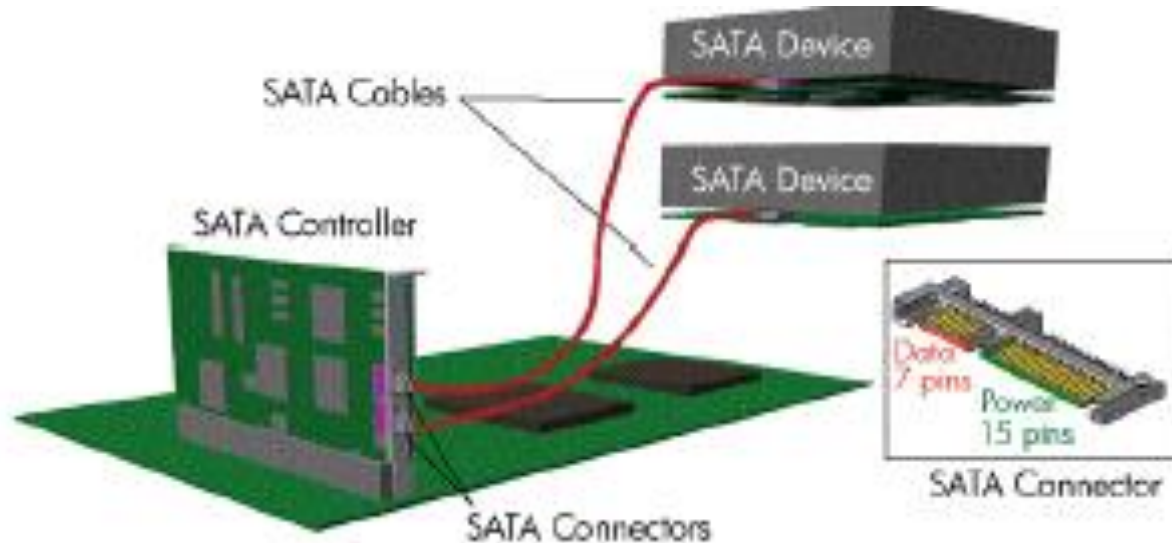
< SATA diskovi >

- odrediti ukupno vreme trajanja oba disk pristupa bez preklapanja media i interface faze

PRIMER BR. 1

< SATA diskovi >

- U slučaju SATA diskova



- Svaki disk radi nezavisno i to sa maksimalnom brzinom.
- 2 ili bilo koliko SATA diskova mogu obaviti N istovremenih operacija, po jednu na svakom disk pojedinačno.

PRIMER BR. 1

< SATA diskovi >

- Oba diska su SATA-1
- i ovde se disk operacije preklapaju, obe se rade istovremeno
- **$T_{total} = \text{Max}(T_{access1}, T_{access2})$**
- disk #1: sa adrese (cilindar 15, head 0, sektor 13), pročitati 10 sektora
- $T_{access1} = T_{seek1} + T_{rotate1} + T_{media1} + T_{interface1}$
- $T_{seek1} = 1 \times \text{average seek time} = 10 \text{ msec}$
- $T_{rotate1} = T_{rotate_avg}(7200\text{rpm}) = 4.1 \text{ msec}$
- $T_{media1} = Q/V_{media} = 10 \times 0.5\text{KB} / 42\text{MB/s} = 0.119 \text{ msec}$
- $T_{inteface1} = Q/V_{interface} = 10 \times 0.5\text{KB} / 150\text{MB/s} = 0.033\text{msec}$
- $T_{access1} = 14.252\text{msec}$

PRIMER BR. 1

< SATA diskovi >

- **disk #2: sa adrese (cilindar 940, head 2, sektor 1), pročitati 40 sektora**
- $T_{\text{access2}} = T_{\text{seek2}} + T_{\text{rotate2}} + T_{\text{media2}} + T_{\text{interface2}}$
- $T_{\text{seek2}} = 1 \times \text{average seek time} = 10 \text{ msec}$
- $T_{\text{rotate2}} = T_{\text{rotate_avg}}(7200\text{rpm}) = 4.1 \text{ msec}$
- $T_{\text{media2}} = Q/V_{\text{media}} = 40 \times 0.5\text{KB} / 24\text{MB/s} = 0.476\text{msec}$
- $T_{\text{inteface2}} = Q/V_{\text{interface}} = 40 \times 0.5\text{KB} / 150\text{MB/s} = 0.133\text{msec}$
- $T_{\text{access2}} = 14.709\text{msec}$
- **$T_{\text{total}} = \text{Max}(14.252, 14.709) = 14.709\text{msec}$**

PRIMER BR. 2

<SATA taktovi i brzine prenosa >

- SATA-1 ima osnovni takt od 1.5GHz. Odrediti maksimalni transfer rate.
- Rešenje:
- odredićemo maksimalnu brzinu za SATA-1, poštujući osnovne činjenice
 - SATA prenosi podatke 1 bit u jednom taktu
 - SATA koristi šemu 8b/10b, za 8 data bitova, prenese ukupno 10
- Na osnovu toga dolazimo do formule:
 - SATA speed=
 - 1500MHz embedded clock
 - x 1 bit per clock
 - x 80% for 8b10b encoding
 - / 8 bits per byte
 - = 150 Mbytes/sec
- Brzina transfera ovog SATA interfejsa je 150MB/s