DataPlay, a New Technology for Information Distribution
Agenda

DataPlay Micro-optical engine & media

Key enabling innovations

Optical head and Actuator

Optical media

Electronic system

Custom ASIC controller

Interface

Content protection & activation method
DataPlay technology – Micro-optical engine & Media

- Integrates to all device types
- Full function optical drive with record and playback
- Matchbox sized
- Portable power levels

Archival media with prerecorded and recordable function
Actuator with Optical Head

- Rotates for tracking
- Tilts to close focus loop
- Optical head
The OPU-Optical Head

- Objective lens
- Beam Routing Periscope
- Polarizing Beam splitter
- Quarter wave plate
- Spacer
- Silicon Submount
- Laser & thermal mount
- Turning mirror
- Segmented Photodiode
- Servo & Data Signals
- OE Block
  Optical Elements for LD APC & Beam shaping, Stray Light Control
- Bond Pads for Flex Circuit
Micro-Optics Active Alignment
DataPlay Module
DataPlay Digital Media

Polycarbonate substrate
0.6mm X 32mm

Molded both sides

Front surface recording

2 layer active surface

Amorphous to crystalline
Phase change
Recordable Mastered Media

Uses the same detector for data and recorded information

Uses the same material as reflector and recording agent

DataPlay™ media can accommodate both written marks and pre-embossed information
DataPlay Media

Microscope photo of pre-mastered data and written data on a 32mm dia. DataPlay™ disk

Pre-mastered Data (bright background, dark pits)

Un-written grooves

Written Data (dark background, light marks)
Media power series

Writable Disk - 4T Power Series

CNR (dB)

Write Power (mW)

CNR

2nd

<ATC>

<ATC> & 2nd (dB)
Timing and address marks

Wobble + HFWM

Push-Pull Tracking Signal

Track position
# Electronics Block Diagram

<table>
<thead>
<tr>
<th>Write Optical Front-End</th>
<th>Actuator, Focus, and Spin Drivers</th>
<th>DRAM Buffer</th>
<th>512KB FLASH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read Optical Front-End</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Indus

<table>
<thead>
<tr>
<th>Read Channel</th>
<th>Address Detector</th>
<th>Servo D/A</th>
<th>Servo Pre-Driver</th>
<th>Interface µP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wobble Detect Write Synth</td>
<td>APC</td>
<td>Servo A/D</td>
<td>Servo µP</td>
<td>DES 3 Engine</td>
</tr>
<tr>
<td>OPU Algebra</td>
<td>Write Strategy</td>
<td></td>
<td></td>
<td>Interface</td>
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<tr>
<td></td>
<td>BCA Detect</td>
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- OPU Algebra
- Write Channel
- Read Optical Front-End
- Actuator, Focus, and Spin Drivers
- Servo Pre-Driver
- Interface µP
- Servo D/A
- Wobble Detect Write Synth
- Servo A/D
- DES 3 Engine
- Interface
- Address Detector
- APC
- Write Strategy
- BCA Detect
- Buffer Manager
- ECC
- DSP Instr. RAM
Engine Electronics PCBA

**Top Side**
- Indus Controller I.C.

**Bottom Side**
- RAM (Buffer)
- Flash ROM (Firmware)
Key Invention--Custom ASIC “Indus”

Embedded ECC (error correction code) most powerful known uses DataPlay invented correction method

Single chip Read / write Controller-first ever

Embedded on the fly encryption for Content Protection and Key encryption

DataPlay digital servo allows strong shock protection
# Power

## Production Level Engine Goal

<table>
<thead>
<tr>
<th></th>
<th>Full Read</th>
<th>Idle</th>
<th>128Kb/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current (3.3V in mA)</td>
<td>352</td>
<td>18</td>
<td>26</td>
</tr>
<tr>
<td>Power (3.3V mW)</td>
<td>1163</td>
<td>60</td>
<td>85</td>
</tr>
<tr>
<td>Batt. Life (2XAA hrs)</td>
<td></td>
<td></td>
<td>55</td>
</tr>
<tr>
<td>Batt. Life (2XAAA hrs)</td>
<td></td>
<td></td>
<td>24</td>
</tr>
</tbody>
</table>
DataPlay Interface

- 8 Bi-Directional Data Lines
  - DPI_Data 0-7
- SPI Bus Signals:
  - DPI_RD* (Read Strobe)
  - DPI_WR* (Write Strobe)
  - DPI_DS* (Device Select)
  - DPI_ADD0,ADD1 (Register Address)
  - DPI_Ready
  - DPI_IRQ* (Interrupt Request)
  - 3.3V
  - GND

15 signal lines, 3 power supply lines → 18 Total
DataPlay File System Interface

-DFS

--Supports content protection

--Intelligent device level caching

--Only requires single software translator

--No limit to storage capacity

--Supports long file & directory names
ContentKey™ Definition

ContentKey™ -- A DataPlay mechanism that allows an authorized user to gain permanent or temporary access to digital content on a DataPlay.com cartridge via the internet.

The ContentKey™ itself is encrypted on the disk cartridge in a region that is not accessible by the user. ContentKey™ is a part of the DataPlay File System.

The ContentKey™ can take on two forms:
- Enable or,
- Enable with decryption key
Mastered DataPlay Disk

- **Encrypted Mastered File System**
- **Mastered Content Image**
- **User Writeable Area**
- **Writable Area for Encrypted ContentKey™ Storage**
- **ContentKey™ downloaded during a ContentKey™ enable session**
Summary of Performance

- Removable 32 mm DataPlay secure cartridge with 500MB user capacity
- Archival life of written and unwritten DataPlay - est. > 100yrs
- Pre-mastered and user recordable content on the same DataPlay
- Unique miniature DataPlay engine - 52mmX48mmX11mm
- Typical average power consumption in application mode <150 mw
- Average access time to retrieve random file < 200ms
- Simple 8-bit parallel interface
- ContentKey™ feature allows unique content enabling and access