ML™ Technology:
The Future of Optical Disc Recording

Tom Burke
Calimetrics, Inc.
815 Atlantic Avenue, Suite 105, Alameda, CA 94501
Phone: +1-510-864-4100 x106  FAX: +1-510-864-4188
E-mail: trburke@calimetrics.com

Presented at the THIC Meeting at the
National Center for Atmospheric Research
Boulder CO 80305-5602
June 12, 2002

ML™ is a trademark of Calimetrics, Inc.
Calimetrics, Inc.

• Inventor and Owner of ML™ Technology
  • Triples Capacity and Speed of CD-RW
  • Doubles Capacity and Speed of Recordable DVD and Blue Laser Systems
  • Provides Tamper Proof Digital Rights Management and Security Features
  • Proprietary Technology: over 70 Patents & Patents Pending
  • Founded in 1994 and Headquartered in Alameda, CA
  • CEO is Ken Campbell (ex-Conner, Archive, Xerox); 24 staff; 10 PhDs

• ML Technology’s Key Features/Benefits
  • Delivers More Secure GBs to the Customer Faster and for Less Money
  • Compatible With CD, DVD, Blue Lasers, and Industry Infrastructure

• Calimetrics’ Mission
  “To Enable Faster-Bigger-Cheaper Digital Data Storage and Transmission for Legacy Systems Using ML and Related Technologies”
Industry Drivers

12 Exabytes and Doubling

80% Created Digitally

Text in Kbytes
Music in Mbytes
Video in Gbytes

Worlds Data

As Customer Demands Richer Content => Capacity Is King
Capacity Demand

1. DRIVEN BY Screen Size / Resolution
2. DRIVEN BY 6 Hour Recording Feature

- **VHS 352x288**: 6 Hours = 1 Tape
- **DVD 780x480**: 6 Hours = 7GB Min.
- **HD DVD 1920x1080 (20xVHS)**: 6 Hours = 25GB Min.
Challenges Facing DVD Suppliers

• **Provide a Cost-Effective Capacity Roadmap to Meet Demand**
  – Requires 6 hours of high-quality video recording on a single-sided disc
  – With backward compatibility to current DVD Format

• **Provide Adequate Content Protection**
  – Content Suppliers Not Satisfied With Current Solutions
  – Lack of Acceptance Creates Multiple Standards
  – Cost Has Not Benefited From Economies of a Standard

• **Protect Investment in DVD Technology**
  – Large Investment in Existing Manufacturing Infrastructure (lasers, optics, media)
  – Capture a Return After Years of “Format Wars” and Before Changing to Blu-ray
  – Capture the Royalty Stream Ahead of Market before Taiwan Cost-reduces DVD
  – Price War Already Started in Attempt to Become the Defacto Standard

**A New Approach is Required**
3 MAIN APPROACHES to Enable DVD growth:

1. Blue Laser Diode with High Power Optics
2. Dual-layer Media
3. Multilevel Recording

From Dr. Takeo Ohta, Matsushita Electric Industrial Co., Ltd. on the “Overview and Future of Phase-change Optical Disk Technology” - 1999 Joint International Symposium on Optical Memory and Optical Data Storage
## ML™ Advantages

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Blue Laser + Optics</th>
<th>Dual Layer</th>
<th>ML™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Capacity</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Backward Compatible with DVD</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Low-Cost Durable Laser</td>
<td>×</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Low-cost Optics</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No Cartridge</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Low-cost Disc</td>
<td>×</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Leverages Infrastructure</td>
<td>×</td>
<td>×</td>
<td>✓</td>
</tr>
</tbody>
</table>
Compatibility of Solutions

ML™ Technology adds to, and is compatible with, other solutions.
ML™ Technology Patents

<table>
<thead>
<tr>
<th>Year</th>
<th>Issued Patents</th>
<th>Patent Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>2,066,202CA</td>
<td>5,029,023</td>
</tr>
<tr>
<td>1995</td>
<td>5,113,387</td>
<td>5,118,548</td>
</tr>
<tr>
<td>1996</td>
<td>5,128,849</td>
<td>5,140,660</td>
</tr>
<tr>
<td>1997</td>
<td>5,195,082</td>
<td>5,854,755</td>
</tr>
<tr>
<td>1998</td>
<td>5,319,630</td>
<td>5,810,006</td>
</tr>
<tr>
<td>1999</td>
<td>5,537,382</td>
<td>5,375,498</td>
</tr>
<tr>
<td>2000</td>
<td>5,657,014</td>
<td>6,150,964</td>
</tr>
<tr>
<td>2001</td>
<td>5,659,310</td>
<td>6,259,860</td>
</tr>
<tr>
<td>2002</td>
<td>5,663,722</td>
<td>5,235,587</td>
</tr>
<tr>
<td></td>
<td>5,663,723</td>
<td></td>
</tr>
</tbody>
</table>
ML™ Industry Awareness

- World Conference Papers

ML™ Seminars

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>ODS (2)</td>
</tr>
<tr>
<td>1997</td>
<td>NSIC</td>
</tr>
<tr>
<td>1998</td>
<td>ISOM (2)</td>
</tr>
<tr>
<td>1999</td>
<td>MORIS</td>
</tr>
<tr>
<td>2000</td>
<td>ODS (4)</td>
</tr>
<tr>
<td>2001</td>
<td>PCOS</td>
</tr>
<tr>
<td>2002</td>
<td></td>
</tr>
</tbody>
</table>
Interested Companies

April 2001 (US)
ML Seminar
• Hitachi Ltd.
• Hitachi Maxell, Ltd.
• Komag, Inc.
• LG Electronics
• Matsushita Electric Industrial Co., Ltd.
• Matsushita Kotobuki Electronics
• Mitsumi Electric Co., Ltd.
• NEC Corporation
• OAK Technology, Inc.
• OES/ITRI
• Panasonic Semiconductor Co.
• Philips Research
• Pioneer Corporation
• Plextor Corporation
• Ricoh Co., Ltd.
• SKC Co., Ltd. Korea
• Sony Corporation
• Stream Machine
• Toshiba Corporation
• Unaxis, Inc.
• Yamaha Corporation
• Zen Research

March 2002 (Taiwan)
ITRI Seminar
• Accesstek
• Acer Laboratories, Inc.
• Actima Technology Corp.
• Artec (Ultima Electronics Corp.)
• BTC Corporation
• CMC Magnetics Corp.
• Far East OST
• Fornex Technology Corp.
• Lite-On IT Corp.
• OES/ITRI
• Ritek Corporation
• U-Tech

December 2001 (Japan)
Sanyo Technology Forum
• Matsushita Kotobuki Electronics
• Mitsubishi Chemical Corp.
• Mitsumi Electric Co. Ltd.
• Panasonic Semiconductor Co.
• Sanyo Electric Co., Ltd.
• Sony Corporation
• TDK Corporation
• TEAC Corporation
• Yamaha Corporation

Industry Leaders Have Accepted ML™ Technology
Digital Rights Management

The KEY to DRM

ML™ Provides the Key

- Calimetrics Controls All of the “Key” Elements of the Optical Disk System.
  - Media Stamping and Formulation
  - Calimetrics ASIC
  - Drive Firmware
  - Drive Hardware

- **Key 1: Media** – Cannot be manufactured without proprietary hardware from Calimetrics, different features can be enabled by codes STAMPED into the disk at manufacture.

- **Key 2: Drive Hardware** – Calimetrics controls the design of the drive electronics board.

- **Key 3: Drive Firmware** – Calimetrics owns the proprietary firmware library.

- **Key 4: The ASIC** – Calimetrics owns the design of the proprietary ASIC for ML™.

- **Master Key**: Unique Combinations of these elements provide multiple options for features.
Video Digital Rights Management

Content Secure

ML™

6 Hours of Play
Supports 6 Hours of Recording

2 Hours Play
Cannot Achieve
6 Hour Recording
of DVD Quality

DeCSS

‘Locked’ from Reading

Open PC
Architecture

Content Not Secure

X

Content

Open PC

Internet

DVD

6 Hours of Play
Supports 6 Hours of Recording

Content

Open PC

Internet

DVD
Secure Content

• Calimetrics’ ML Technology Offers Unique Security Features
• ML Format Designed for Content Authors To Control:
  – Which Drive(s) Certain Disc(s) Can Be Played On
  – Unique Drive and Disc Combinations (1-to-1 or 1-to-Many)
  – Tamper-Proof Security Passwords
  – Limits on Time and Length of Play
  – Read-Once Disc Feature
• ML Security Features Minimize Counterfeiting Opportunities
  – E.g., Security Card/Identification applications
Two Major Components
ML Optimizes The CD-RW Legacy
ML Optimizes The CD-RW Legacy

“Design In” a Single ML Read/Write Chip
ML Optimizes The CD-RW Legacy

Same Optics

CD-R/RW Recording & Playback

Same Mechanics

Same Electronic Architecture

“Design In” a Single ML Read/Write Chip
ML Optimizes The CD-RW Legacy

Unique ML-R/RW Media

Same Optics

CD-R/RW Recording & Playback

Same Mechanics

Same Electronic Architecture

"Design In" a Single ML Read/Write Chip
ML Optimizes The CD-RW Legacy

Unique ML-R/RW Media

Same Optics

Standard Recording Software Update

Same Mechanics

CD-R/RW Recording & Playback

Same Electronic Architecture

“Design In” a Single ML Read/Write Chip
ML CD-RW: Affordable Way to Backup

- **Capacity**
  - 2GB in ML mode and 700MB standard CD

- **Speed**
  - 36X ML/5.4MB per second

- **Value**
  - $1/Gigabyte
ML Audio Player

120mm mojol/ML
12cm/8cm/6cm
60mm ML

23 Hours of near CD Quality MP3
7 Hours of near CD Quality MP3
74 Min CD Audio
ML Applications: Enterprise

- ML Writing Speed is Fast…More Than 2 Times Faster Than Recordable DVD Systems.
- ML’s 5.4MB/s Data Transfer Rate Is Very Attractive to Enterprise Backup Apps Currently Using Jaz, MO, and/or DVD Recordable Systems
- Cost of storage and ownership lower than competitors
ML Applications: Desktop

- Affordable, Reliable ML CD-RW Drives and Media Offer the Speed & Capacity that Professionals Demand

- Video Production
- Graphics
- Pre-Press
### ML Applications: ML VCD

<table>
<thead>
<tr>
<th>Format</th>
<th>VCD</th>
<th>HQ VCD</th>
<th>SVCD</th>
<th>DVDPhoto</th>
<th>CD DVD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>74 min</td>
<td>37 min</td>
<td>37 min</td>
<td>98 Images</td>
<td>18 min</td>
</tr>
<tr>
<td>ML</td>
<td>3.7 hr</td>
<td>1.8 hr</td>
<td>1.8 hr</td>
<td>294 Images</td>
<td>54 min</td>
</tr>
</tbody>
</table>
Enabled 2 Hours HQ Video
At Home or on the GO!!

Full Screen HQ Video
Uses Standard 12 cm Disc

8 cm Disc
6 cm Disc

4" Screen
2" Screen
Customer Opportunities

• ML™ CD-RW
  – ML ASIC and ML CD-R/RW 2GB discs are completed
  – Fully-operational ML CD drive prototype available for demonstration
  – Calimetrics is ready to implement ML for customers’ applications

• ML DVD
  – ML ASIC enables 7GB/disc recording on a DVD base
  – Next ML ASIC under development for 10GB/disc on DVD

• ML Blue
  – Next ML ASIC will also enable 25GB/disc with 0.6mm substrate
  – 50GB/disc feasible with proposed Blu-ray format

• Unique Security Features and Digital Rights Management