“MEMS4Display”
MEMS-based microdisplays market analysis
Content

• Executive summary
  • Definitions and methodology

• The MEMS market
  • The 2005 - 2010 MEMS market forecast
  • The MEMS laws
  • The key challenges for the MEMS industry
  • The MEMS business models
  • Evolution of the MEMS business models
  • Key challenges
  • Next steps in the MEMS industry consolidation

• The MOEMS market
  • The different MOEMS devices
  • The 2005 – 2010 MOEMS market forecast
  • MOEMS roadmaps
  • Product market introduction forecast
  • Applications development status
  • MOEMS players’ strategies
Content (ctned)

- MEMS-based microdisplay applications
  - DMD market forecasts for RPTV and projection
  - FPDs segmentation and markets
  - FPDs revenues per technology
  - DLP™ technology evolution
  - TI strategy analysis
  - Other DMD applications and market forecasts
  - Evolution for RPTVs
  - Competing technologies and cost breakdown
  - Trends for direct view microdisplays: LEDs and lasers
  - DMD process flow description
  - Main microdisplays players’ profiles
  - Newcomers and success chances
  - Future applications for MEMS-based microdisplays:
    - Portable applications (compact projectors, HMDs)
    - Future applications (AFS, HUDs)

- Synthesis and conclusions

- What could happen in 10 years for micro displays?

- Presentation of Yole
1. Executive summary
Definitions

• **Micro-optical scanners:**
  – We define micro-optical scanners as optical MEMS (micro-mirrors mainly) which deviate light beams
  – Mirrors matrix, single mirror and actuated gratings are considered in the report

• **MEMS (Micro Electro Mechanical Systems) and MOEMS (Micro Opto Electro Mechanical Systems or Optical MEMS):**
  – Only devices including moving parts in the µm to mm range and using photolithography process for manufacturing will be considered
Introduction

- For a long time, MOEMS applications have been separated in two main fields:
  - Telecom applications: this market has driven the MOEMS community during the 90’. Optical switches are the main applications.
  - Non telecom applications: these applications were quite confidential except in the TV and projection systems with the success of DLP™ Texas Instruments technology.

- Downturn of telecom business in 2001 change the MOEMS landscape:
  - Some MEMS companies who were focusing only on telecom applications shut down (example: OMM).
  - Many companies stopped their MOEMS developments (example: Atmel, Memscap).
New MOEMS markets

• Today, projection and TV are the most important applications for optical micro-mirrors arrays

• But several new niche applications are now appearing aside TV and projections systems that will widespread the use of optical MEMS-based micro mirrors and micro scanners:
  – Barcode readers
  – Compact projectors
  – Head-Mounted Displays (HMDs)
  – Head-up displays (HUDs)
  – Adaptive front light systems (AFS)
  – Printers
  – Fingerprint sensors
  – Maskless lithography
  – Adaptive optics
Market opportunity for micro mirrors: schedule for product introduction

Products on the market

- Volume production (> 100 MUS$)
- Small production

90's 2005 2010 2020

- Front Projection
- RP TV
- Head Up Display
- Head Mounted Display
- Small compact projectors
- Bare Code reader
- Automotive Adaptive Front lighting
- AFS

Executive summary
DMD main applications: projection and display

- **Two main applications:**
  - **Front projection systems:**
    - Total market 2004 for TI: 1.8 Munits (WW)
    - Strong leadership of TI for DLP™ technology w/ 50% market share
  - **DLP™ TV (>40”):**
    - First TV based on the DLP™ hit the market in 2002
    - We estimate that TI has delivered 700k units in 2004
    - XHD4 chip is used (Samsung, Akai, hp) for 46 to 56” screens
    - Already 125 TV models: Sagem, LG, Daewoo, hp, Mitsubishi, Toshiba and Samsung are now using DLP™
    - Mid-2006, Samsung will commercialize a LED-based DLP TV

By 2008, DLP™ could represent almost 30% of the RPTV (rear projection) technology (>40”)
DMD main applications: projection and display

• Digital cinema projector (three-chip solution):
  – Market share TI: 100% digital cinema screens (365 screens in 2005)
  – In March 2005, Ireland is forging ahead to become the first country to convert all its movie theaters to digital projection. Under a deal announced by the Irish Film Board, investors led by privately held Avica Technology Corp. of Santa Monica, CA, will convert 500 Irish cinema screens to digital projection, at an estimated cost of $50 million.
DMD market forecast for Front Projection and RPTV

- In 2010, the market for RPTV will be close to the market for front projection

**Executive summary**

Market value for DMD RPTV and front projection
The optical MEMS market will grow from $1.3 B in 2005 to > $3.2 B in 2010. Projection/display will be > 50% of the total MOEMS market (µbolometers, spectrometers, barcode readers …)

Front projection & RPTV:
- DMD for front projection is a mature market now with a continuous growth. Texas Instruments is now strongly investing into the RPTV application for the DLP chip.
- In 2010, the market for RPTV will be close to the market for front projection.
- Texas Instrument is a strong leader and will remain ahead for at least 4 years. But TI leadership will be challenged by:
  1. Newcomers: Sony, Micralyne, Kodak, Miradia and Reflectivity.
  2. The DLP patent going to the public domain: it will be an open way to competitors. Many MEMS competitor technologies have appeared in the last 4 years but they will have to find a path in the patent field of TI to succeed. However, the question when the TI patent will go public is open.
  3. The ability of TI to decrease its DLP chip price to be cost competitive with LCDs and plasma. LCDs (and plasma) costs are decreasing fast. Cost will have make the difference between the different technologies.
- Although DLP RPTVs are expensive today (in the range of US$3,000), the technology allows very large screens (56”). However, DLP RPTVs are thicker than LCDs. Can they really be considered as FPDs and attract customers?
Trends per application

• Small compact projectors:
  • It is in development today with a time-to-market estimated to be 2010-2012
  • Micro mirrors can be used, with the same technology used for HMDs (see below)
  • This application is still at research stage: European project MIMOSA with STM, Nokia …
  • Microvision, Philips and Mitsubishi have developments. Mitsubishi has released a hand projector based on DLP with RGB LEDs low luminance: only 15 ANSI lumens while 1000 are needed for office products) at $700

• Head mounted displays:
  • Today sales mainly comes from military programs (60% of today market): Microvision and Kaiser are working with the US Defense
  • Industrial and medical applications are emerging: players are Microvision, Otrivisio, iDisplay Systems, MicroOptical
  • Consumer applications are not expected before 2010