CE-ATA, it's a smart move …

IEEE Santa Clara Valley Consumer Electronics Society
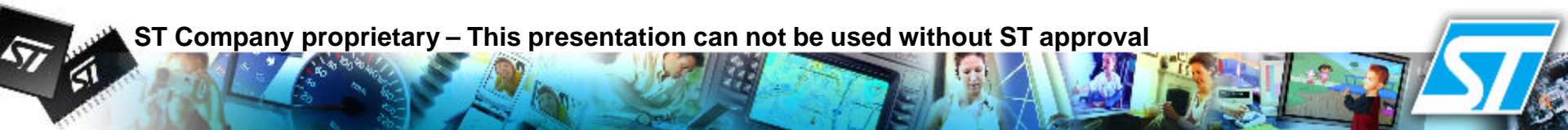June 28, 2005
by
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STMicroelectronics

CE-ATA for SFF Storage Interface Need

- Dual Objective:
  - Create an alternative to CF+ targeting total cost of the application
  - Avoid the proliferation of interfaces as seen today for Flash memories

- How we accomplished that
  - Addressing the high voltage signaling requirements
  - Reducing the number of I/O
  - Simplifying the ATA interface
  - Creating consensus within the industry: Today All major HDD manufacturers are active within the CE-ATA organization in full sync with the rest of the CE industry
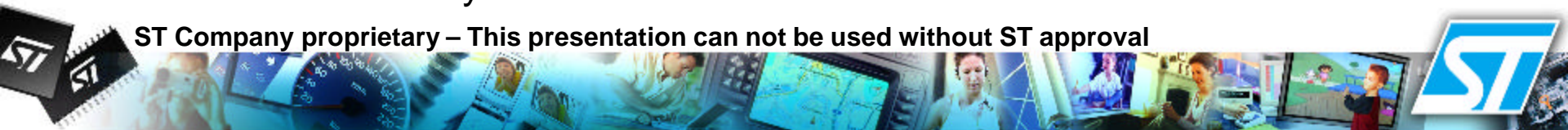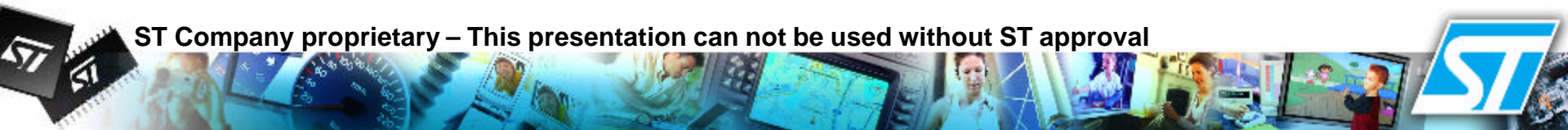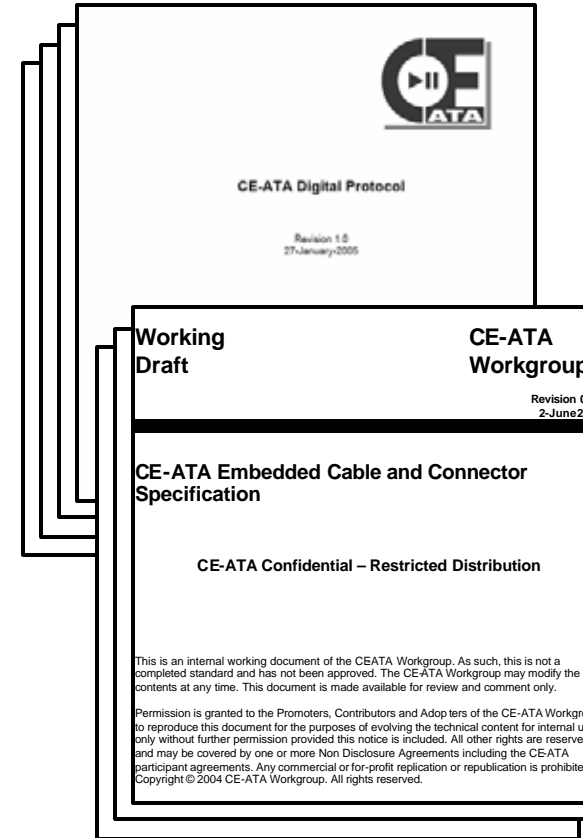
CE-ATA: Specs Definition

- CE-ATA specs are expected to have at least over 10 years of lifespan
- <u>CE-ATA Digital Protocol</u> Revision 1.002 dated June 21st, 2005
- <u>CE-ATA Embedded Cable and Connector</u>, Specification Revision 0.741 dated June 17th, 2005
- Augmented MMC interface to efficiently support of ATA HDDs
- Initial effort focused on embedded applications, removable HDD will be defined as a next step
  - First CE-ATA products with embedded solution are expected on the market by year end (2005)

CE-ATA Digital Protocol

Revision 1.0
27-January-2005

Working Draft	CE-ATA Workgroup
	Revision 0 2-June 2

CE-ATA Embedded Cable and Connector Specification

CE-ATA Confidential – Restricted Distribution

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CE-ATA: Goals

- Optimized for handheld embedded applications of storage
- Low/minimal pin count
- Accommodates fast time-to-market initial solution leveraging existing technologies
- Provides interface transfer rates sufficient for current small form factor disk drives with performance scalability to support several future product generations
- Consistent with ATA software infrastructure, but complete legacy software compatibility is not a requirement
- Only a single device need be accommodated per connection

  - CE-ATA is supported over the MMC electrical interface using a protocol that utilizes the existing MMC access primitives. The interface electrical and signaling definition is as defined in the MMC reference.
    - MMC System Specification v4.0 available to MMC members under NDA;
   - MMC System Summary Specification v3.31 is available on the web

CE-ATA: Cable & Connectors

- The CE-ATA embedded connector and cable shall support either x4 data lines or x8 data lines.
- The maximum clock rate is 52 MHz.
- Two separate power lines deliver the supply voltage and the interface voltage reference.
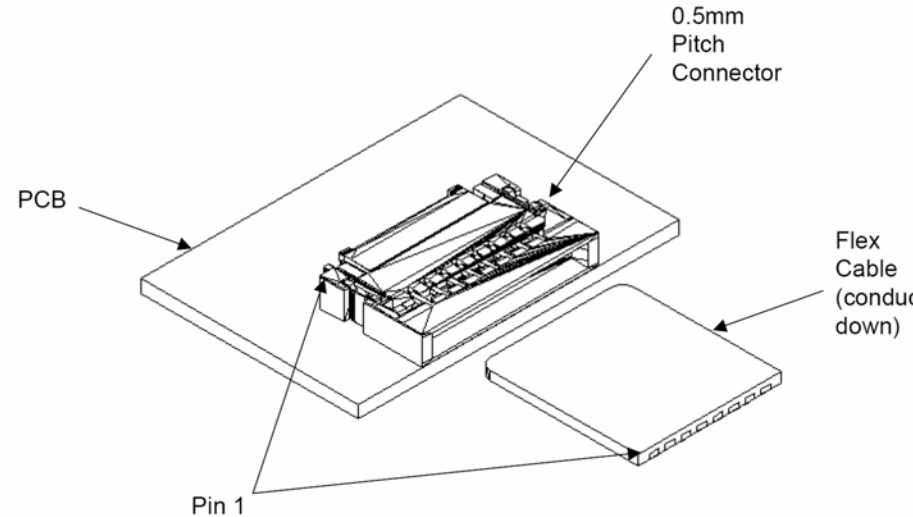
- Solution is cost competitive for consumer electronics applications
- Minimal electrical discontinuity at connectors
- Low profile solution, fitting for 1.8", 1" and sub 1" hard disk drives (HDD's) and other storage devices
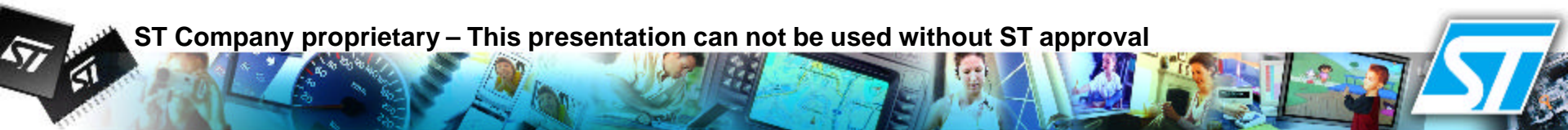
CE-ATA: MMC commands

- CE-ATA utilizes five MMC commands:
  - **CMD0** = GO_IDLE_STATE: Used for hard resets
  - **CMD12** = STOP_TRANSMISSION: Causes the ATA command currently executing to be aborted
  - **CMD39** = FAST_IO: Used for single register access to the ATA taskfile registers, 8-bit access only
  - **CMD60** = RW_MULTIPLE_REGISTER: Used to issue an ATA command or access the status/control registers
  - **CMD61** = RW_MULTIPLE_BLOCK: Used to transfer data for an ATA command
- CMD60 and CMD61 are **new** commands defined by CE-ATA for efficient HDD command execution
- CE-ATA utilizes the same MMC command sequences for initialization as traditional MMC devices
 - CE-ATA operates out of the MMC TRAN state
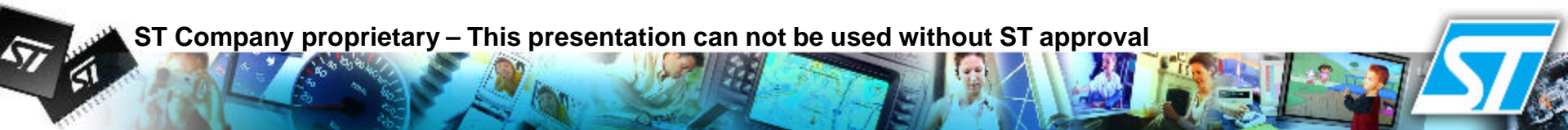
CE-ATA: MMC commands contd.

- ## CMD60:
  - RW_MULTIPLE_REGISTER allows multiple registers to read/write in a single transaction sequence
  - Using RW_MULTIPLE_REGISTER, an ATA command can be issued with a single MMC command
    - Alternative is to do up to 13 individual taskfile register writes with FAST_IO (CMD39)

- ## CMD61:
  - RW_MULTIPLE_BLOCK is used to transfer data for an ATA command issued with RW_MULTIPLE_REGISTER
  - For media access commands, the data transferred must be in multiples of the CE-ATA sector size
  - CE-ATA sector sizes are a minimum of 4KB
  - Each transfer is broken into multiple MMC data blocks which are 512 bytes, 2KB, or 4KB in size
  - To avoid polling the protocol uses a "smart" interrupt procedure
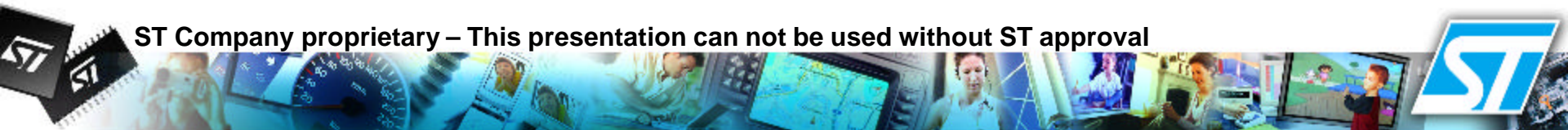
CE-ATA: Executing an ATA command

- Issue READ DMA EXT with RW_MULTIPLE_REGISTER (CMD60) for 8KB of data
- Issue RW_MULTIPLE_BLOCK (CMD61) to transfer data
- Device signals interrupt when ATA command complete
- Read the ATA Status register once to get final status

CMD60	R1b Response	Register Contents

CMD61	R1 Response	4KB Data	4KB Data		Interrupt
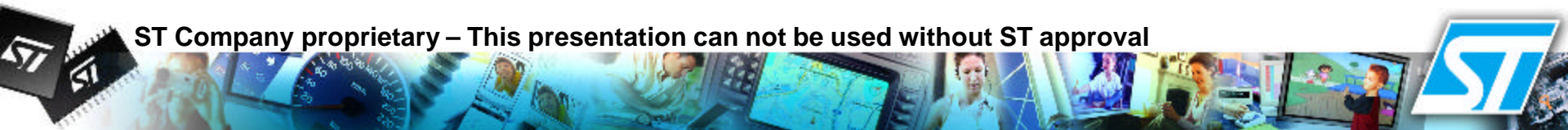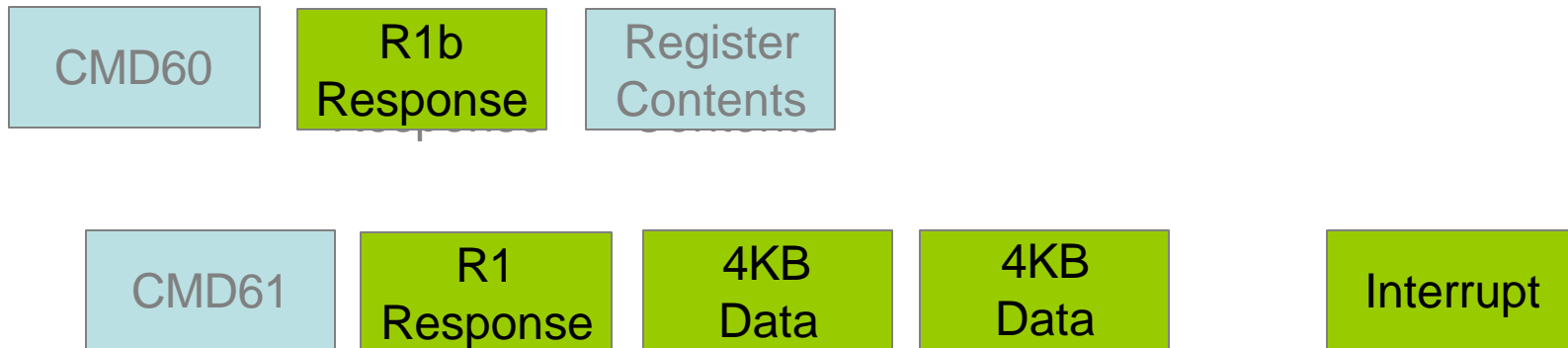
CE-ATA: Reduced ATA Command Set

- CE-ATA command set (complete)
  - IDENTIFY_DEVICE
  - READ_DMA_EXT
  - WRITE_DMA_EXT
  - STANDBY_IMMEDIATE
  - FLUSH_CACHE_EXT
- All the different ATA flavors of reading and writing to the disk reduced to single pair
- Command set stripped down to bare essentials
- Firmware, software, validation, and boundary cases simplified
  - SET FEATURES is no longer required
  - SMART is simplified into a few new registers
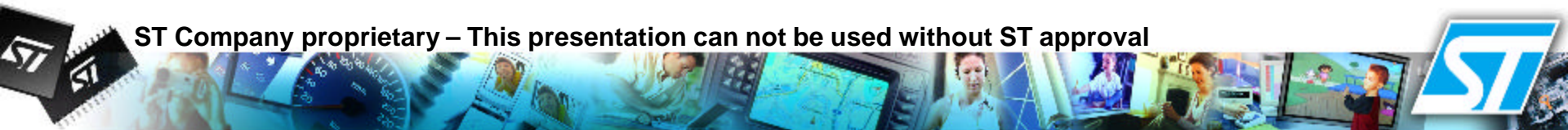- Forward-looking from start with 48-bit support

CE-ATA For Hand-Held Applications

- CE-ATA saves in excess of 60% of the die size of a typical CF+ interface
  - Pin-count: Only 6 or 10 interface signals depending on performance needs (plus power and ground pins)
- Moving forward with voltage requirements: away from the 5V tolerance and with voltage negotiation bottom up to guarantee future compatibility
- Optimizes power, performance, pin-count, and protocol
  - Power: Small number of low-voltage transceivers with low static-power consumption
  - Performance: Scalable transfer rates appropriate for needs of SFF drives (range from modest transfer rates to up to 50MB/s)
  - Protocol: Reduced feature set, streamlined ATA command set, and simple digital protocol
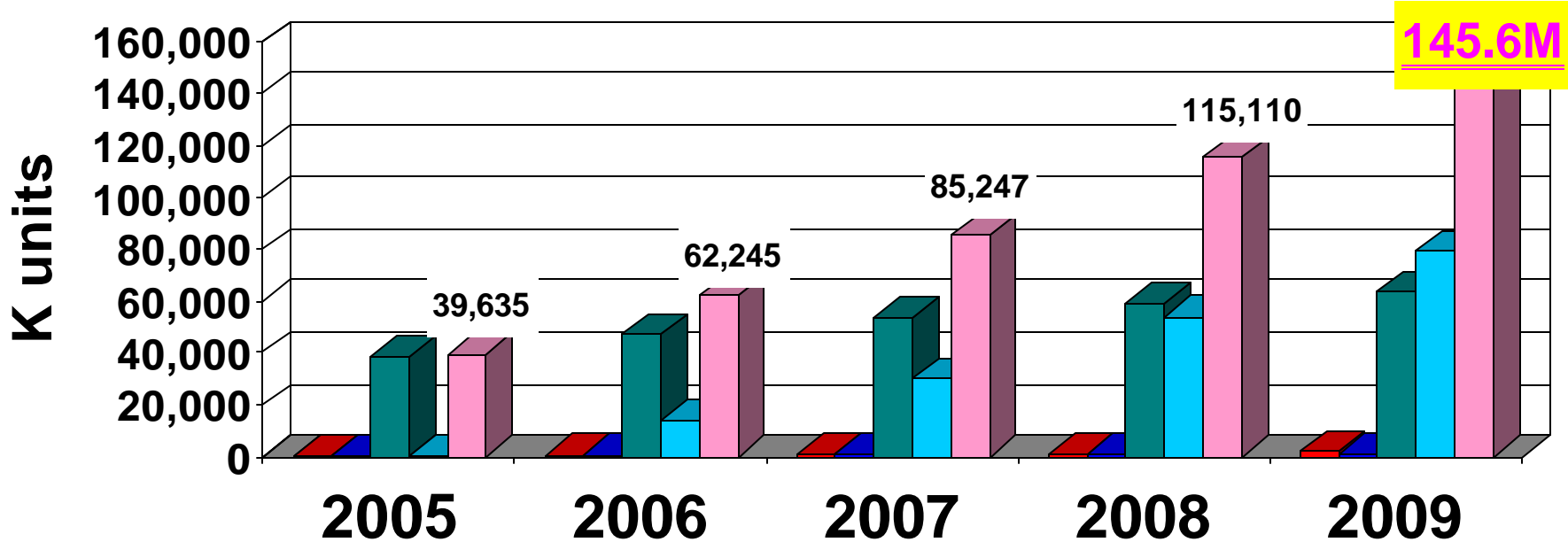
… and the Applications are?

- Mobile Phones (A.K.A. the Holy Grail of all the marketers)
  - Supporting the expansion of new application – music, personal video, digital TV
    - Business model augments value added and revenues, of Service providers
- Music Players
  - 40M Personal Audio Digital Player produced in 2004 – 30% w/ HDD - and 160M projected by Y2010 - 35% w/ HDD -
- Video & media
  - Personal video recorders, personal media players, video cameras, digital camera
    - Enabled by the "Ease-of-use"/"Ease-to-share" digital video application are pervading
    - Higher resolution pictures and video requires 1GB and more of storage
- Others
  - GPS, video games, Karaoke …

Sub 2.5 inch drives: Market Evolution

K units (y-axis: 0 to 160,000)

Values by year:
- 2005: 39,635
- 2006: 62,245
- 2007: 85,247
- 2008: 115,110
- 2009: 145.6M

Legend:
- ■ PMPs
- ■ Cameras (Film Cartridges)
- ■ PDAPs tot. (sub-2.5 inch)
- ■ Cellular Phones
- ■ Total Sub-2.5-Inch HDDs for Non-PC Markets

Personal Media Player CAGR 05-09 = 61%	
Portable Digital Audio Player CAGR 05-09 = 13.5%	
Cellular Video Phones CAGR 05-09 = 79%	
Cameras CAGR 05-09 = 28.5%	

The Challenge from the Flash Memories

- Cost of 1GB Flash memory is today in the range of 65 US$ and up challenging the market share of Hard Disk Drive in CE applications Perpendicular recording and a few other technology enhancements may help in keeping the HDD ahead of the race for high capacity but is that enough?

- With a volume of more then 150M units per year projected in 5 years from now, half the total HDD shipments in Y2004, HDD industry has the capability to differentiate the products and take the full advantage from the "intelligence" already embedded into the drive to reduce power dissipation and cost of the final application

- CE-ATA is enabling HDD becoming pervasive
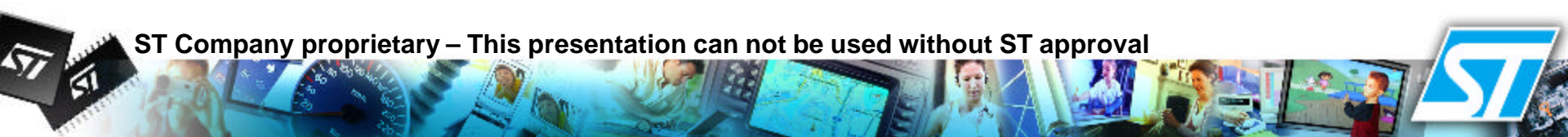
STMicroelectronics Positioning

- ST fully supports the HDD industry to take advantage of the new market opportunity
  - Among the first ones to join the CE-ATA organization,
  - ST is leading the way for consumer applications
- Conventional approach is not considered enough. It is fundamental to
  1. move ahead of the simple compromise between performance and power dissipation, And
  2. do better than counting only on the technology evolution

Three steps to move ahead of the game

1. Technology Innovation
2. Optimized power management
3. System architecture

Proven record in delivering SoCs

Technology Advancements

- All current SoC design activity uses CMOS90
  - LP option used in volumes for Mobile application
- … and 65 nanometer technology is available now for design
  - Preliminary feasibility study shows very interesting advantages for an "All in one" approach
- Advanced BCD technology for Power enabling future system integration
- SiGe technology for PA
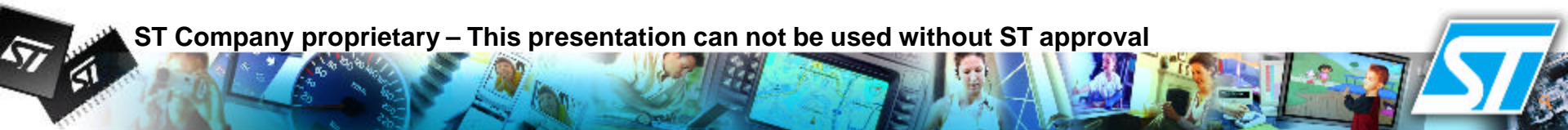
Optimized Power Management

- Striving for power saving
  - Using LP option to reduce static power
  - 40% of dynamic power saving using "under-drive" supply
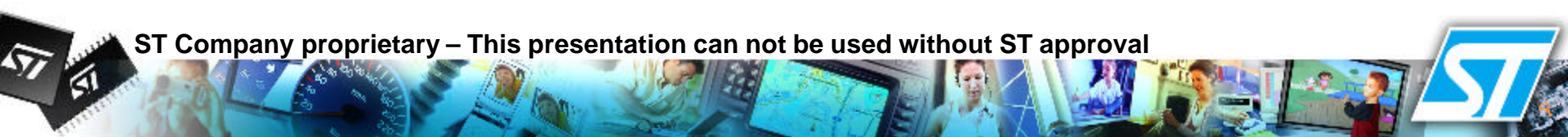 - Next R/W channel for microdrive, at 300Mbps, consuming 150mW

System Architecture

HDD can easily embed MP3 and MM functionalities

- Distributed computing architectures for integration & optimization of Application Specific IP

- Smarter use of buffer memories

Among the first ones to join the CE-ATA organization, ST is leading the way supporting consumer application

- Reduced power dissipation
  - 90nm process with Low Leakage option;
  - Embedded memories,
  - Optimized R/W Channel

- Supporting HDD manufacturers to supply Consumer Electronics industry with complementary Multi-Media expertise through open market as well as royalty free solution for Audio and Video application
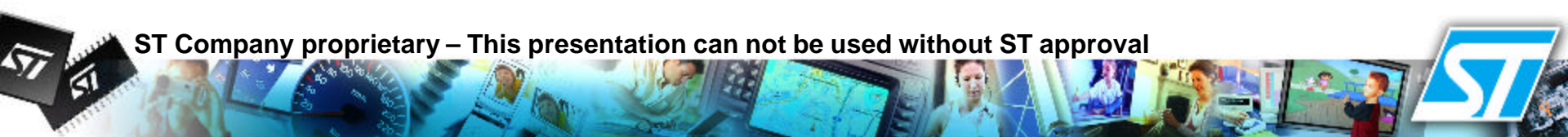
Call for Actions

- Join the CE-ATA organization
- Think Smart and stay ahead of competition
- Make sure you talk to STMicroelectronics for any of your needs in consumer application
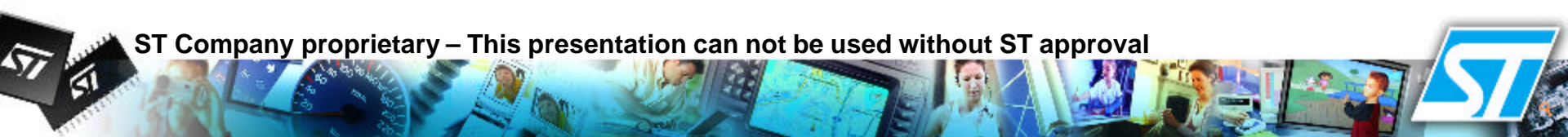
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… for those who will be ready to seize the opportunity!

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FEEDBACK

Developing and deploying the standard small form factor storage specification for handheld and consumer electronics applications

Portable music and video players • Smartphones • Digital video and still cameras • Personal digital assistants • External storage devices

Specification Now Available

The CE-ATA movement

- Broad industry support from CE and storage industry leaders
- Focused on a single storage specification for CE applications
- Open to additional participation from CE industry players

The emerging standard

- Optimized for mobile power and performance
- Scalable for future usage models
- Ensures compatibility between host and storage devices
- Lowers development costs and speeds time to market for CE devices