

ASTC HDD Roadmap Process

Roadmap Planning Committee: J. Best, G. Bertero,
R. New, T. Chang

Roadmap Goals

- Provide a likely direction to member companies and associates on the industry path for achieving higher areal densities in HDD products
- Early identification of major technology gaps to roadmap closure and sponsoring of the necessary research and development to eliminate them

Roadmap Approach

- Develop strawman system roadmaps for major technology alternatives
 - Likely first product introduction time and density
 - Subsequent generations to 4X density (≥ 4 Tb/sq in)
 - Sufficient detail for discussion with component groups to evaluate technical alternatives and identify major technical barriers
- Develop roadmaps for fundamental technologies to support the system roadmaps
 - Include tools as well as heads, disks, tribology, servo, signal processing

Roadmap Taxonomy

- Overall
 - Areal density vs. time
 - Range of fundamental parameters: tpi, bpi, spacing, datarate
 - Summary outlook for solid state memory density/cost vs. time
- System Technologies
 - PMR w/ & w/o SMR
 - BPMR
 - HAMR
 - TDMR
 - MAMR
- Core Technologies

Roadmap Activity Organization

- Overall guidance to be provided by roadmap co-leaders
 - J. Best, G. Bertero, R. New, T. Chang
- System strawman roadmaps
 - Systems leaders and modelers
 - PMR: T. Chang*, R. Wood, E. Champion
 - BPR: T. Albrecht*, B. Clark, R. van de Veerdonk, R. Victora, S. Greaves
 - HAMR: M. Gibbons*, T. Rausch, B. Stipe, J. Thiele, J. Zhu
 - TDMR: F. Erden*, R. Wood,
 - MAMR: M. Mallery*, P. van der Heijden, J. Zhu
- Technology elements roadmap
 - Selected company functional leads to coordinate efforts (all need to pitch in)
 - Head: Tim Rausch, Disk: Dieter Weller, Signal processing: Greg Burd, Servo: Guaoxiao Guo, Head Disk Interface: Yiao-Tee Hsia

DRAFT: to be defined by PMR system leads

PMR

- Extendibility
 - What is consensus view on density limit?
 - With and without shingled write
 - Is shingled write short term solutions, or will it be carried to all future technologies
 - Two classes of drives?
 - TDMR option?

DRAFT: to be defined by TDMR system leads

TDMR

- PMR option only, or for BPM and/or HAMR?
- How much ultimate areal density benefit does TDMR provide?
- What is effective native block size for TDMR device as a function of areal density and time?
 - HDD architecture implications
 - HDD application shift to primarily archive, backup, streaming, data access, with reduced performance requirements on random write?
 - Flash on drive? Flash on system with HDD?

DRAFT: to be defined by BPMR system leads

BPMR

- At what density and time frame can it realistically be introduced into products?
- How far can patterning density go without self-assembly?
- Basic technology and tool strategies for:
 - Master generation
 - Self assembly resolution enhancement
 - Pattern transfer – imprint
 - Etch
 - Planarization
- Density limits of various technology options
- Media magnetic material requirements

DRAFT: to be defined by HAMR system leads

HAMR

- At what density and time frame can it realistically be introduced into products?
- Disk magnetic material options vs. density limits
- Roadmap for small grain HAMR material
 - Known roadmap vs. breakthroughs required
- Roadmap for light generation
- Roadmap for light delivery
 - Density vs. spot size vs. efficiency
 - Basic design and fabrication approach
- System reliability/Head Disk Interface

DRAFT: to be defined by systems and head function leads

Heads

- Roadmap for lithography
 - Tools and basic process for head vs. density
 - Tools and basic process for HAMR NFT vs. density
- Sensitivity, noise roadmap
- Basic technology roadmap to support read parameters
 - Limits of TMR
 - CPP GMR
 - Materials structure roadmap
 - Other architectures
 - Requirements for depositions systems
- Fly height control roadmap

Other Technology Elements

- Disk, Signal Processing, Tribology, Servo
 - Systems and Functional leaders to develop list of key questions and roadmap elements for each area

Timetable

2/1/2011	Roadmap Kickoff
	Strawman proposal development Functional outline and question development
3/15/2011	Strawman System Proposal Drafts Complete
	Functional details development Revise and update strawman system roadmaps
4/30/2011	Functional Groups Drafts Complete
6/30/2011	Final Roadmap Report Complete
1/31/2012	Kickoff annual update
3/31/2012	Complete update

Multiple conference calls and one or two physical meetings to communicate and refine system proposals, function details, and final draft