ASTC

Project Proposal Process

Steering Committee

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ASTC Organizational Structure
- Project Responsibilities

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Executive Council (EC)

- Define ASTC vision and mission
- Approve projects as summarized by the SC
- Approve budgets
- Appoint SC members

Steering Committee (SC)

- Provide guidance to the TC for new projects, changes to existing projects, and adjustments to budgets
- Provide project and budget recommendations to EC
- Approve TC members and project leaders

Technology Committee (TC)

- Generate project proposals for SC action
- Monitor and review projects
- Oversight of project leaders

Working Groups (WG)

- Ad-hoc, organized on an as-needed basis
- Elect project leaders

(significant overlap of project leaders and TC members)

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Funding Levels

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	Travel	Partially-Funded	Fully-Funded
Amount	7 – 10K	35 – 70K	> 70K
Goal	Information sharing/ interaction	More projects with limited budget; Partner members who cannot agree to IP licensing	Focused research and development into select, critical areas
IP	No	Case-by-case decision	Inventor(s) hold IP; License to Tier-1 and Tier-2 members
Publication	No restriction	Waiting period (90 days)	Waiting period (≥ 90 days), patent application can cause delay
Reports	Voluntary	Monthly	Monthly
Meetings	Required	Required	Required
ASTC membership	Required	Required	Required

- Membership agreement includes acceptance of by-laws, NDA, and IP agreement.
- More details are in the solicitation letters that will be widely distributed, and in the by-laws.

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We strongly encourage proposals be cooperatively developed with the System and Functional WGs

Research Project Areas

(priorities as agreed upon by HGST, STX and WDC)

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	HAMR	BPR	TDMR	MAMR	Adv PMR
Recoding Subsystem	high interest	high interest	intermediary interest	moderate interest	moderate interest
Heads	high interest	intermediary interest	moderate interest	intermediary interest	intermediary interest
Media	high interest	high interest	moderate interest	intermediary interest	intermediary interest
Signal Processing	moderate interest	high interest	intermediary interest	moderate interest	intermediary interest
Servo Mechanics	moderate interest	high interest	moderate interest	moderate interest	moderate interest
HDI	high interest	high interest	moderate interest	moderate interest	moderate interest
Tool Dev	high interest	high interest	moderate interest	moderate interest	moderate interest

- high interest
- intermediary interest
- moderate interest

HAMR: Heat-Assisted Magnetic Recording
BPR: Bit-Patterned Recording
TDMR: Two-Dimensional Magnetic Recording
MAMR: Microwave-Assisted Magnetic Recording
Adv. Topics: Advanced Perpendicular Magnetic Recording

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Time Table

Nov, 2010	Decision on continuation projects (Transitioning from INSIC, partially-funded projects, run from January – July, 2011)
Feb	Release of project proposal guidelines and prioritized list of project areas for each recording system Distribution of proposal solicitation letters
April 30	Proposal deadline
June 1	Decision on project selection
July 1	Start of projects/funding

Working Groups

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System Working Groups

Functional Working Groups

	HAMR	BPR	TDMR	MAMR	…
Heads					
Media					
Signal Processing					
Servo-Mechanics					
Head-Disk Interface					

Role of System Working Groups

- Define funding priorities for projects for each system area, and guide selection of projects.
- Ensure a coordinated portfolio of projects for each system area.
- Oversee activities in associated functional areas.
- Define roadmaps for each system area.

Role of Functional Working Groups

- Day to day management of university research projects across each functional area.
- Generate periodic status reports and summaries, and provide feedback to universities.
- Manage project proposal process within each functional area, subject to funding priorities and guidance provided by system area working groups.

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WG Members

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System WG

	Western Digital	Hitachi GST	Seagate	Marvell	LSI	TI	Xyratex
BPR Sys	Eric Champion, Paul Dorsey	Tom Albrecht*	Rene van de Veerdonk	Michael Madden	Jason Goldberg, George Mathew	Axel Alegre de la Soujeole	Byran Clark
HAMR Sys	Eric Champion, Matt Gibbons*	Barry Stipe	Jan Thiele	Greg Burd	Jason Goldberg, George Mathew	Axel Alegre de la Soujeole	Andrei Brunfeld, Giora Tarnopolsky
TDMR Sys	Eric Champion	Roger Wood	Fatih Erden*	Greg Burd	Jason Goldberg, George Mathew	Axel Alegre de la Soujeole	Giora Tarnopolsky
MAMR Sys	Mike Mallary*	Paul van der Heijden	Tim Rausch	Greg Burd	Jason Goldberg, George Mathew	Axel Alegre de la Soujeole	Giora Tarnopolsky

Functional WG

	Western Digital	Hitachi GST	Seagate	Marvell	LSI	TI	Xyratex	Fuji Electric	Veeco
Heads	Jishan Li, Matt Gibbons	Paul van der Heijden**	Tim Rausch*		Jason Goldberg		Nick Granger-Brown, Giora Tarnopolsky		
Media	Kumar Srinivassen, Antony Ajan	Dieter Weller*, Olav Hellwig	Jan-Ulrich Thiele**, Tim Klemmer		Jason Goldberg		Bryan Clark	Shinichi Nakazawa	
Signal Processing	Shayan Garani	Travis Oenning	Fatih Erden*, Bill Radich	Greg Burd**	George Mathew		Giora Tarnopolsky		
Servo-mechanics	Guoxiao Guo*	Toshiki Hirano	Barmeshwar Vikramaditya	Michael Madden	Xun Zhang	Jason Clark	Shirish Bahirat		
Head-Disk Interace	Yiao-Tee Hsia*, Bernhard Knigge	Bruno Marchon	Tom Pitchford**		Jason Goldberg		Mohammad Kazemi		
Tools									Adrian Devasahayam

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Critical areas of technical interest for HAMR

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Functional Area	Proposed Research Project		Priority (working group only)
		Sub-projects which could be split out from the major project	
System	System and component modeling to generate an analysis of HAMR performance. Desired modeling capabilities include micromagnetic, FEM, thermal, and optical. Produce a design range:		1
	a	The selection of a bit aspect ratio, BAR, range appropriate for HAMR at 4 Tbpsi. This range determines the track pitch and linear density ranges.	
	b	At points in the BAR range, model and define system (performance) requirements for the components. These will include: a) the thermal spot size, magnitude, and gradient; b) magnetic field magnitude and gradient; c) reader track width, sensitivity, and SNR; d) media grain size, Hk, Tc, and Tc sigma.	
	c	Including performance characteristics of specific designs would enhance the results. For this reason, the system analysis may include detailed modeling of the components such as NFT, writer, and reader. Collaboration with other participants is an alternative avenue for getting component characteristics for use in the system model. The characteristics may be the results of modeling or experiment.	
Media	Physics of magnetic materials at the Curie point		1
	a	Thermal Dynamic Modeling - what does magnetzation switching look like as a function of temperature and how do system noise metrics depend on the details of this switching.	
	b	Modeling of thermal refreeze (phase transition as media passes through the Curie Point)	
	c	Experimental verification of thermal refreeze (phase transition as media passes through the Curie Point)	
Media	Media Magnetic materials for HAMR application (Hk, Hk sigma, Tc, Tc sigma, ECC / graded / etc)		1
Media	Media with small grain size for HAMR application		1
Head	NFT and light delivery design		1
	a	Continuation of NFT modeling/design including input waveguide, pole, and media optical properties. Optimization of the NFT, such as alternative/innovative NFT designs, termperature and protrusion controll of NFT, HMS effect, coupling to the media, etc.	
	b	Modeling/design of light coupling/delivery into the slider	
	c	Waveguide materials : understanding the fundamentals/properties of materials given a set of head	
	d	Investigation of reliability	
HDI / media	HAMR lube, COC, and HDI		1
Head	NFT Metrology - it has become increasingly difficult to measure spot confinement on NFTs for HAMR. Metrology techniques are required. Characterization in the presence of media is highly desirable		1 or 2
Head	Head overcoat materials exploration: Effect of TAR heating as function of area effected, time and max temperature		2
Media	Media test and metrology for HAMR applications (i.e high Hk)		2
System	Interaction of HAMR with TDMR		3
System	Interaction of HAMR with BPMR		3

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BPR Proposed Technical Target Areas

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Technical Target Areas for University Research	WD	STX	HGST	Marv	LSI	Xyrtx	Prior.
BPM recording system simulation – write process	X	X	X	X	X	X	1
BPM recording system simulation – readback process	X		X	X		X	2
Coding and detection for BPM recording system		X		X	X		3
Write precompensation and mitigation of nonlinear and data-dependent effects in BPM writing				X		X	4
Experimental R/W analysis of BPM recording system					XX		4
Servo patterns and demodulation for BPM				X	X	X	3
Servo compensation for BPM-unique challenges (RRO/ NRRO, very high TPI, etc.)							6
Magnetic materials and properties for BPM							6
BPM island fabrication strategies (etch, ion implant, alternative) and effects on magnetic properties	X	X	X				3
Master pattern generation for BPM (e-beam, self-assembly, etc.)	X	X	X				3
Extendibility of nanoimprint lithography	X	X	X				3
Metrology for BPM fabrication and production						X	5
HDI and tribology for BPM							6

Method Used: Each company had 5 votes to indicate their top priority target areas. All companies weighted equally.

Detailed descriptions of each technical target area on following pages.

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Critical areas of technical interest for TDMR

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Proposal Area for TDMR		Priority
Recording Subsystem	RSS modeling for TDMR (head/media/read channel/etc)	1
Recording Subsystem	Data architecture and performance modeling (throughput & I/O per sec etc.)	1
Heads	Multiple reader design on the same slider to simultaneously read data at adjacent tracks	1
Signal Processing	Joint recovery of position and timing information	1
Signal Processing	Joint 2-D practical soft detection and coding design for TDMR	1
Signal Processing	Information theoretic 2-D channel capacity in more realistic scenarios (e.g. rectangular grain medium without bit/grain alignment, or Voronoi-based media) or in presence of residual timing and position errors	2
Heads	TDMR specific writer designs robust to conventional system parameters, like skew	2
Media	Media design with improved short range order (e.g. by self assembly)	3
Servo-Mechanics	TDMR specific servo mechanics design alternatives (e.g. low-skew to allow multiple reader design)	3
Tool Development	Manufacturing and metrology tools for multiple reader design on the same slider	3

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Priority: 1➔High, 2➔Medium, 3➔Low

Prioritized generic topics for MAMR

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MAMR PRIORITIES BY FUNCTIONAL AREA

Recording Subsystem	Study microwave preamp & connect for remote MAMR sources	8
Heads	Feasibility study (mfg & performanc of MAMR	10
Heads	Fabricate and measure the performance of Spin Torque Oscillators	10
Heads	Tools:Develop a tool to measure the microwave field ABS output from heads with a Spin Torque Oscillator or other source	8
Heads	Propose other (than STOs) MAMR sources & compare them to STOs	7
Heads	Calculate the field available from an STO	7
Heads	Tools: Measure intrinsic damping of Co/Pd ?Co/Pt multilayers for STOs.	6
Heads	Study the life time of MAMR sources	5
Media	Develop high Hk (i.e.> 22kO media granular MAMR films	9
Media	Measure the intrinsic damping constant for present recording media	8
Media	Tools: Switch media with microwaves with a micro-loop MAMR source	7
Media	Study of BPM + MAMR	6
Media	Calculate the effect of the media layer conductivities on MAMR	5
Signal Processing	Use signal processing of MAMR simulations to predict AD gai	9
Signal Processing	Characterize the media noise from MAMR writing (sim. &/or exp.)	7
Servo Mechanical	Simulate and or measure MAMR servo writing	4
Head Disk Interface	HDI- Calculate MAMR write spacing loss effect (spacing specification)	9

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Recommended Details to Include in Proposal

- Technical Description
- Timeline with milestones
- Itemized budget – travel, student salary, overhead, etc.
- Any linkage with related proposals
- Reporting plan
- IP agreement (exceptions to by-law)

Summary

ASTC

- Multi-level funding
  - Fully-funded projects for focus areas
  - Partially-funded projects to cover a broader range of topics
  - Travel grant to encourage interaction
- Develop proposals collaboratively
  - More so for fully-funded projects
- April 30, 2011 proposal deadline
  - IP agreement worked out

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Critical areas of technical interest for HAMR

Proposal Area for TDMR	Priority
Thermal Dynamic Modeling - what does magnetzation switching look like as a function of temperature and how do system noise metrics depend on the details of this switching.	
System and component modeling to generate an analysis of HAMR performance. Desired modeling capabilities include micromagnetic, FEM, thermal, and optical. Produce a design range:	
1 The selection of a BAR range appropriate for HAMR at 4 Tbpsi.	
2 At points in the BAR range, model and define system (performance) requirements for the components. These will include: a) the thermal spot size, magnitude, and gradient; b) magnetic field magnitude and gradient; c) reader track width, sensitivity, and SNR; d) media grain size, Hk, Tc, and Tc sigma.	
3 Including performance characteristics of specific designs would enhance the results. For this reason, the system analysis may include detailed modeling of the components such as NFT, writer, and reader. Collaboration with other participants is an alternative avenue for getting component characteristics for use in the system model. The characteristics may be the results of modeling or experiment.	
HMS dependence of optical efficiency, impact of heating to the head and media (head design group)	
Modeling of thermal refreeze (phase transition as media passes through the Curie	
Interaction of HAMR with TDMR	
Interaction of HAMR with BPMR	
Investigation of heating, protrusion, and reliability	
Capability of measuring NFT output (in the head list)	

Critical areas of technical interest for MAMR

ASTC

Proposal Area for TDMR		Importance
Heads	Feasibility study (mfg & performance) of MAMR	10
Heads	Fabricate and measure the performance of Spin Torque Oscillators	10
Media	Develop high Hk (> 22kOe) media granular MAMR films	9
Signal Processing	Use signal processing of MAMR simulations to predict AD gain	9
Head-Disk Interface	Calculate MAMR write spacing loss effect (spacing specification)	9
Recording Subsystem	Study microwave preamp & connect for remote MAMR sources	8
Heads	Develop a tool to measure the microwave field ABS output from heads with a STO or other sources	8
Media	Measure the intrinsic damping constant for present recording media	8
Heads	Propose other (than STOs) MAMR sources & compare them to STOs	7
Heads	Calculate the field available from an STO	7
Media	Switch media with microwaves with a micro-loop MAMR source	7
Signal Processing	Characterize the media noise from MAMR writing (sim. &/or exp.)	7
Heads	Measure intrinsic damping of Co/Pd and Co/Pt multilayers for STOs	6
Media	Study of BPM + MAMR	6
Heads	Study the life time of MAMR sources	5
Media	Calculate the effect of the media layer conductivities on MAMR	5
Servo Mechanical	Simulate and/or measure MAMR servo writing	4

Importance: 10 → high, 1 → low

Critical areas of technical interest for BPMR

ASTC

Technical Target Areas for University Research	Priority
BPM recording system simulation – write process	
BPM recording system simulation – readback process	
Coding and detection for BPM recording system	
Write precompensation and mitigation of nonlinear and data-dependent effects in BPM writing	
Experimental R/W analysis of BPM recording system	
Servo patterns and demodulation for BPM	
Servo compensation for BPM-unique challenges (RRO/NRRO, very high TPI, etc.)	
Magnetic materials and properties for BPM	
BPM island fabrication strategies (etch, ion implant, alternative) and effects on magnetic properties	
Master pattern generation for BPM (e-beam, self-assembly, etc.)	
Extendibility of nanoimprint lithography	
Metrology for BPM fabrication and production	
HDI and tribology for BPM	

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