

Western Digital®

EAMR for Future Data Storage Growth

*Xiaodong (Carl) Che @ 2018 Library of
Congress Storage Architectures Meeting
September, 2018*



Forward-Looking Statements

Safe Harbor | Disclaimers

This presentation contains forward-looking statements that involve risks and uncertainties, including statements regarding our intellectual property portfolio and HDD products and technologies. Forward-looking statements should not be read as a guarantee of future performance or results, and will not necessarily be accurate indications of the times at, or by, which such performance or results will be achieved, if at all. Forward-looking statements are subject to risks and uncertainties that could cause actual performance or results to differ materially from those expressed in or suggested by the forward-looking statements.

Key risks and uncertainties include volatility in global economic conditions, business conditions and growth in the storage ecosystem, impact of competitive products and pricing, actions by competitors, unexpected advances in competing technologies, difficulties or delays in manufacturing, and other risks and uncertainties listed in the company's filings with the Securities and Exchange Commission (the "SEC") and available on the SEC's website at www.sec.gov, including our most recently filed periodic report, to which your attention is directed. We do not undertake any obligation to publicly update or revise any forward-looking statement, whether as a result of new information, future developments or otherwise, except as required by law.

The Evolving Role of Data

Creating the data-driven economy, government and civilization

Richness

Data as a record



| | | | | | | |
|-------|-------|-------|-------|-------|-------|---|
| 164 | 94 | 45 | 73 | 38 | 99 | 2 |
| 166 | 172 | 54 | 91 | 85 | 40 | 7 |
| | | 10 | 30 | 62 | 49 | |
| 896 | 2.132 | 2.390 | 3.850 | 2.175 | 1.280 | |
| 2.845 | 1.001 | 1.920 | 1.748 | 2.387 | 2.5 | |
| 1.133 | 1.308 | 3.928 | 3.176 | 2.514 | 7 | |
| 4 | 2.697 | 1.710 | 1.287 | 1.272 | 2.553 | |
| 02 | 1.844 | 1.725 | 2.110 | 1.928 | 1.56 | |
| 99 | 1.903 | 1.442 | 3.292 | 3.553 | 1.56 | |
| 032 | 1.198 | 2.453 | 1.272 | 1.928 | 1.56 | |
| | | 298 | | | | |
| | | 158 | | | | |
| | | 324 | | | | |

INVOICE

647-444-1234 1 Your Address
your@email.com yourwebsite.com City, State, Country ZIP CODE

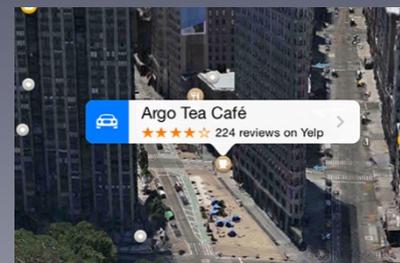
| | | |
|----------------------|----------------|---------------|
| Billed To | Invoice Number | Invoice Total |
| Client Name | 000000 | \$4520.00 |
| 1 Client Address | Date Of Issue | |
| City, State, Country | 10/07/14 | |
| ZIP CODE | | |

| Description | Unit Cost | Qty / Hr Rate | Amount |
|---|-----------|---------------|--------|
| Your Item Name | \$1000 | 1 | 1000 |
| <small>Item description goes here</small> | | | |

Data as communication



Data as efficiency



Data as currency



Value

Diverse and Connected Data Types

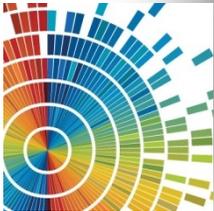
Tight coupling between Big Data and Fast Data

Big Data

Insight



Prediction



Prescription



Scale

Fast Data

Mobility



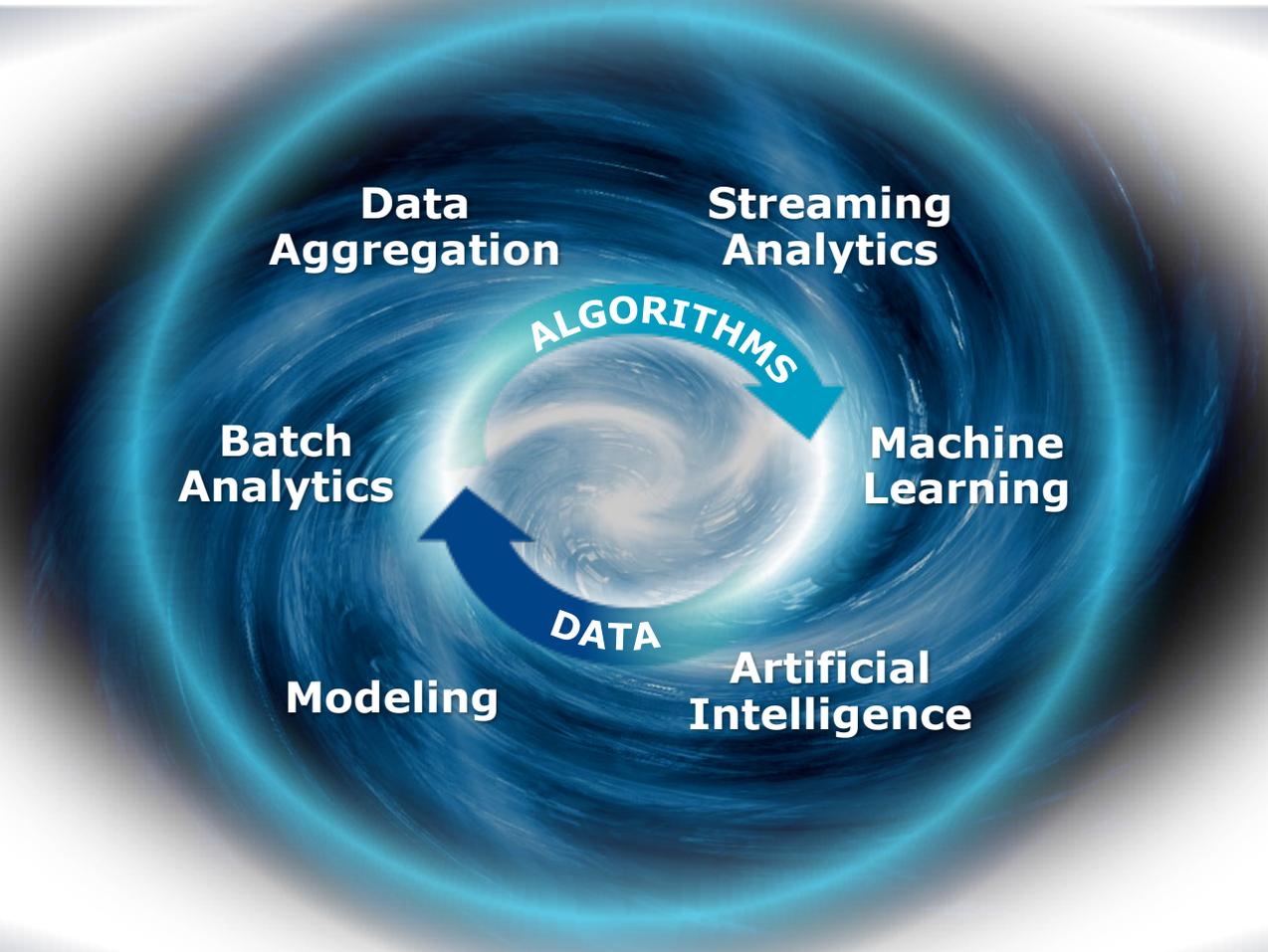
Real-time Results



Smart Machines



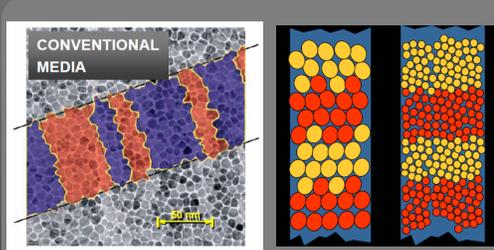
Performance



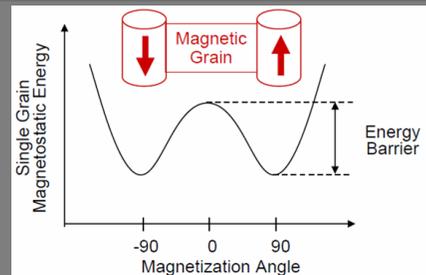
Energy Assisted Magnetic Recording is Required

The physics behind the EAMR

Scaling Capacity



Switching Challenge

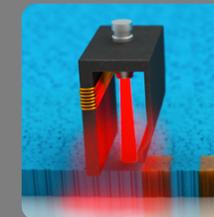


Magnetic Stability

Magnetic Stability:

$$\frac{\text{energy barrier}}{\text{thermal energy}} \propto \frac{\text{anisotropy} \times \text{volume}}{k_B \times \text{temperature}} = \frac{K_u V}{k_B T} > 70$$

Energy Assist



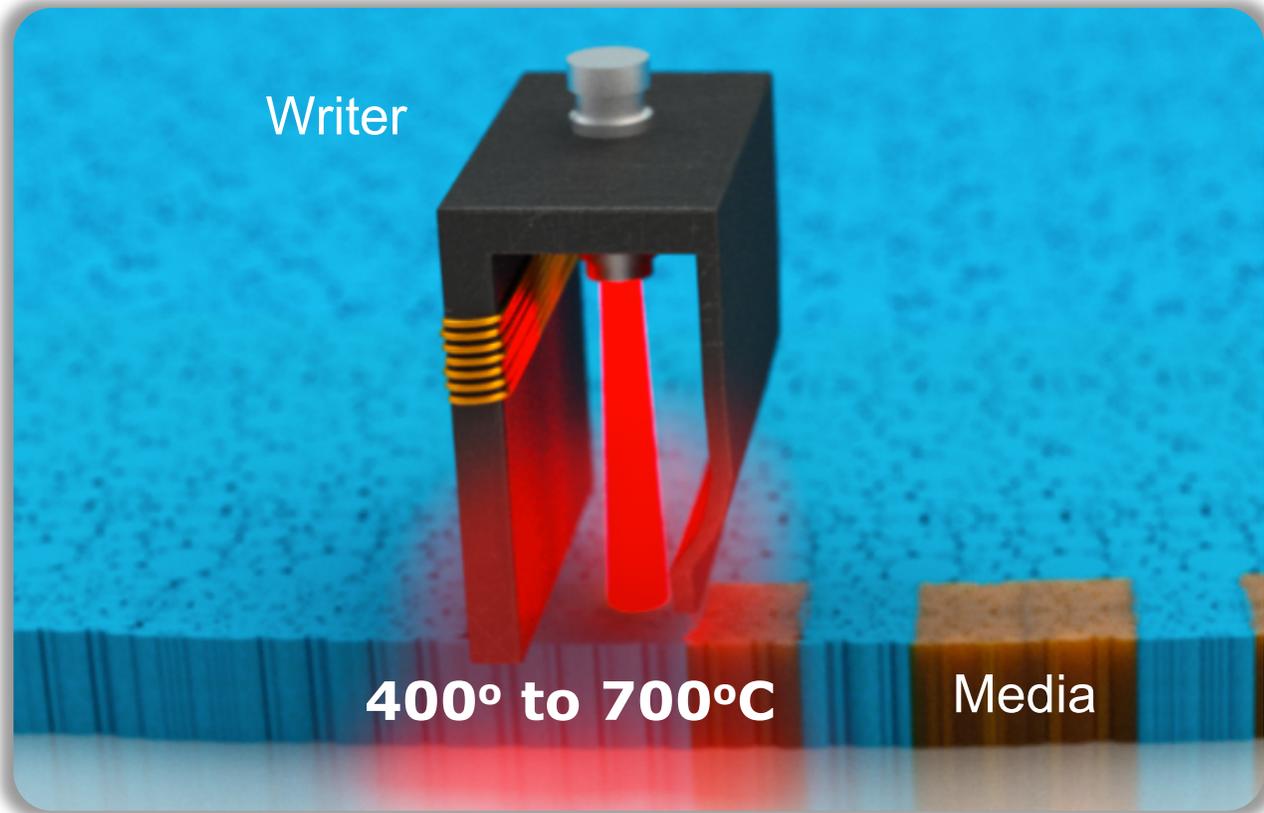
HAMR



MAMR

Scaling beyond PMR requires energy assisted recording

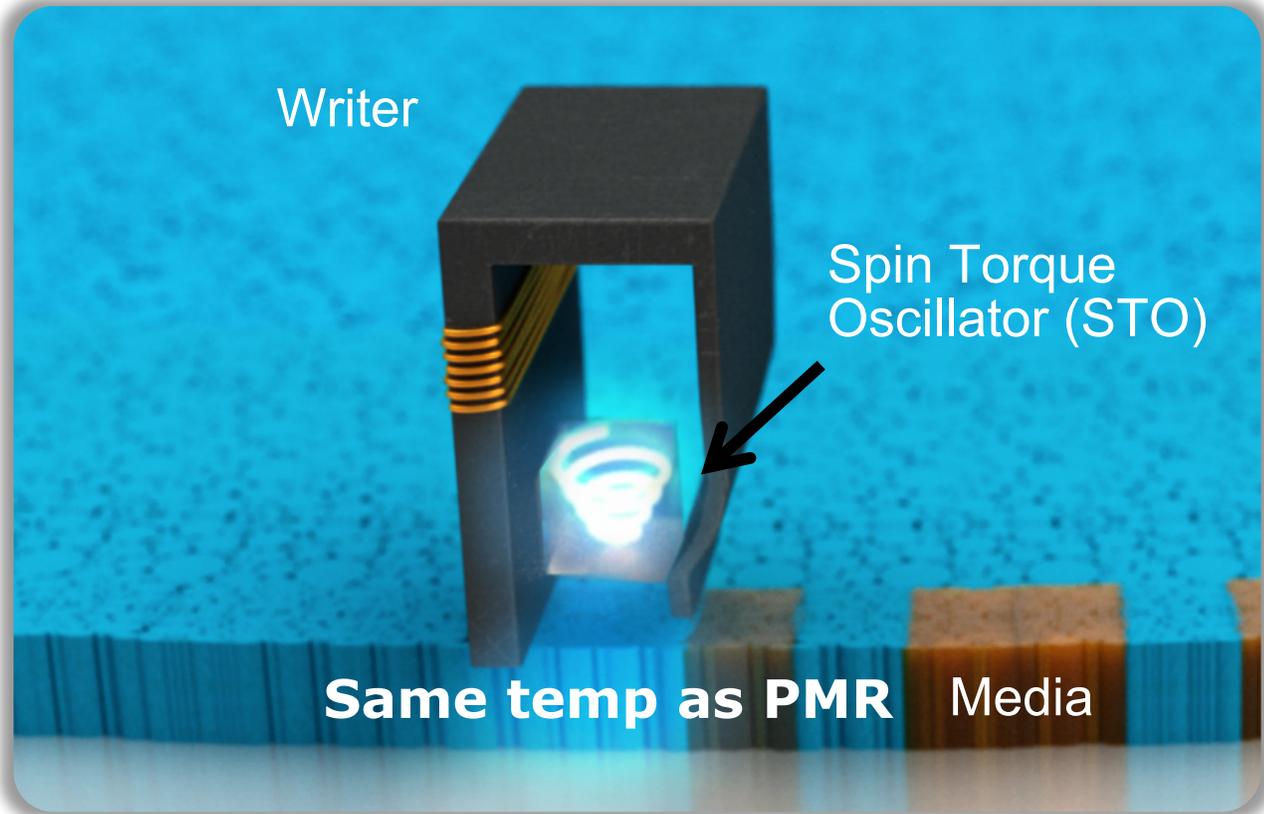
How HAMR Works



- Heat from laser lowers the energy barrier to write on media and magnets can be switched with smaller magnetic field
- When media cools, the data is harder to erase

HAMR comes with reliability, cost and complexity challenges

How MAMR Works

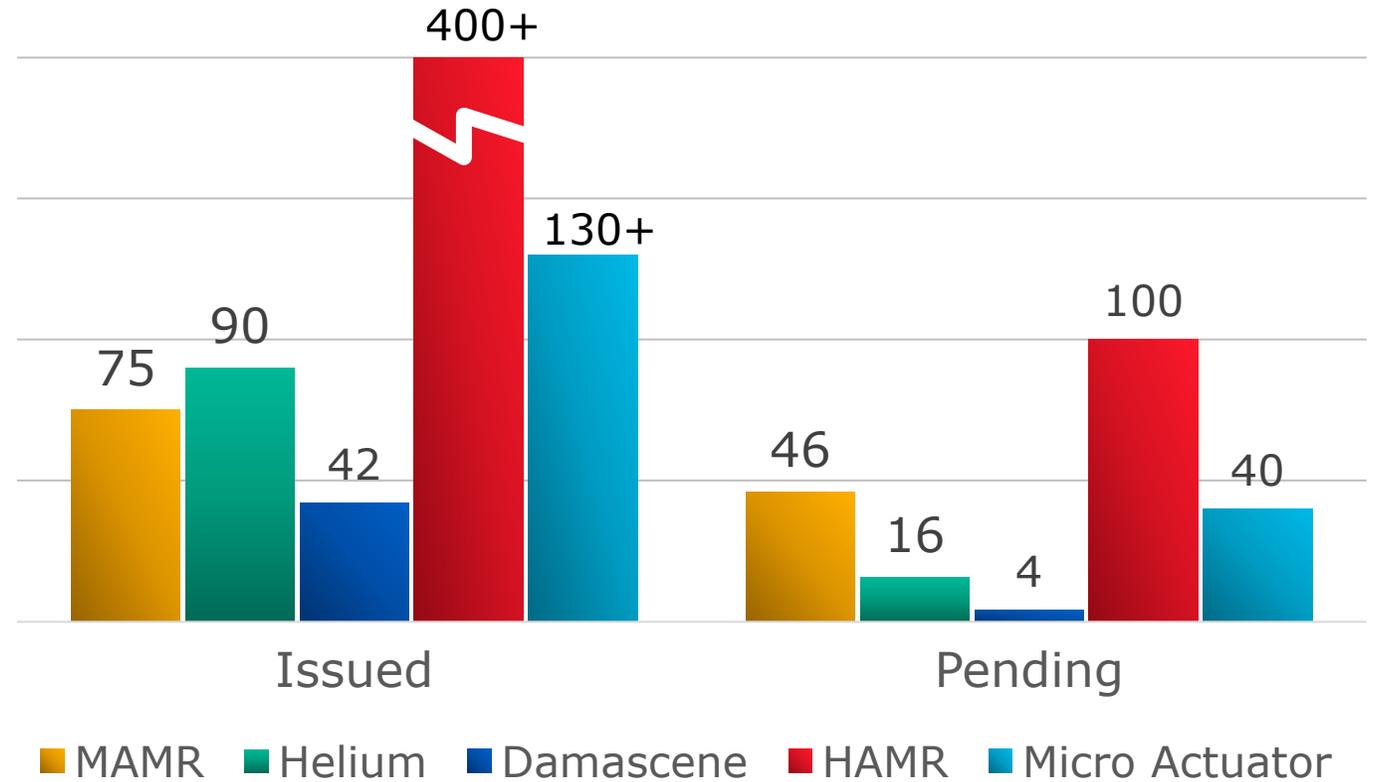
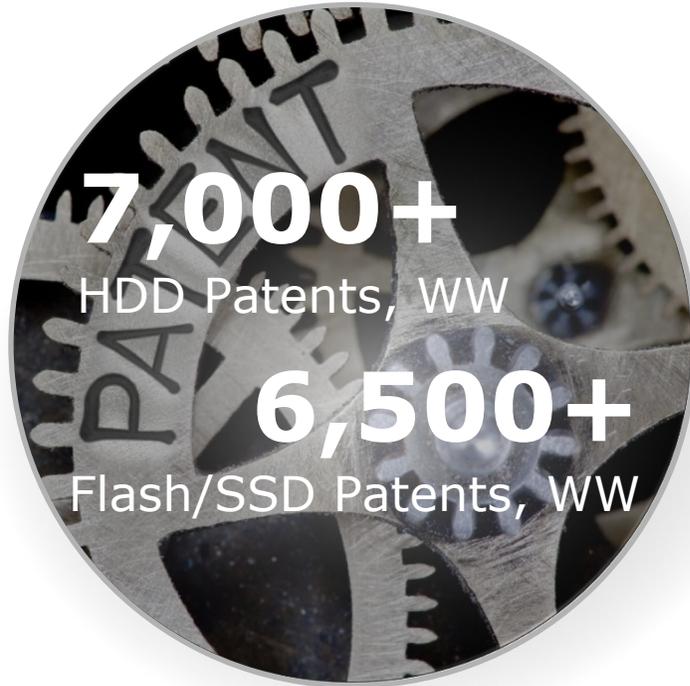


- Microwave fields emitted by a Spin Torque Oscillator (STO) located near the write pole allows writing of perpendicular media at lower magnetic fields

MAMR achieves density without reliability, cost or complexity challenges

Strong Intellectual Property Portfolio

EAMR Patent Portfolio Continues to Grow



Commitment to technology leadership and fundamental research

Capacity Enterprise HDDs are the Foundation

EAMR technology will enable 40TB by 2025 and even higher beyond

EAMR will Fuel the Next Decade of Big Data



Western Digital.

Thank You!

