Flash Memory Summit

# Getting the Most Out of Performance Specs:

## Top Ten Points for Embedded Designers

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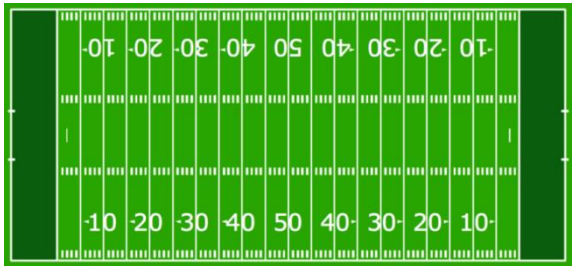
# Forward statement

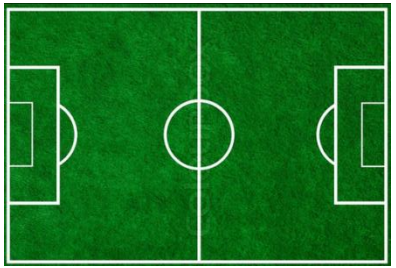
- Paper written during the Football (Soccer) World Cup

- Performance in sports, but also for Flash memory storage systems

# Anyhow, what is Football?

- The importance of semantic



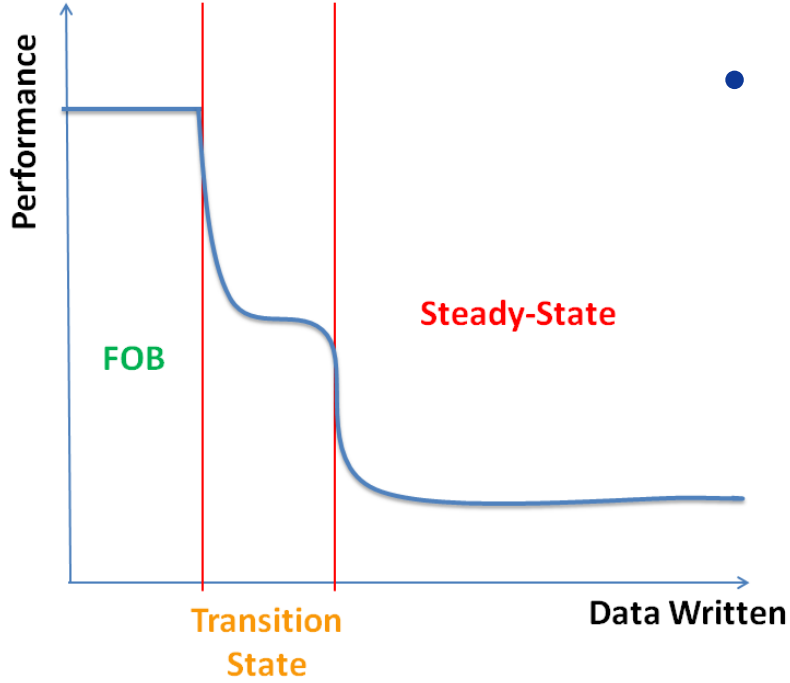
- Same situation to define and report performance for a NAND Flash storage.

# #10. Sprinting **vs** distance running

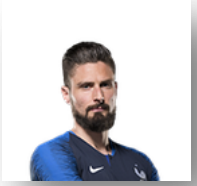
- FOB* vs steady-state Flash storage performance
  - No standard benchmark
  - Check performance after drive written 2 or 3 times
  - Trade-off performance **vs.** endurance (ask us)


* FOB: Fresh-Out-of-the-Box

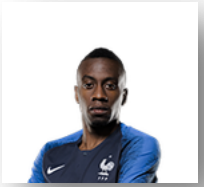
# #9. Performance through the match



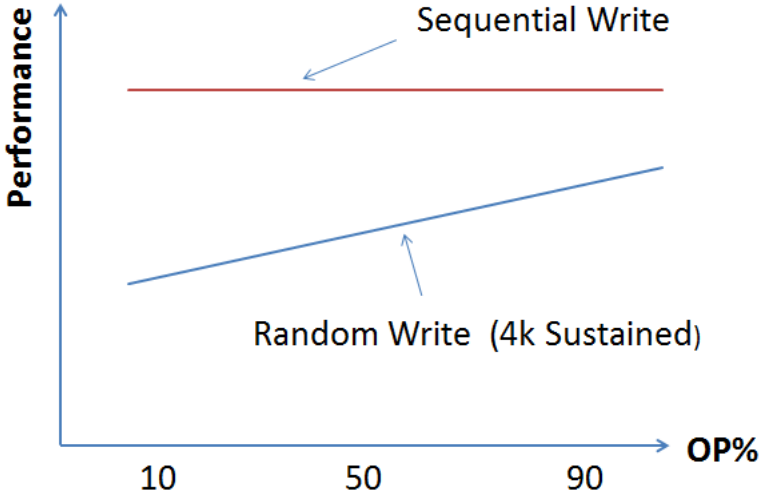

- Workload is key
  - Steady state dependency on workload
  - Use-Case Tracker tool available to characterize your workload (ask us)



# #8. Performance factor



- Overprovisioning (OP) as a possibility
  - lower WAF* / longer lifetime
  - Better random performance
  - TBW** with different OP?
  - Lifetime Estimation Tool (ask us)

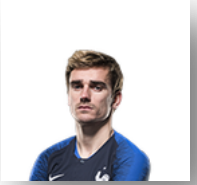



* WAF: Write Amplification Factor
** TBW: Total Bytes Written

# #7. Resting periods

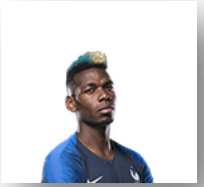
- Static vs. Dynamic data
- Different FTL* configurations
  - Lower WAF and increased Lifetime
  - Effect on reliability
- Consider Dynamic Data Refresh (patented)

  & Read Disturb Management (ask us)



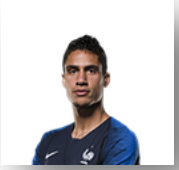
* FTL: Flash Translation Layer

# #6. Your health first !



- Health monitoring throughout lifetime
  - Diagnostics
  - Reports
  - Warnings
  - Maintenance schedule
- hySMART ® diagnostic tool (ask us)

# #5. Placed or counter attacks



- Sequential or Random performance
  - Use-case importance
  - Page Base Mapping vs. Block Base Mapping
  - PBM vs. BBM performance comparison (ask us)
  - hyMap®

    > 10x IOPS increase, lower WAF, longer lifetime

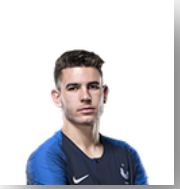
# #4. Approved performance boosters

- Many options depending on use case
  - Early Acknowledgment
  - SLC/pSLC/MLC/TLC/pMLC modes
  - Read Disturb Management, etc…
  - Latency and start-up time (Instant-up)
- Controller vendor relationship is key (talk to us)

# #3. Short cuts for performance

- MLC and TLC Flash memories can be used in pseudo modes (pSLC or pMLC)
  - Enhanced performance
  - Reliability at the cost of drive capacity
  - Is it right for you?
- Option for industrial application ($$/Gb ⬇)

# #2. Prevent heart failure!

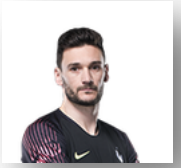


- Reliability trade-off against performance
  - Sudden Power Fail robustness

| TOTAL LOSS OF DRIVE | MANAGEMENT DATA DISTURBED | HIGH \| SMALL USER DATA DISTURBED | NO IMPACT |
|---|---|---|---|

  - Intensive test
  - Guaranteed Robustness (ask us)

# #1. Setup your objectives



- Your requirements

| | Performance | Reliability | Price |
|---|---|---|---|
| Consumer | ++ | + | +++ |
| Industrial | + | +++ | ++ |
| Enterprise | +++ | ++ | + |

  - System bottlenecks? TCO?
- Industrial controller might be right for you…

# Conclusion

- Beware of advertised performances
- Define your use case & requirements
- Consider the TCO
- Check industrial controllers

- Ask the tough questions !

# 2018 FIFA World Cup Champions


## Objectives met:

Assembly of many (player) options, strong management

→ winning combination

Same as:

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Flash Memory Summit

Revisit Hyperstone's FMS 2018 presentation at:

https://www.hyperstone.com/en/Flash-Memory-Summit-Presentation-2018-1279.html

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