



Flash Memory Summit

Applying Swarm Intelligence to Optimize Flash Utilization

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ioFABRIC context



Always-On
Evergreen
Cost-optimized
Simple to use

Data Fabric

Isilon
DAS
Array
RAM
San Jose Data Center

Amazon

Azure

PMEM
Array
VNX
London Data Center



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Problem Statement

Many applications



Available
Resilient
Elastic



Policy-Driven
Differentiated

Each its own:
perspective,
requirements,
objectives

Many shared
storage resources



Each its own:
performance,
capacity,
features,
best use



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Solution Options

You CANNOT run a global optimizer

Must hand tune or overprovision or ...

Give it life!

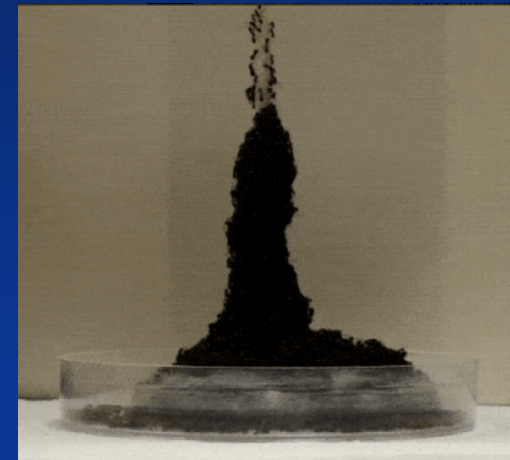


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Swarm Intelligence

Collective simple behaviors creates emergent complex behavior ~ Intelligence

- Element** Ant
- Stimulus** > 3 ants on my back
- Action** Leave to rest and return later
- Interaction** Support ants above me



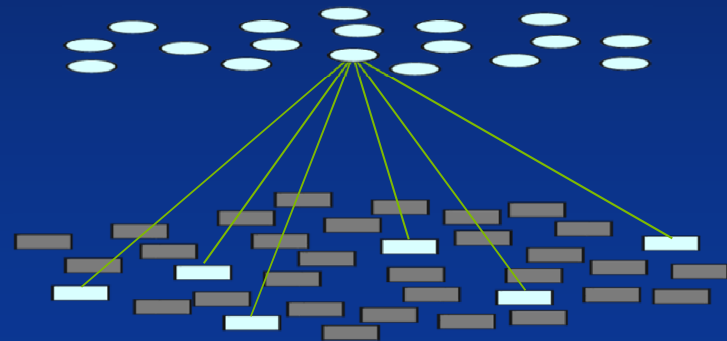


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The Volume – local optimization

Reach and maintain objectives given resources

Element	Volume manager
Stimulus	I/O telemetry
Action	Move data
Interaction	Competition for space and I/O capacity



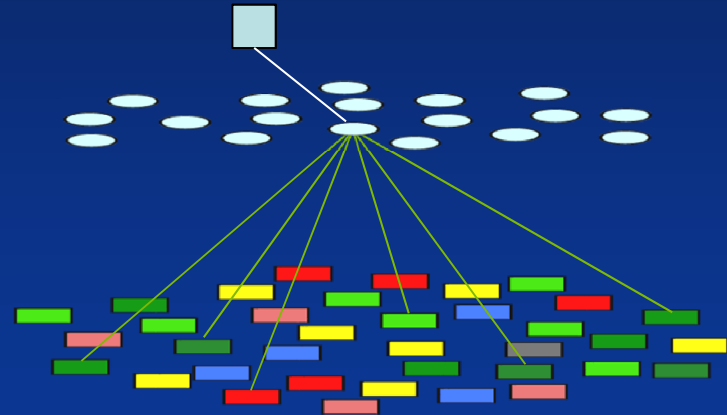


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The Workload – global optimization

Change resources available to Volumes

Element	Volume resource manager
Stimulus	Volume is starving or steady
Action	Change eligible resources
Interaction	Change competition for individual resources





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Optimize Flash Utilization

Flash is shared

I/Os and Data accumulate until there is no more headroom

Devices are used for their strength: read-preference, write-preference, or change over time as they wear

Stale data is moved off flash to cheaper media

Biased to using existing in-use resources

Very efficient data fabric



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Advantages for the Data Fabric

Avoid issues caused by homogeneous algorithms

Small, continuous, concurrent corrections

Deals naturally with a dynamic world

Self-managing infrastructure