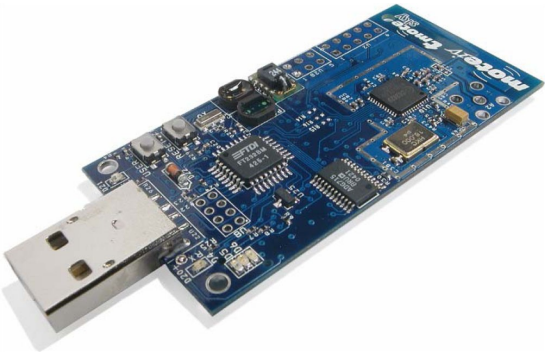
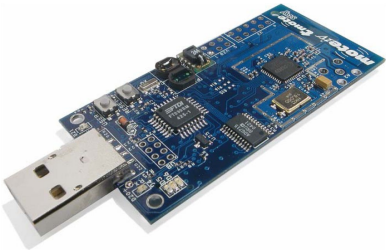
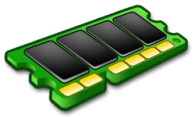
The Case for Power-Agile Computing

Geoffrey Challen (SUNY Buffalo), Mark Hempstead (Drexel University)



DELL





Computer Science Genius TODO

- Selecting devices for each application

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- Selecting devices for each application
- Measuring application efficiency

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- Measuring application efficiency
- Predicting device performance for a given application

Computer Science Genius TODO

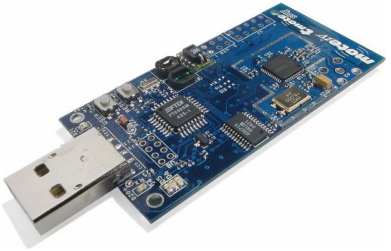
- Selecting devices for each application
- Measuring application efficiency
- Predicting device performance for a given application
- Executing transitions between devices

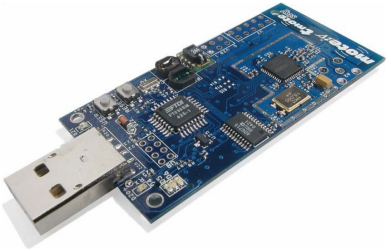
Shazam!

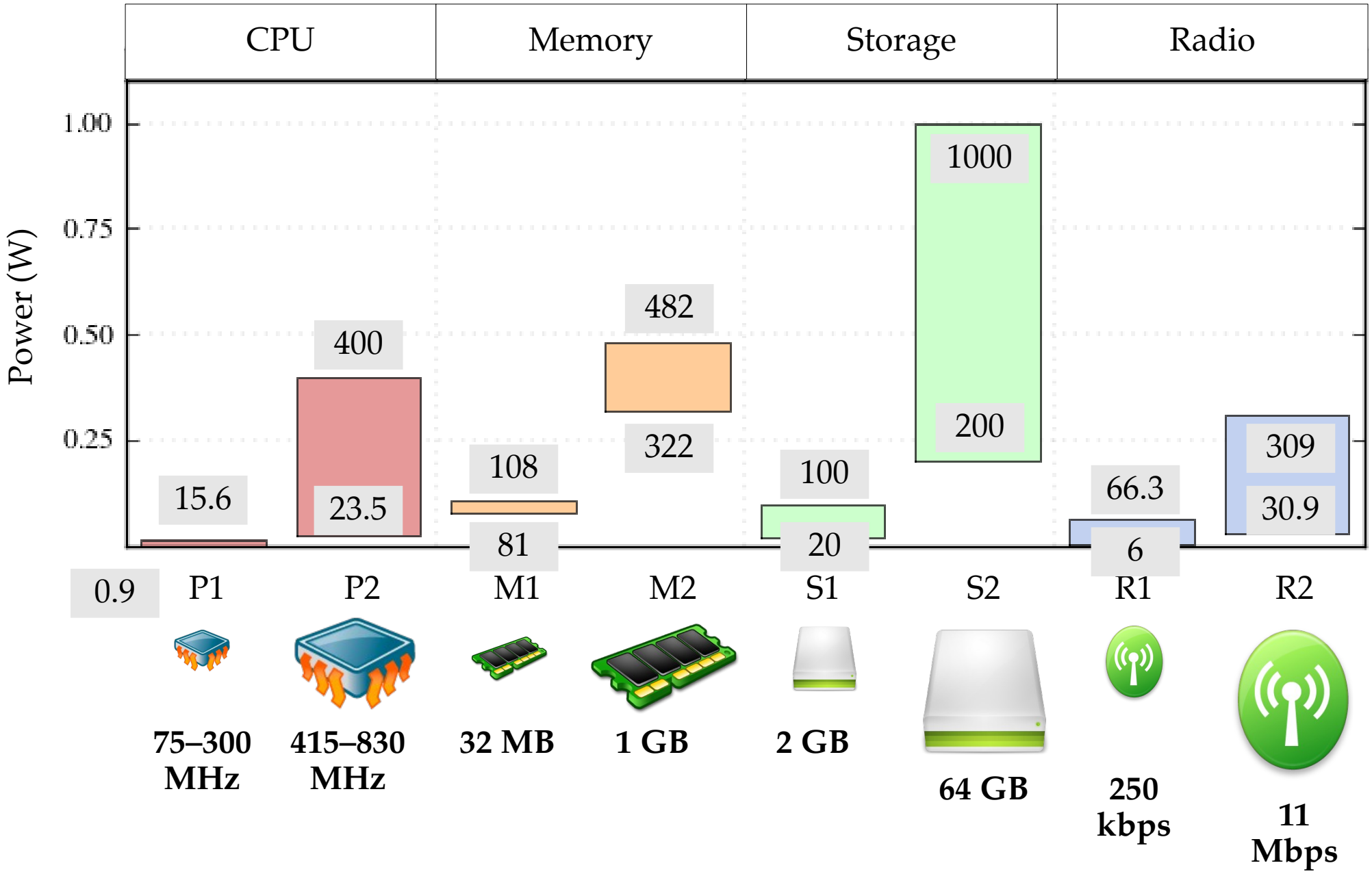
Shazam!
BLD018265 [RF] © www.visualphotos.com

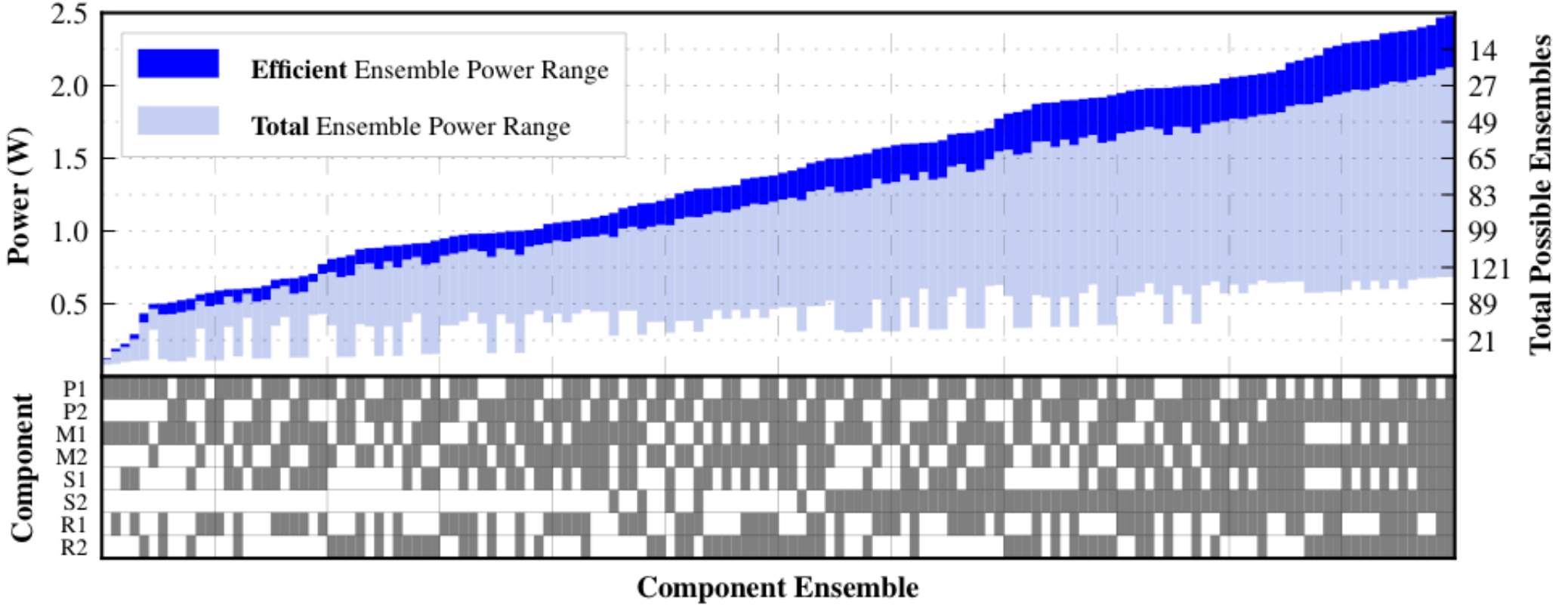
Shazam!

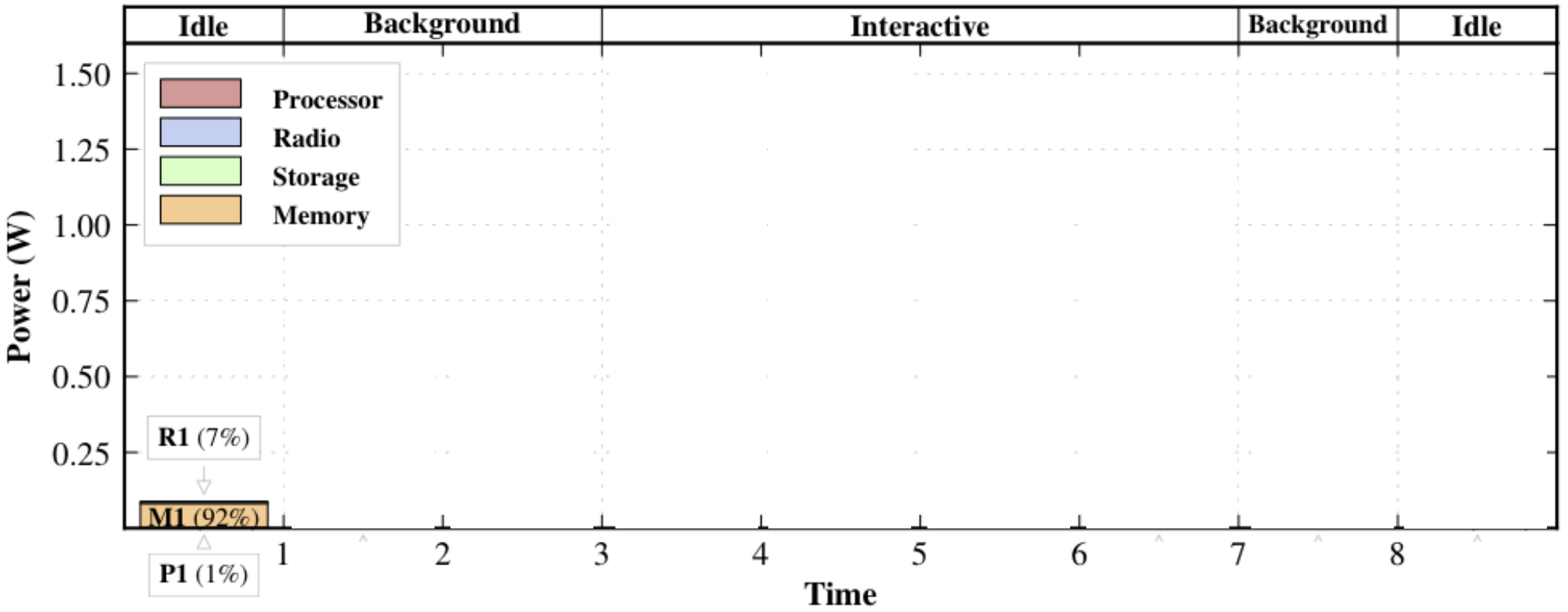
Shazam!






CPU
Memory
Storage
Radio
Power (W)
1.00
0.75
0.50
0.25
15.6
400
23.5
108
81
482
322
100
20
1000
200
66.3
6
309
30.9
0.9
P1
P2
M1
M2
S1
S2
R1
R2
75–300 MHz
415–830 MHz
32 MB
1 GB
2 GB
64 GB
250 kbps
11 Mbps


2.5
2.0
1.5
1.0
0.5
Power (W)
Efficient Ensemble Power Range
Total Ensemble Power Range
14
27
49
65
83
99
121
89
21
Total Possible Ensembles
Component
P1
P2
M1
M2
S1
S2
R1
R2
Component Ensemble


Idle
Background
Interactive
Background
Idle
Processor
Radio
Storage
Memory
Power (W)
1.50
1.25
1.00
0.75
0.50
0.25
R1 (7%)
M1 (92%)
P1 (1%)
1
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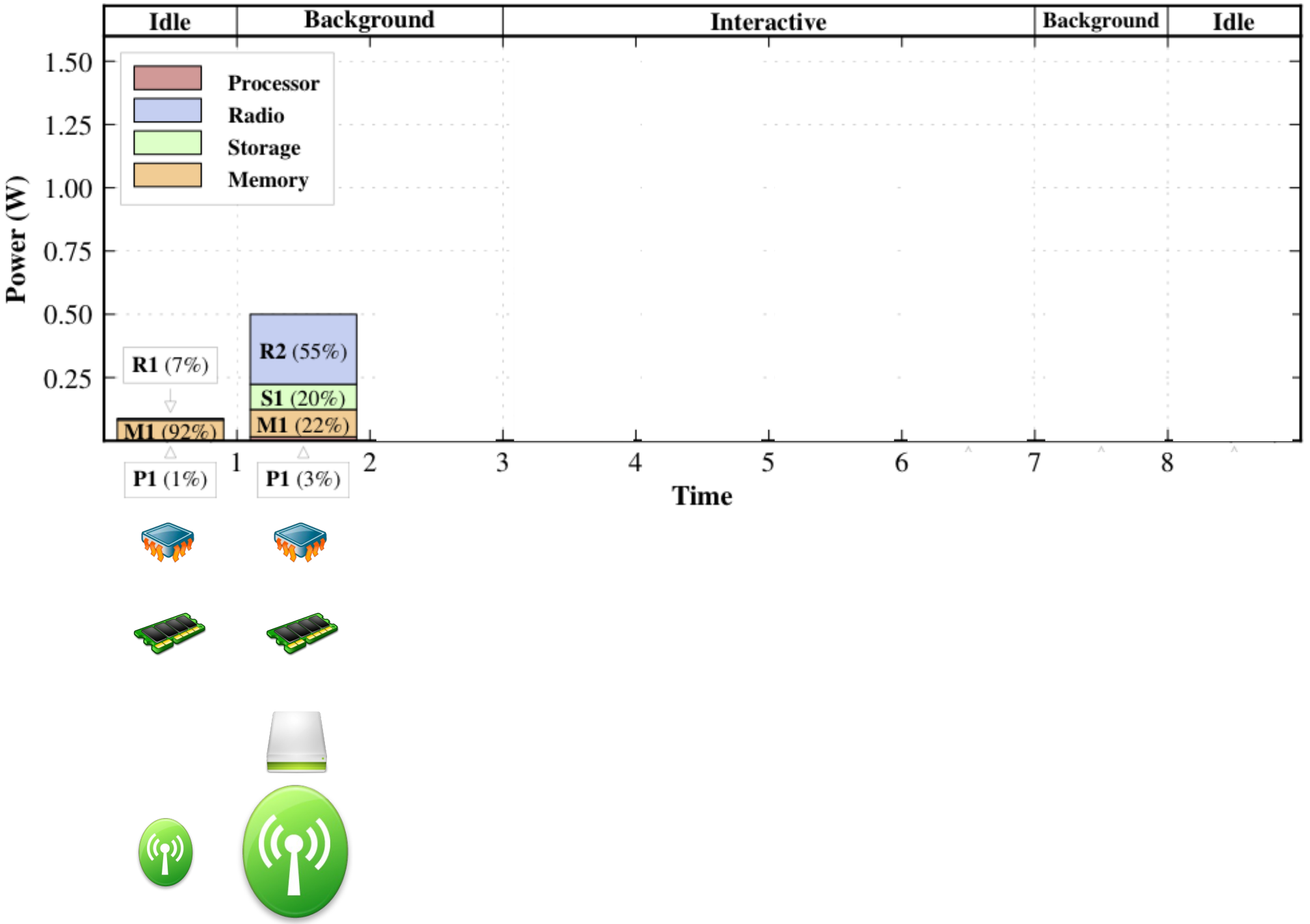
7
8
Time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Interactive
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Idle
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Memory
Power (W)
1.50
1.25
1.00
0.75
0.50
0.25
R1 (7%)
M1 (92%)
P1 (1%)
R2 (55%)
S1 (20%)
M1 (22%)
P1 (3%)
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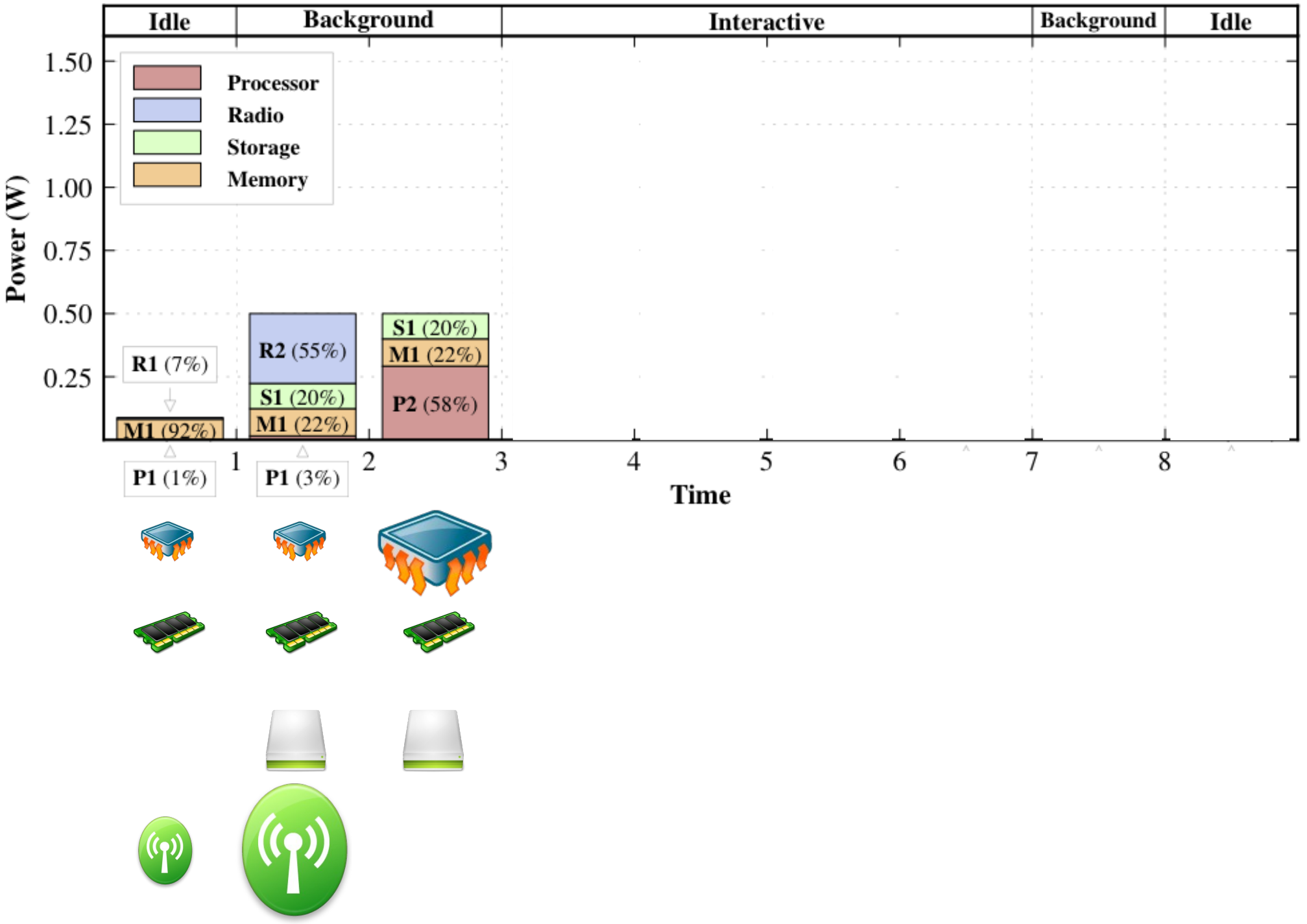
Time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P1 (1%)
R2 (55%)
S1 (20%)
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P1 (3%)
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M1 (22%)
P2 (58%)
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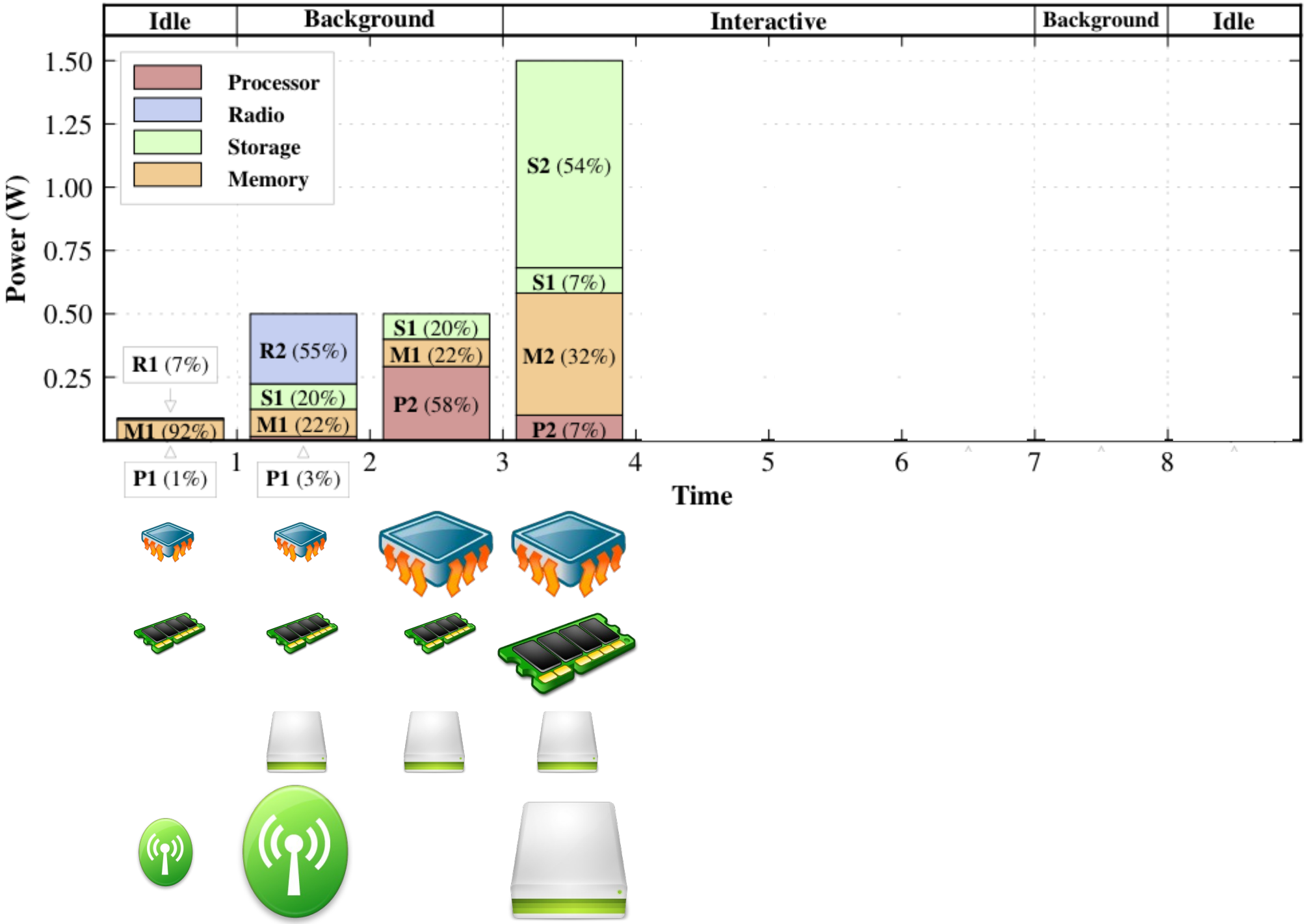
Time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P2 (58%)
S2 (54%)
S1 (7%)
M2 (32%)
P2 (7%)
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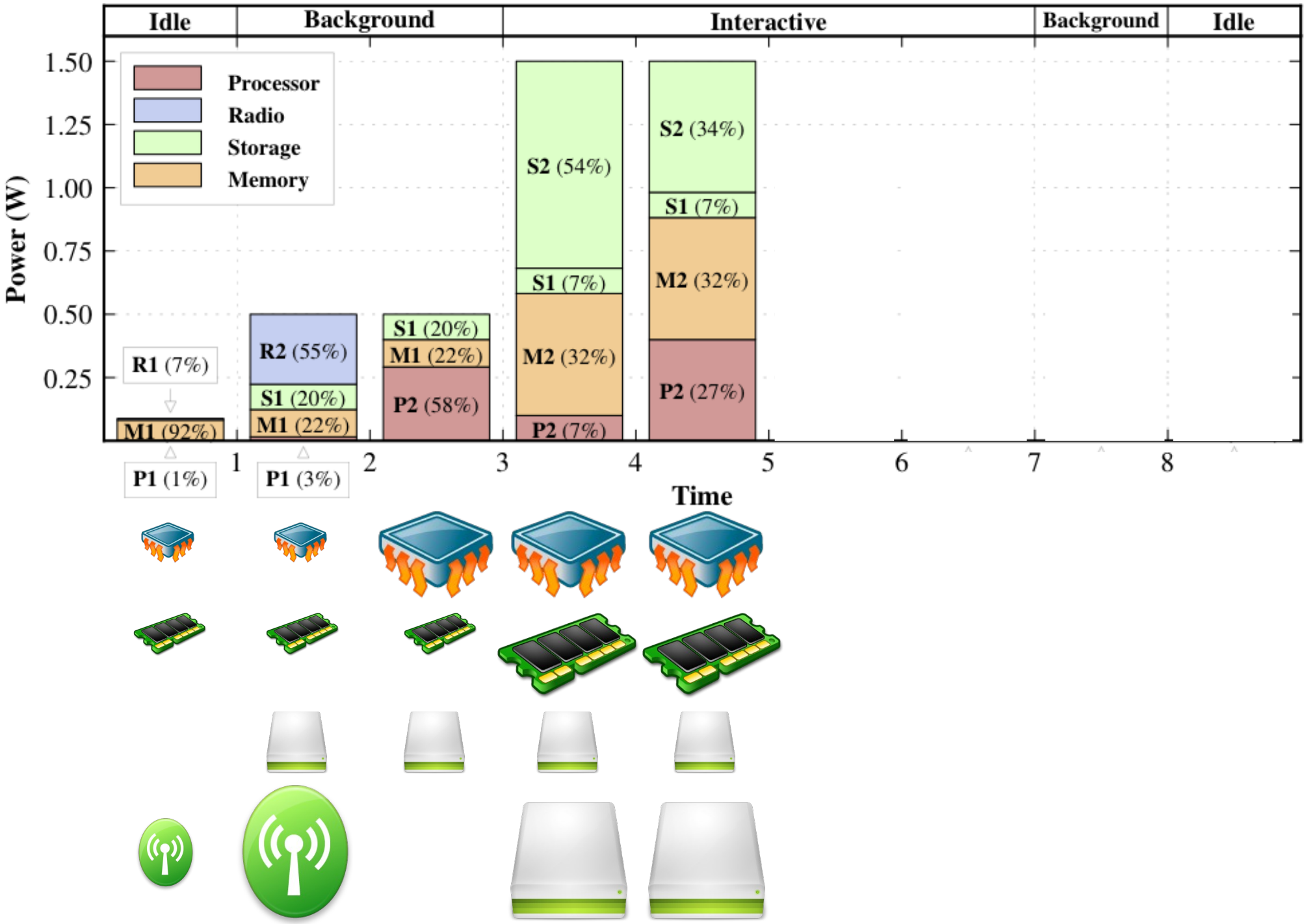
Time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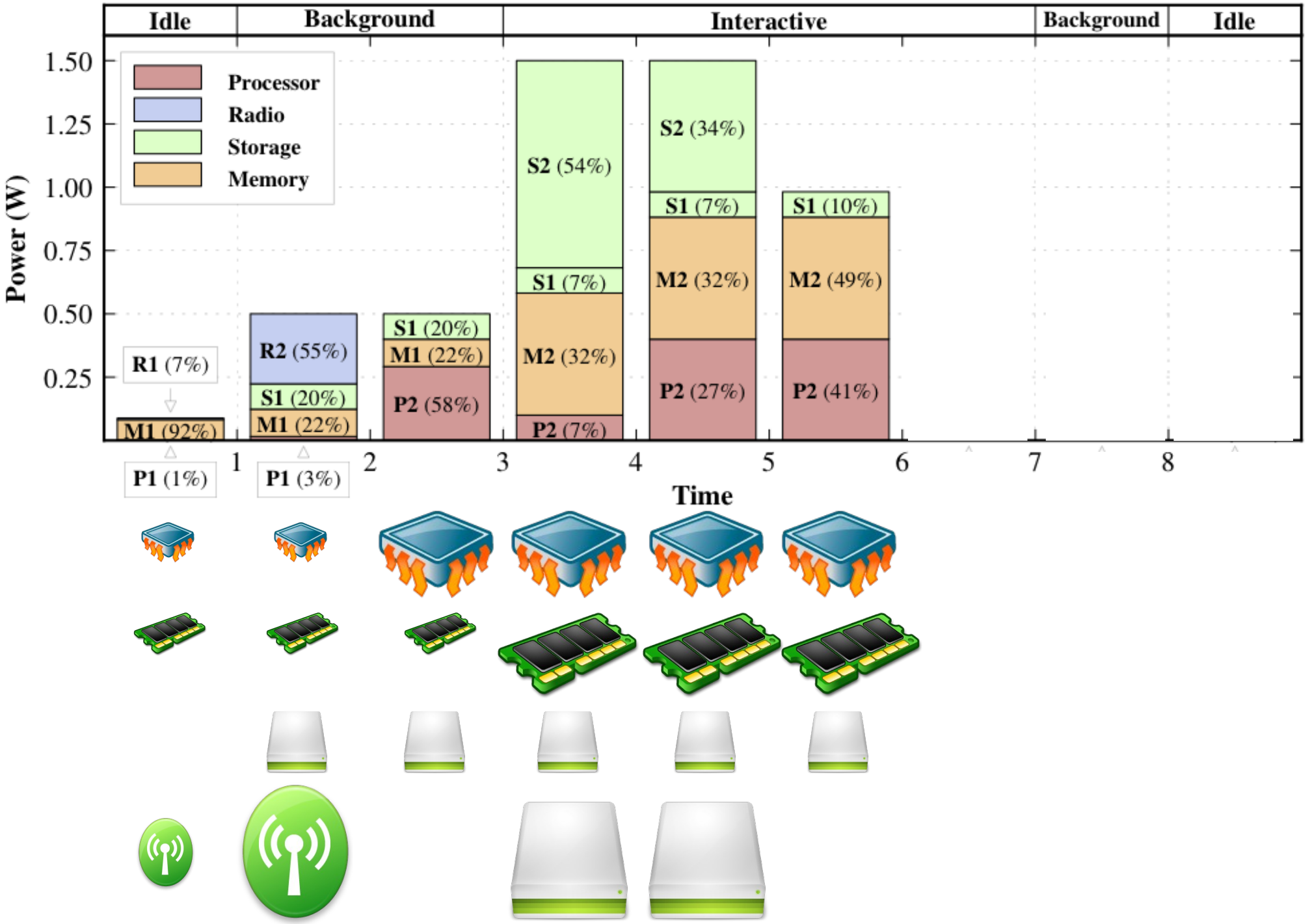
Time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M2 (32%)
P2 (7%)
S2 (34%)
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M2 (32%)
P2 (27%)
S1 (10%)
M2 (49%)
P2 (41%)
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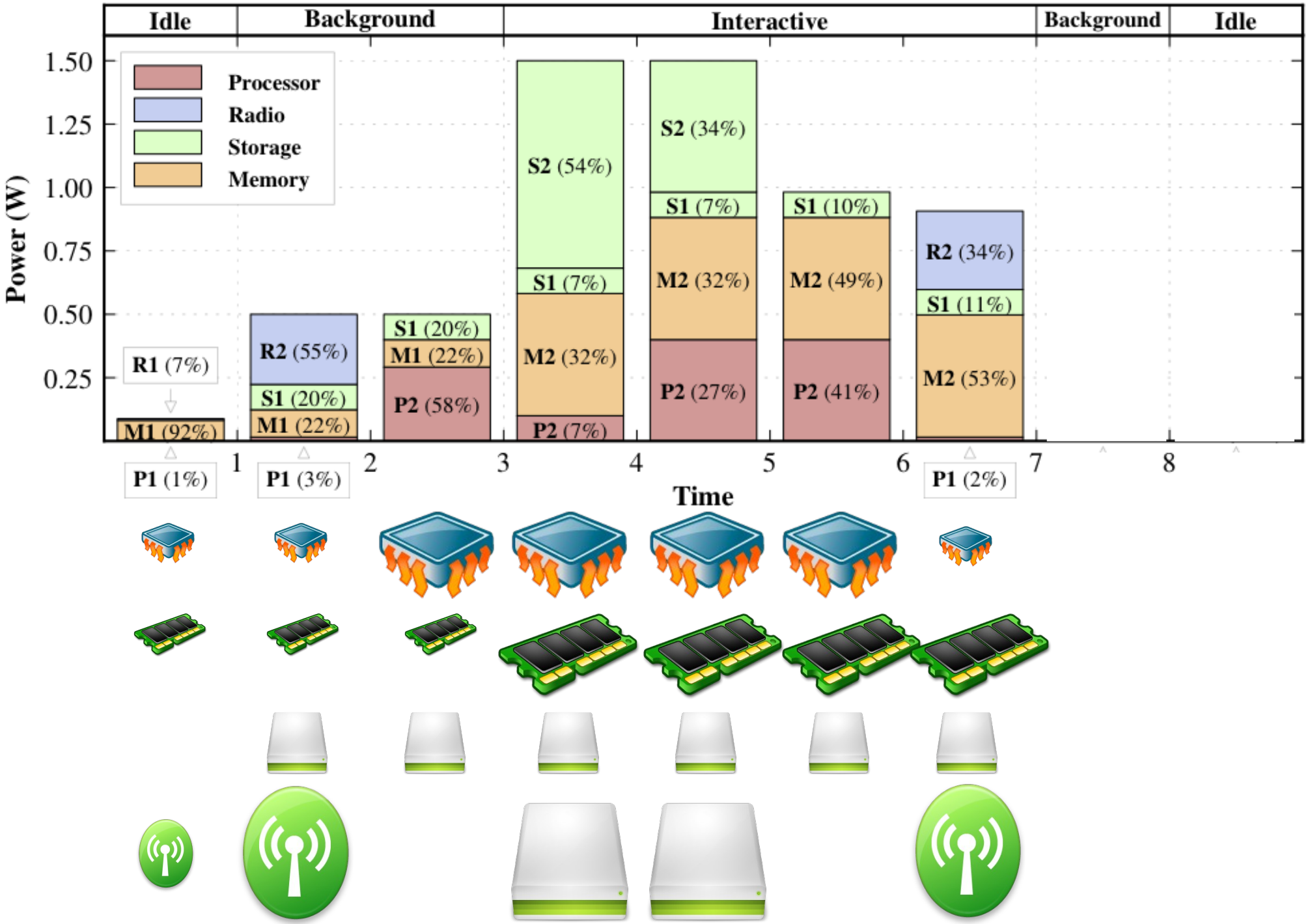
Time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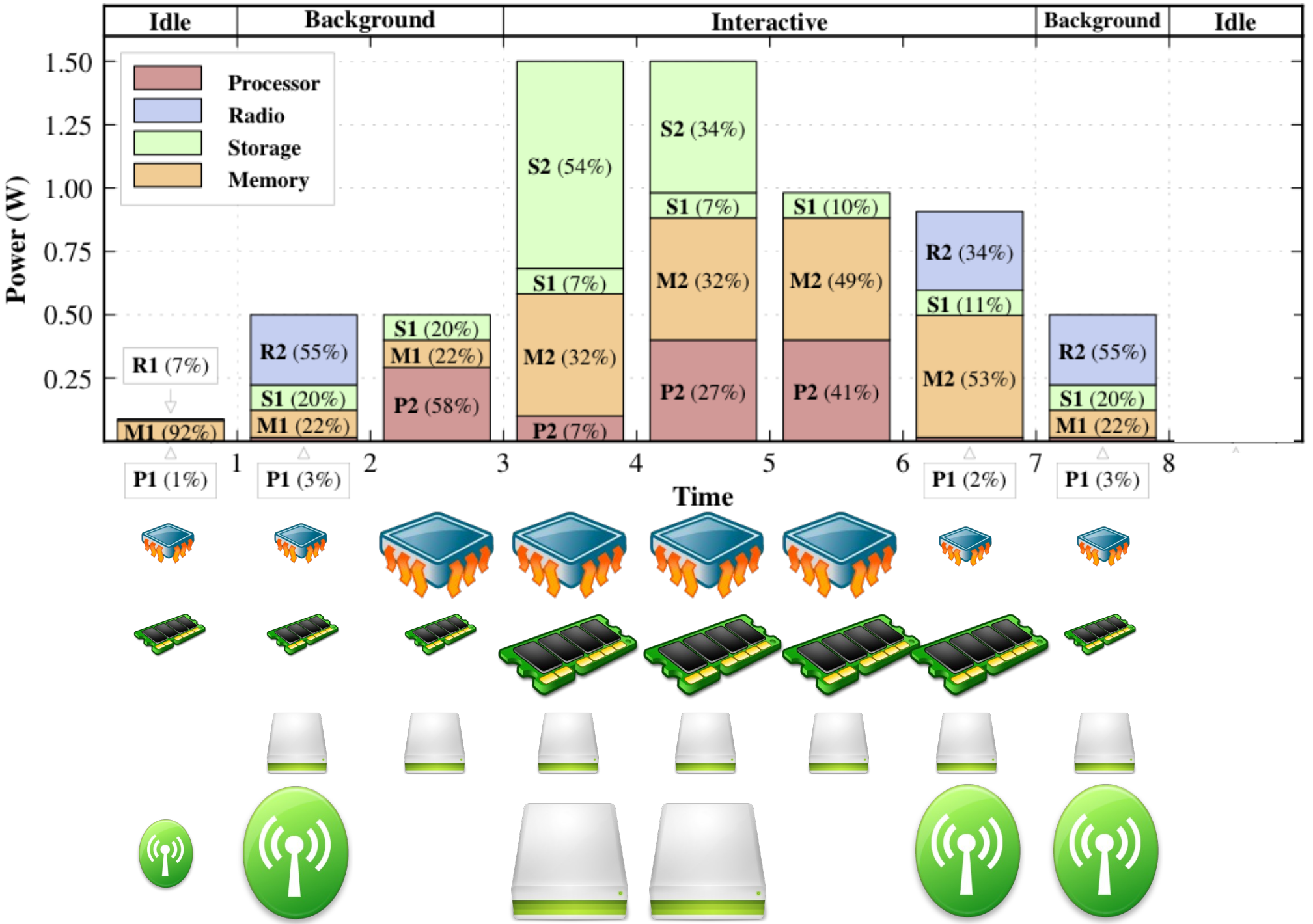
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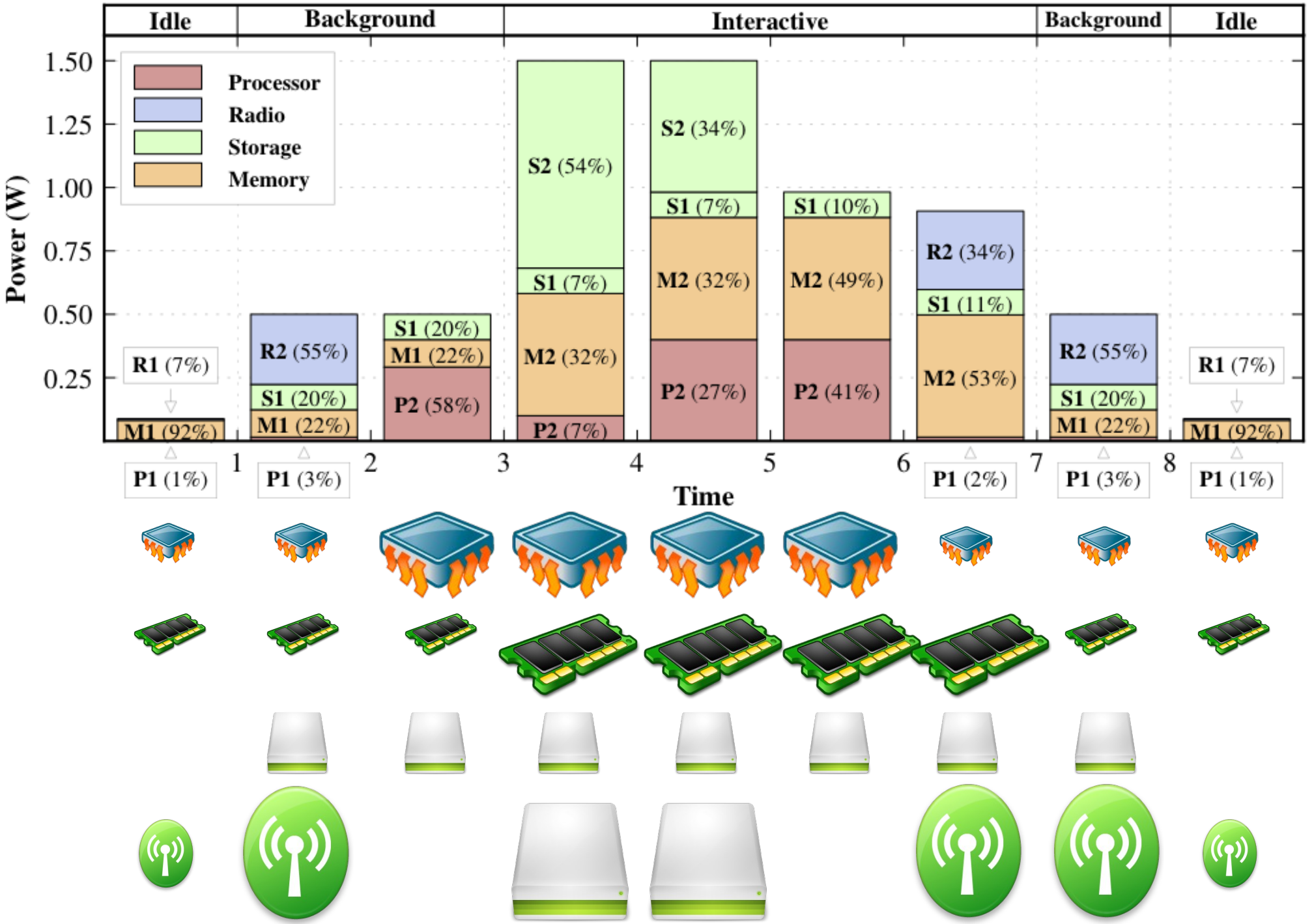
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The Power-Agile Multicomputer

Power-Agile Computing Challenges

- Selecting *component ensembles* for each application
- Measuring application efficiency
- Predicting *ensemble* performance for a given application
- Executing transitions between ensembles
- Increased device complexity and cost

Shazam!

Benevolent Dictator

Peaceful Buddha

Power-Agile Computing

Opportunity:

A device composed of ***multiple heterogeneous components*** allows power to be flexibly allocated across subsystems in ways that improve application performance while reducing overall power usage.

Challenges:

- ***Measuring*** application efficiency
- ***Predicting*** ensemble performance for a given application
- ***Selecting*** component ensembles for each application
- ***Executing*** transitions between ensembles
- Increased device complexity and cost

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