

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- **No** performance, **no** consistency, **no** idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . **yet?**
- Customers should **demand** better & providers should **supply** better
- **What is better?**
- First, either **para-virtual I/O** that is as efficient as device assignment
- Or **device assignment** that is as flexible as para-virtual I/O
- Fundamentaly, **virtualization should be free**
- Second, it's **all about the application**
- Because that's what the user cares about at the end of the day
- **Our challenge:** monitor, buy & sell **useful work**, not raw CPU, memory & I/O resources.

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- No performance, no consistency, no idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . yet?
- Customers should demand better & providers should supply better
- What is better?
- First, either para-virtual I/O that is as efficient as device assignment
- Or device assignment that is as flexible as para-virtual I/O
- Fundamentally, virtualization should be free
- Second, it's all about the application
- Because that's what the user cares about at the end of the day
- Our challenge: monitor, buy & sell useful work, not raw CPU, memory & I/O resources.

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- **No** performance, **no** consistency, **no** idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . **yet?**
- Customers should **demand** better & providers should **supply** better
- **What is better?**
- First, either **para-virtual I/O** that is as efficient as device assignment
- Or **device assignment** that is as flexible as para-virtual I/O
- Fundamentaly, **virtualization should be free**
- Second, it's **all about the application**
- Because that's what the user cares about at the end of the day
- **Our challenge:** monitor, buy & sell **useful work**, not raw CPU, memory & I/O resources.

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- **No** performance, **no** consistency, **no** idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . **yet?**
- Customers should **demand** better & providers should **supply** better
- **What is better?**
- First, either **para-virtual I/O** that is as efficient as device assignment
- Or **device assignment** that is as flexible as para-virtual I/O
- Fundamentaly, **virtualization should be free**
- Second, it's **all about the application**
- Because that's what the user cares about at the end of the day
- **Our challenge:** monitor, buy & sell **useful work**, not raw CPU, memory & I/O resources.

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- **No** performance, **no** consistency, **no** idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . **yet?**
- Customers should **demand** better & providers should **supply** better
- **What is better?**
- First, either **para-virtual I/O** that is as efficient as device assignment
- Or **device assignment** that is as flexible as para-virtual I/O
- Fundamentaly, **virtualization should be free**
- Second, it's **all about the application**
- Because that's what the user cares about at the end of the day
- **Our challenge:** monitor, buy & sell **useful work**, not raw CPU, memory & I/O resources.

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- **No** performance, **no** consistency, **no** idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . **yet?**
- Customers should **demand** better & providers should **supply** better
- **What is better?**
  - First, either **para-virtual I/O** that is as efficient as device assignment
  - Or **device assignment** that is as flexible as para-virtual I/O
  - Fundamentally, **virtualization should be free**
  - Second, it's **all about the application**
  - Because that's what the user cares about at the end of the day
  - **Our challenge:** monitor, buy & sell **useful work**, not raw CPU, memory & I/O resources.

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- **No** performance, **no** consistency, **no** idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . **yet?**
- Customers should **demand** better & providers should **supply** better
- **What is better?**
- First, either **para-virtual I/O** that is as efficient as device assignment
  - Or **device assignment** that is as flexible as para-virtual I/O
  - Fundamentally, **virtualization should be free**
- Second, it's **all about the application**
- Because that's what the user cares about at the end of the day
- **Our challenge:** monitor, buy & sell **useful work**, not raw CPU, memory & I/O resources.

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- **No** performance, **no** consistency, **no** idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . **yet?**
- Customers should **demand** better & providers should **supply** better
- **What is better?**
- First, either **para-virtual I/O** that is as efficient as device assignment
- Or **device assignment** that is as flexible as para-virtual I/O
- Fundamentally, **virtualization should be free**
- Second, it's **all about the application**
- Because that's what the user cares about at the end of the day
- **Our challenge:** monitor, buy & sell **useful work**, not raw CPU, memory & I/O resources.

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- **No** performance, **no** consistency, **no** idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . **yet?**
- Customers should **demand** better & providers should **supply** better
- **What is better?**
- First, either **para-virtual I/O** that is as efficient as device assignment
- Or **device assignment** that is as flexible as para-virtual I/O
- Fundamentaly, **virtualization should be free**
- Second, it's **all about the application**
- Because that's what the user cares about at the end of the day
- **Our challenge:** monitor, buy & sell **useful work**, not raw CPU, memory & I/O resources.

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- **No** performance, **no** consistency, **no** idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . **yet?**
- Customers should **demand** better & providers should **supply** better
- **What is better?**
- First, either **para-virtual I/O** that is as efficient as device assignment
- Or **device assignment** that is as flexible as para-virtual I/O
- Fundamentaly, **virtualization should be free**
- Second, it's **all about the application**
- Because that's what the user cares about at the end of the day
- **Our challenge:** monitor, buy & sell **useful work**, not raw CPU, memory & I/O resources.

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- **No** performance, **no** consistency, **no** idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . **yet?**
- Customers should **demand** better & providers should **supply** better
- **What is better?**
- First, either **para-virtual I/O** that is as efficient as device assignment
- Or **device assignment** that is as flexible as para-virtual I/O
- Fundamentaly, **virtualization should be free**
- Second, it's **all about the application**
- Because that's what the user cares about at the end of the day
- **Our challenge:** monitor, buy & sell **useful work**, not raw CPU, memory & I/O resources.

# Whither I/O in the Cloud?

- Today I/O in the (IaaS) cloud is . . . **less than optimal**
- **No** performance, **no** consistency, **no** idea what's going on
- Many I/O-intensive applications will not move to the cloud . . . **yet?**
- Customers should **demand** better & providers should **supply** better
- **What is better?**
- First, either **para-virtual I/O** that is as efficient as device assignment
- Or **device assignment** that is as flexible as para-virtual I/O
- Fundamentaly, **virtualization should be free**
- Second, it's **all about the application**
- Because that's what the user cares about at the end of the day
- **Our challenge**: monitor, buy & sell **useful work**, not raw CPU, memory & I/O resources.