Span VM: Multi-Hypervisor Virtual Machines

Enabling An Ecosystem of Hypervisor-Level Services In Cloud

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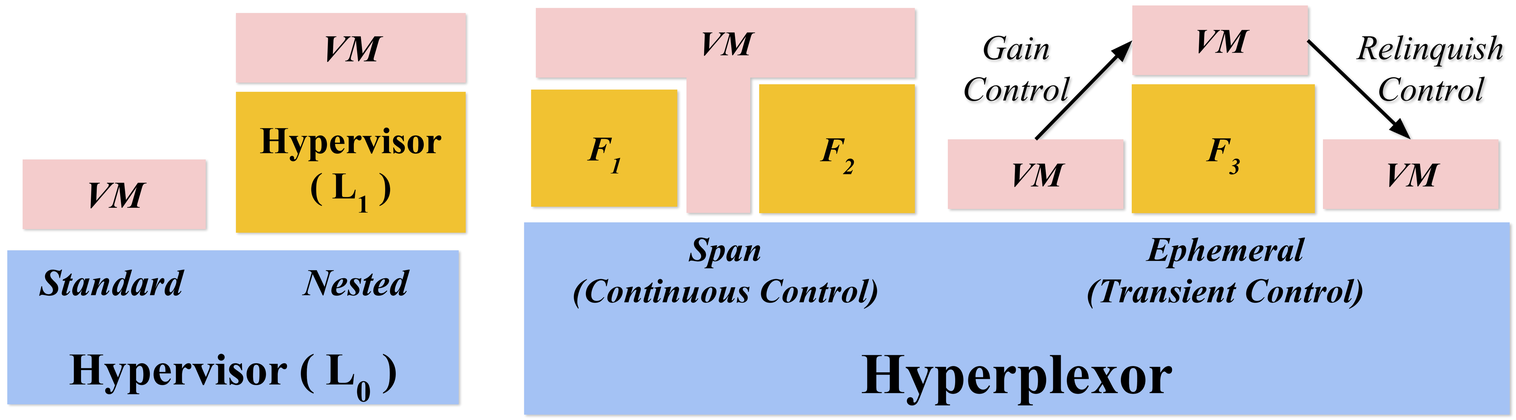
Problem: Support for 3rd-Party Hypervisor-level Services

1. **Growing Number of Hypervisor-level Services:** VM Introspection, Intrusion Detection, High Availability, Live Migration, Live Patching, etc.

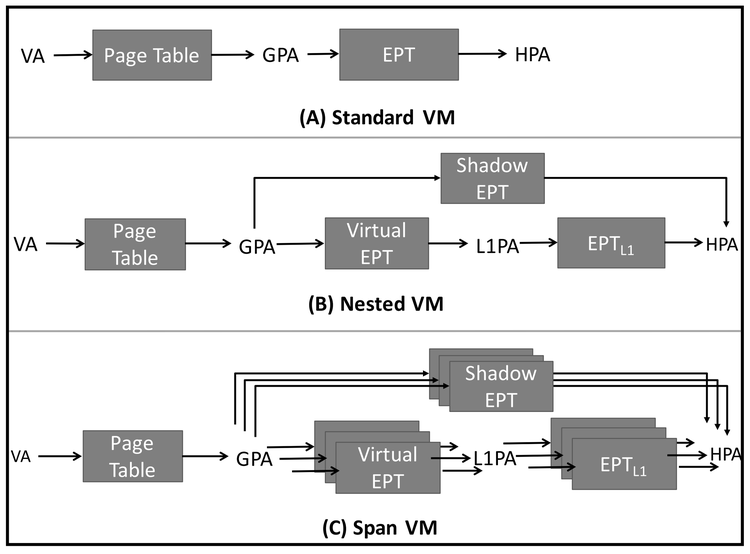
2. **Guests Cannot Simultaneously Use <u>Multiple</u> 3rd-party Services:** E.g. Cross-cloud migration, Customized guest security, Attestation, etc.

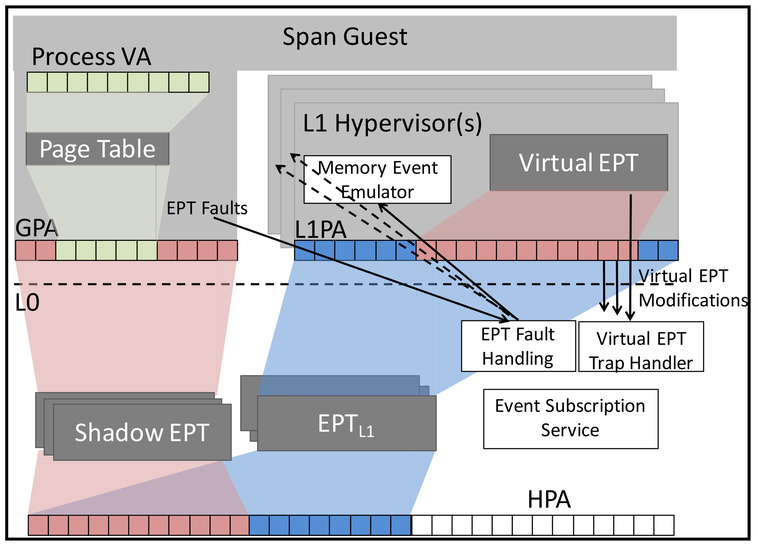
Solution: Compartmentalize Services & Share Guest Control

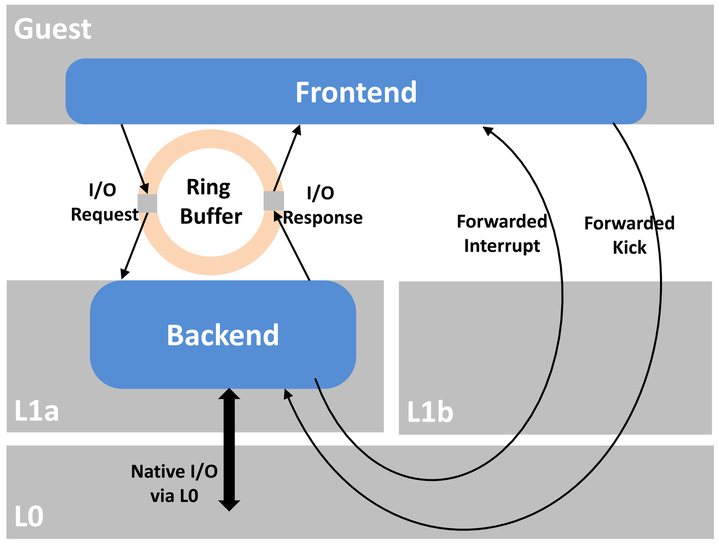


<u>Featurevisors</u> (F) : 3rd-party deprivileged "Hypervisors" providing guest services. **<u>Hyperplexor</u>** : Base L0 hypervisor.

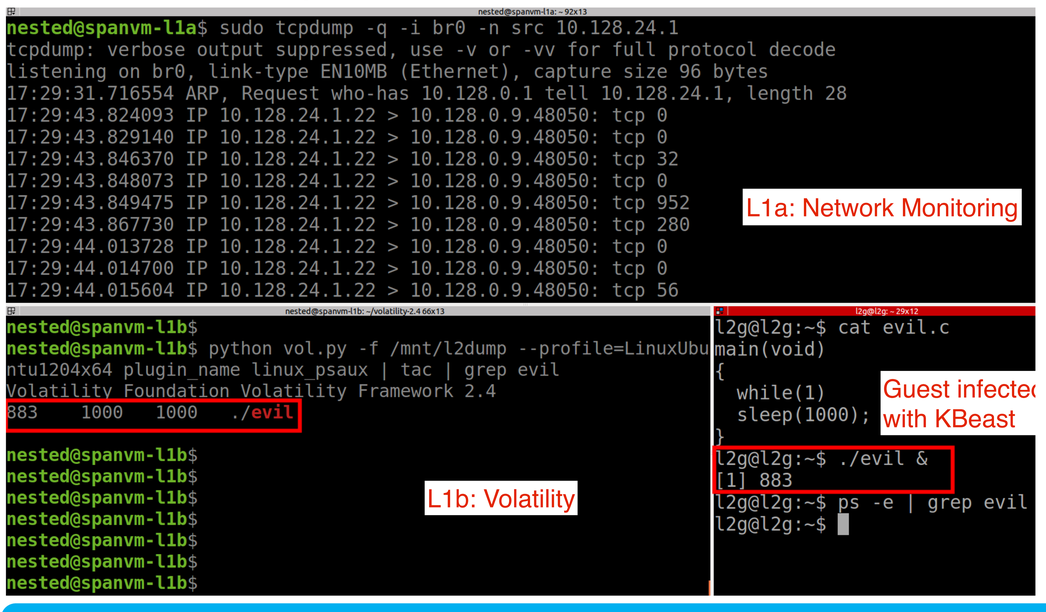
Approach: Transparent and Simultaneous Control of Guest by Multiple L1 Hypervisors







- **Guest Transparent:** No modifications to guest.
- **Attach/Detach L1s to/from guest at runtime:** Partial/full control over guest memory, VCPUs, and I/O devices.
- **Event Subscription:** L1s subscribe to guest events via L0.



Status, Results, and Future Work

- **Key Publications:**
  1. *Multi-hypervisor Virtual Machines: Enabling an Eco-system of Hypervisor-level Services*, **Accepted in USENIX ATC, 2017**
  2. *Enabling Hypervisor-as-a-service Clouds with Ephemeral Virtualization*, **VEE 2016.**
- **Prototype on KVM/QEMU Platform**
  - 0—15% overhead on benchmarks: Kernbench, iperf, quicksort.
  - Ephemeral virtualization: 80ms average switching times
  - Page fault servicing: 3.6—4.2us; Event Redirection: 13-41us.
- **Ongoing/Future Work:**
  - Supporting unmodified L1 hypervisors.
  - Live hypervisor patching.
  - Support on public clouds.

Funded by NSF 1527338: CSR: Small: Multi-hypervisor Virtual Machines - Enabling an Ecosystem of Hypervisors in the Cloud

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