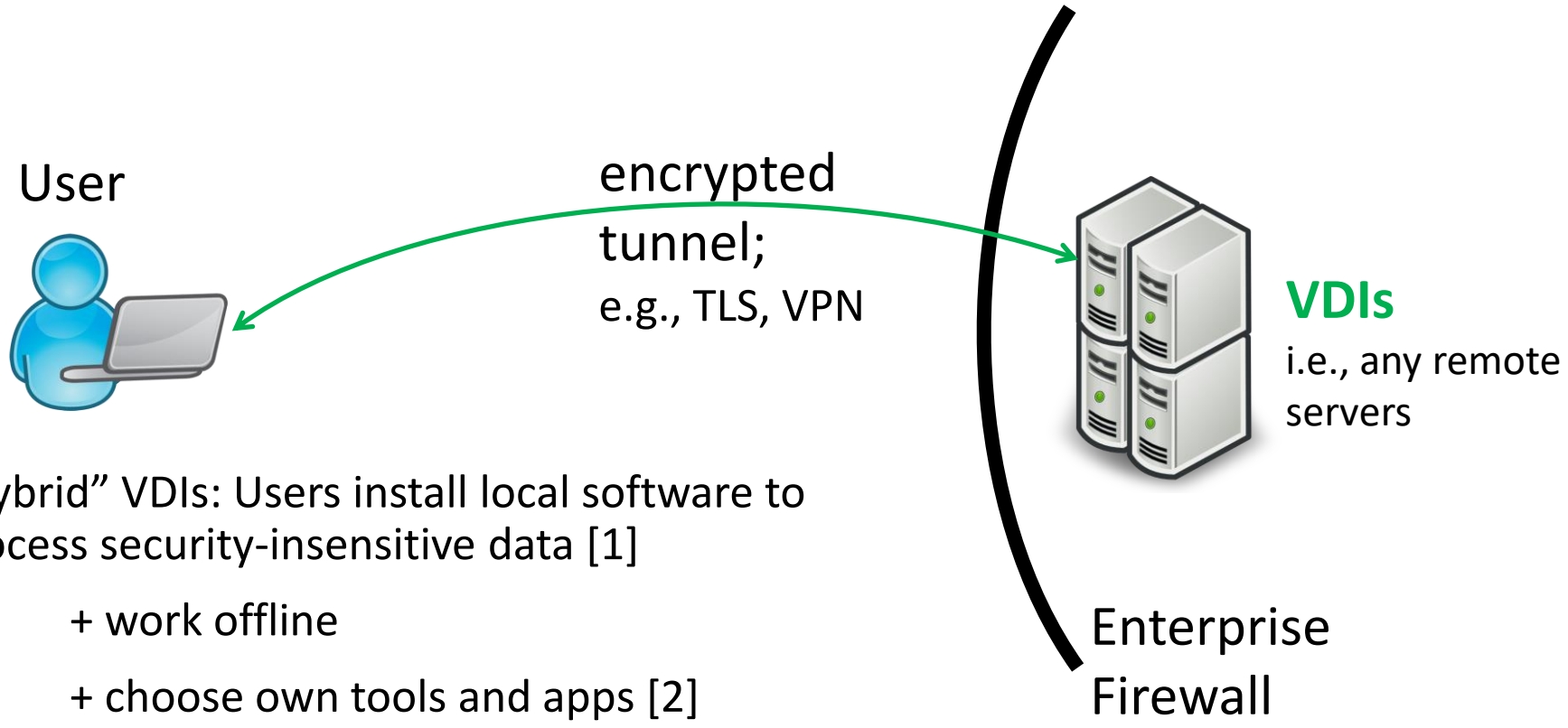
Secure VDI Client on Untrusted Endpoints

Secure Virtual Desktop Infrastructure (VDI) for Enterprise IT Security

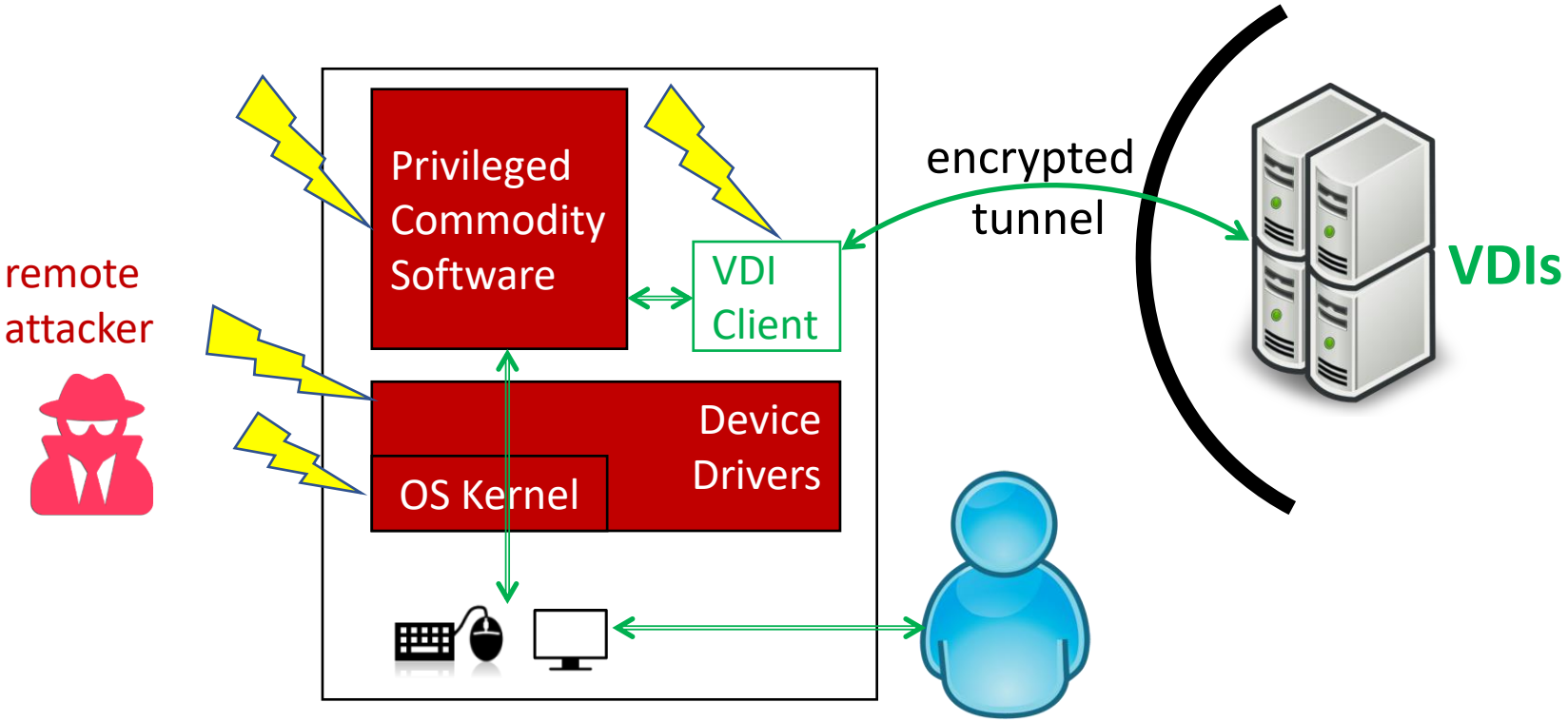


- "Hybrid" VDIs: Users install local software to process security-insensitive data [1]
  - + work offline
  - + choose own tools and apps [2]
  - + setup golden VDI images; i.e., less software

[1] VMWare. Is VDI dead?. 2018
[2] Gartner. Satisfy Digital Workers and Improve Employee Experience by Embracing Choice of Workplaces and Tools. 2020

Problem: No *End-to-End* Security to VDIs

***Huge untrusted code base → Many 0-day vulnerabilities* [1]**



Need: ***trusted path User*** <-> VDI client

[1] Klein et al. *seL4*: Formal Verification of an OS Kernel. SOSP. 2009

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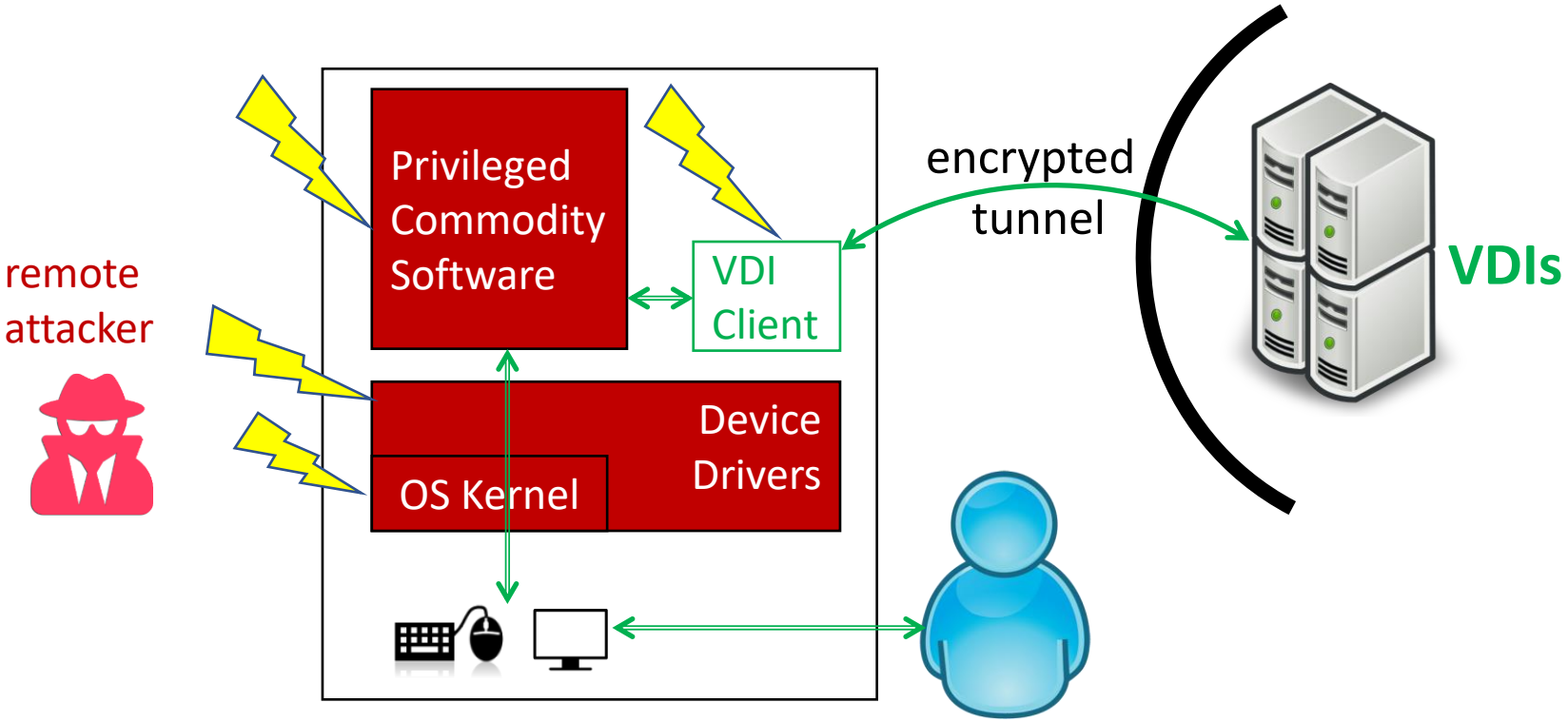

Attackers

- ***capture*** screen and view confidential data on VDIs
- ***capture*** user's keystrokes; e.g., passwords
- ***inject*** fake keystrokes to modify sensitive data
- ***corrupt*** VDI client process

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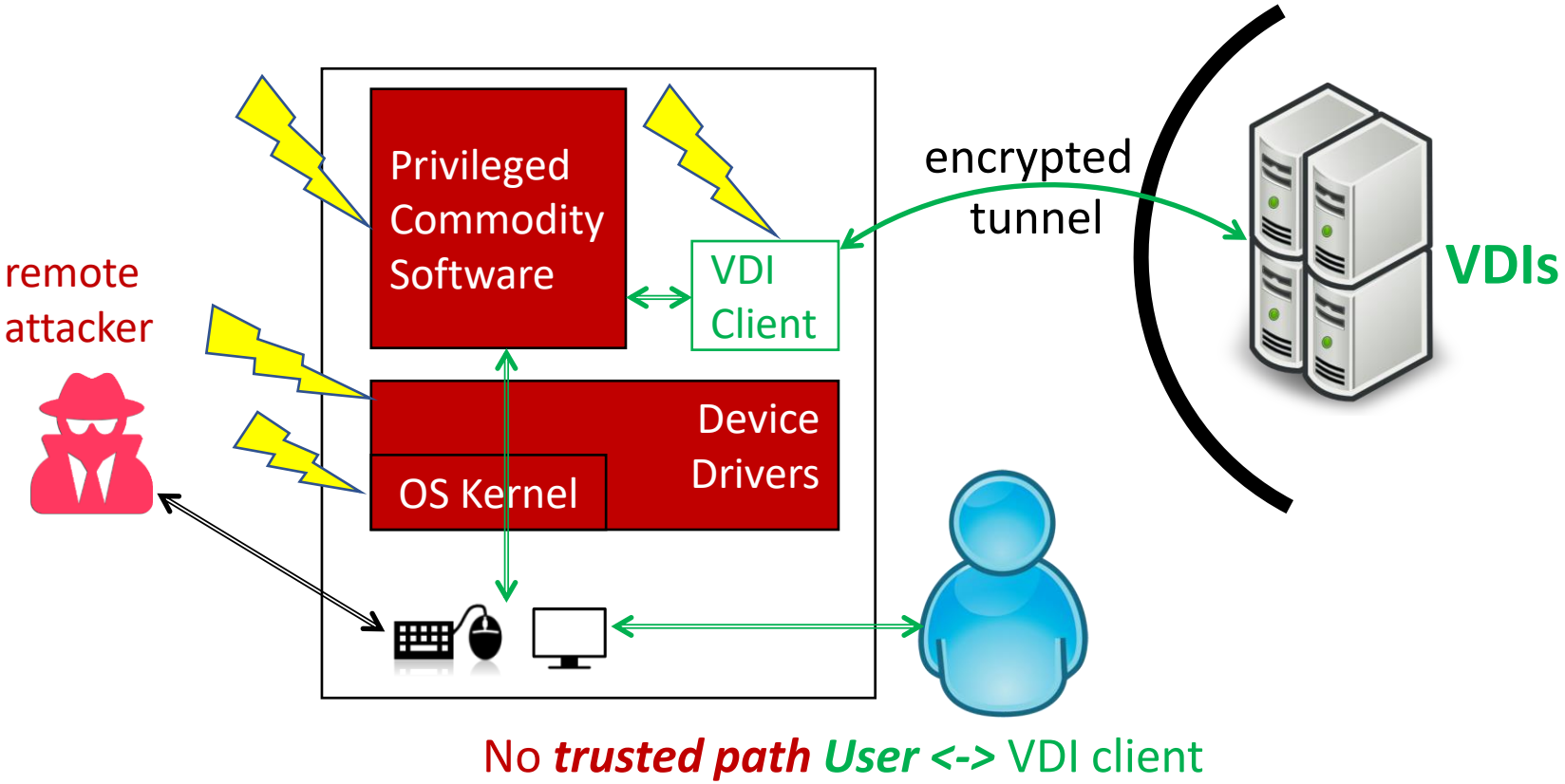


Consequence:

Attackers have *same* VDI data accesses as the unsuspecting users,

despite *perfect network & VDI security*

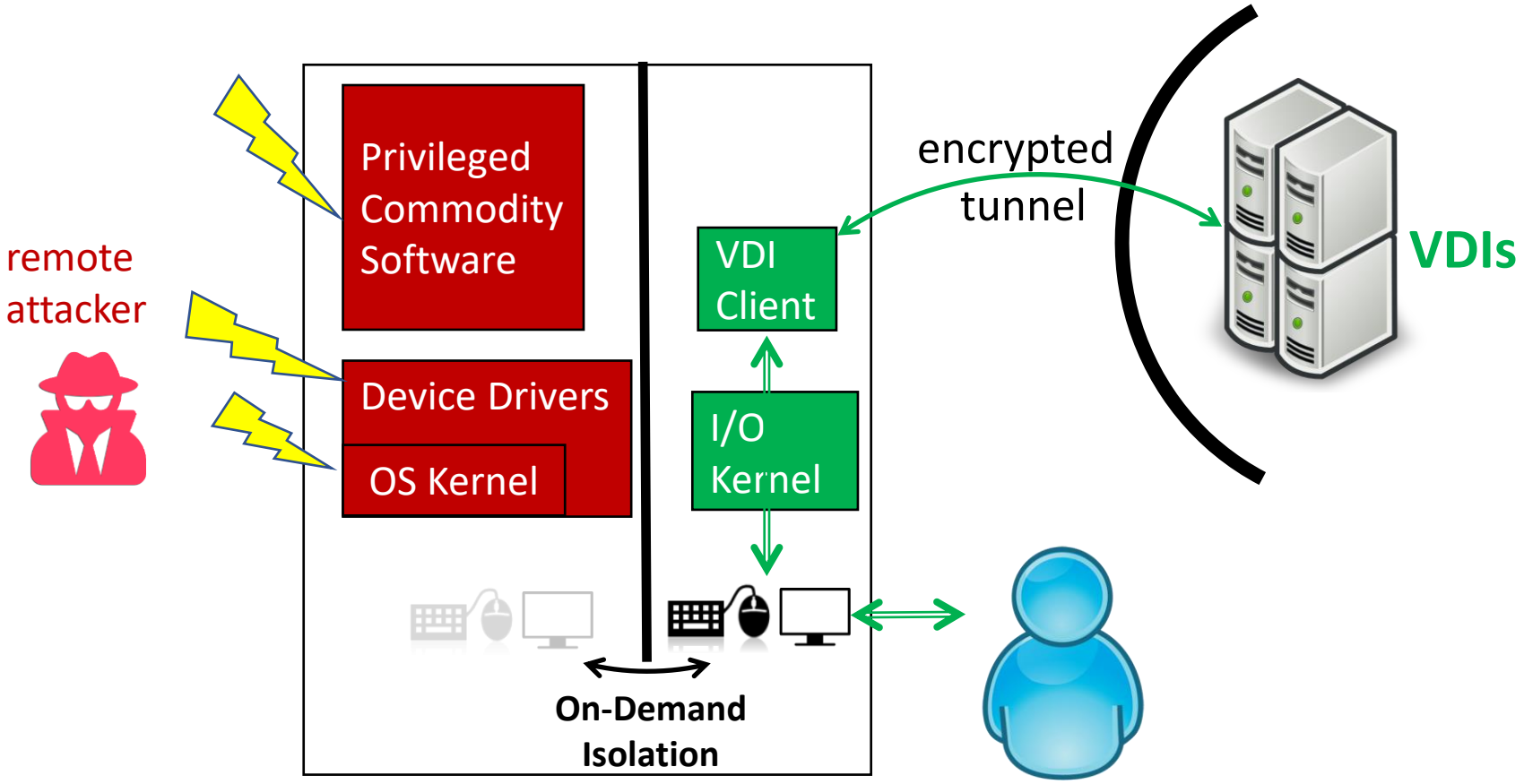
Inadequacy of Current Solutions

- Insecure
  - Antivirus Tools, Firewall – broken by undiscovered attacks
  - VPN – broken by local virus and malware
  - Bromium, Hysolate, Forcepoint Trusted Thin Client – broken by security flaws in huge code base

- Violate users' experience
  - Forcepoint Trusted Thin Client – very few local apps supported

- Incompatible with Enterprise Applications
  - Green Hills' *Integrity MultiVisor* – limited to embedded systems only

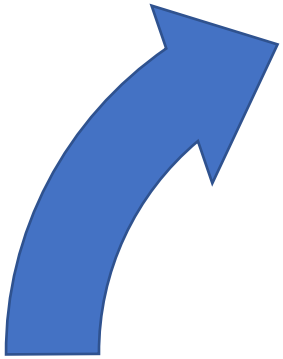
Our Solution: On-Demand Isolation

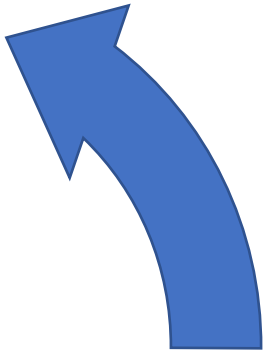


Security Guarantee:
Attackers ***can no longer break*** user's trusted path,
regardless of how they ***compromises other software***; e.g., OS, apps, users' tools

Advantages of Our Solution

- Usable security despite *any* commodity OS/apps 0-day flaws
  - commodity OS/apps will *always* exhibit 0-day flaws; see axioms of insecurity





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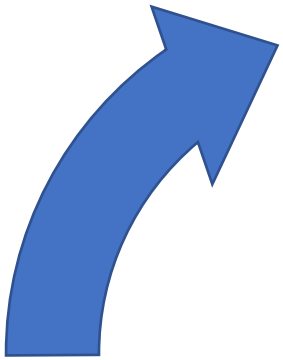
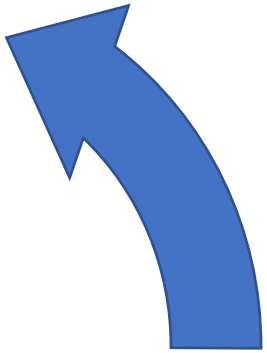
  - maintain users' experience
    - users can process security insensitive data with commodity local tools/apps





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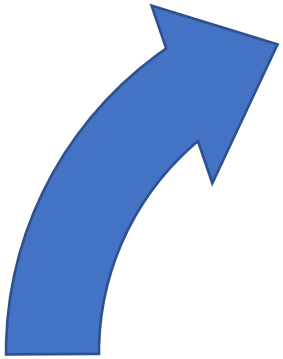
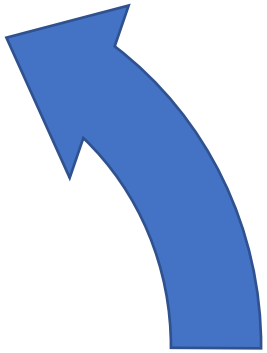
  - maintain users' experience
  - reduce enterprise IT cost
    - eliminate IT administrative labor to maintain VDI security





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  - reduce enterprise IT cost

On-Demand Isolation:

- Security with mathematical proofs!

- Many more secure applications!

- Support PCs, laptops, mobile phones, tablets!

Other solutions

Insecure

Antivirus,
Firewall

Hysolate,
Bromium

Forcepoint
Trusted Thin Client

Violate Users' Experience

Forcepoint
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Incompatible with Enterprise Apps, Tools

Green Hills'
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Our solution

Secure by design,
Enable mathematically verified security

Maintains Users' Experience

Compatible with Enterprise Apps, Tools

Who Needs Our Solution?

(Limited to current VDI Markets)

- Large numbers of users need *secure remote* enterprise accesses
  - > **45 M** *enterprise employees* in > 7,000 enterprises globally [1]
    - most employees have 2~3 endpoints; e.g., PC, laptop, mobile phone, tablet
    - most employees work both on- and off-site
  - > **45 M** *government employees* in G-20 countries
  - Estimated **16.76 M** users on 2020-06-30 [1, 2, 3, 4]

- Other enterprises' employees
  - Rapid and steady *move to VDI*; e.g., ~$7B today, 16.5% CAGR [5]
  - Permanent shift to *secure remote access*; e.g., due to COVID-19

[1] HG Insights. Companies using "Citrix Virtual Desktops", "VMware Horizon", "Microsoft Windows Virtual Desktop". Count all companies have 10K+ employees as 30K. [Fetched on 2020-09-28]
[2] Citrix. Form 10-Q Quarterly Report. 2020-07-31. https://investors.citrix.com/financials/sec-filings/
[3] HG Insights. Companies using "Citrix Virtual Desktops", [Fetched on 2020-10-07]
[4] Citrix. Citrix Endpoint Management (Pricing). https://www.citrix.com/products/citrix-endpoint-management
[5] Allied Market Research. Cloud-based VDI Market Expected to Reach $10,154 Million by 2023. 2017

Go-To-Market Strategy

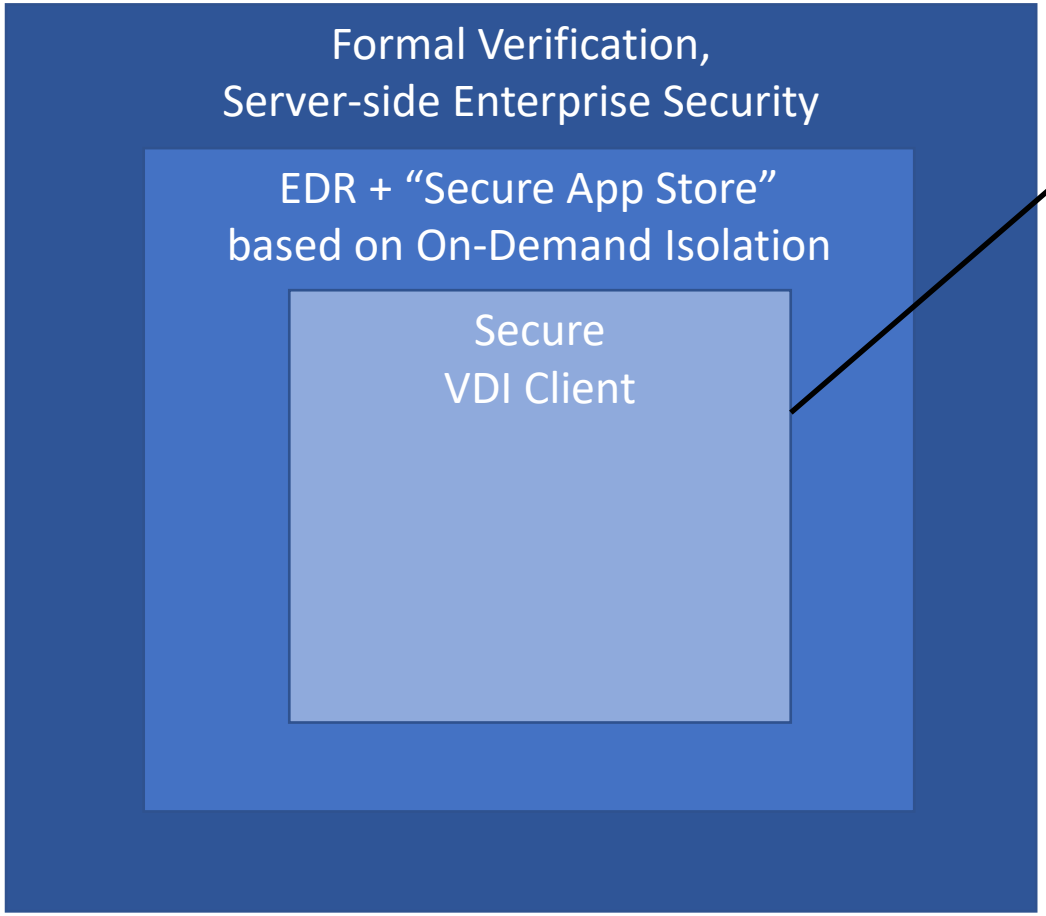
(Limited to current VDI Markets)

- For small and mid-size business: turn-key VDI solutions + IT security services
  - Reason 1: Satisfy great demand [1]
  - Reason 2: Solve the pain-point “Lack of staff or expertise in security” [2, 3]
  - Reason 3: Introduce in our solution to provide real security with a low cost

- For large business: Promote our secure VDI clients

[1] Allied Market Research. Cloud-based VDI Market Expected to Reach $10,154 Million by 2023. 2017
[2] Veeam. 2020 Data Protection Trends. 2020
[3] Gartner. The Managed Security Services Landscape Is Changing. 2020

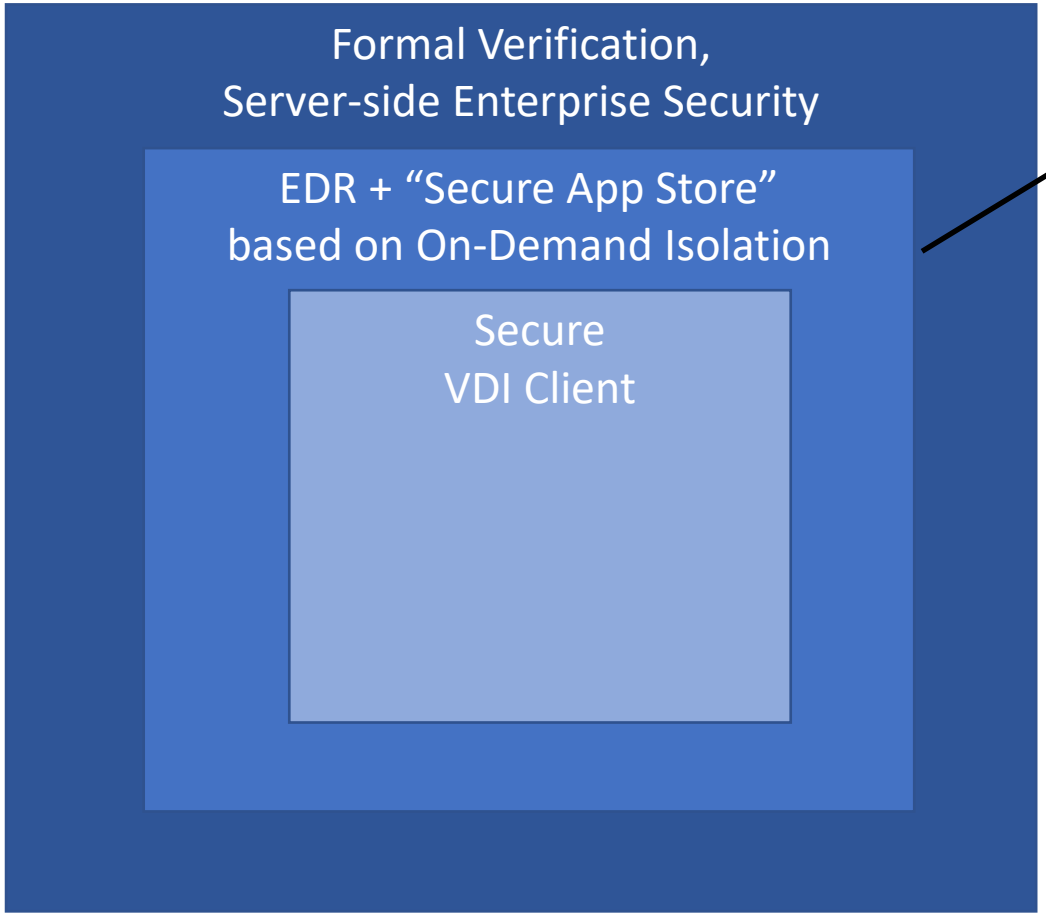
Future Plans



Short-term:

- Implement VDI client for PCs and laptops

Future Plans



Mid-term:

- Implement VDI client for smart phones and tablets
- Establish an “App Store” based on our I/O Kernel and On-Demand Isolation
- Implement new Endpoint Detection and Response (EDR) approaches based on our tech

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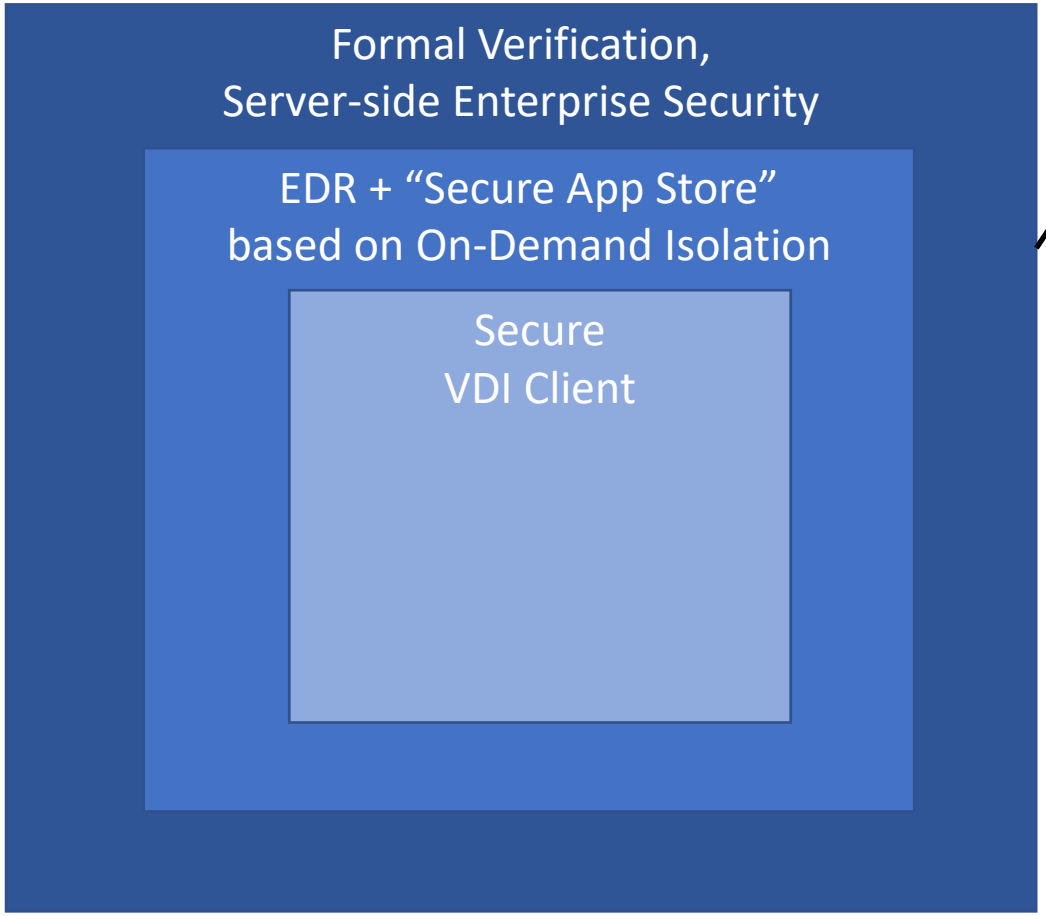

Mid-term:

- Complete mathematical verification of entire VDI client set
- Adopt our other secure solutions to protect server security

Level of Effort - Estimate

- Short-Term “Implement VDI client for PCs, laptops”
  - Timespan: ~1.0 year
  - No. of developers on I/O kernel and drivers for VDI client:
    2 (highly skilled) – 5 (average skilled)
  - No. of developers on VDI client: 2 - 3 (average skilled)
- Mid-Term
  - Timespan: ~ 2 – 2.5 years
  - No. of developers:
    6 (high skilled) – 12 (average skilled)
  - No. of developers on VDI client: 5 - 10 (average skilled)

Patents for On-Demand Isolation

- Current CMU Patents: 4
- Pending CMU Patents: 2