# ECOSYSTEM DEPENDENCY PROJECT

## Module 08 — Leak Site Operations

**HANDLING: INTERAGENCY**

| Field | Value |
|---|---|
| Module Number | 08 |
| Module Name | Leak Site Operations |
| EDP Node Reference | Node 06 (Leak-Site Hosting Stack) — PRIMARY |
| Ecosystem Layer | Extortion Pressure / Publication Infrastructure |
| Upstream Connections | Node 03 (BPH — primary hosting backbone); Module 07 (RaaS Operators — data source and publication trigger); Node 04 (IAB Markets — initial access enabling exfiltration); Node 14 (Exfil Staging Infrastructure) |
| Downstream Connections | Module 07 (RaaS Operators — DLS pressure drives ransom payment); Node 01 (OTC Brokers — payments triggered by DLS pressure); Node 10 (Credential Markets — leaked data sold post-deadline) |
| Research Date | April 2026 |
| Primary Researcher | Reno |
| Source Tools Used | Perplexity AI; Unit 42 (Palo Alto); Secureworks; ReliaQuest; BankInfoSecurity; Risky Biz; Cybernews/Sophos; Intel471; Resecurity; Analyst1; BlackFog |

# SECTION 1 — WHAT IT IS

### 1.1 Definition

Leak Site Operations encompass the infrastructure, operational practices, and criminal services used to host, manage, and weaponize data-leak sites (DLS) as extortion instruments within the ransomware supply chain. A data-leak site is a Tor-based or bulletproof-hosted web publication that ransomware operators use to publicly name victims, display proof-of-compromise data samples, apply countdown timers, and incrementally release stolen data if ransoms are not paid. Leak sites are the enforcement mechanism of double extortion: they convert data theft into sustained, escalating reputational and regulatory pressure against victim organizations.

Node 06 (Leak-Site Hosting Stack) in the EDP Dependency Map captures this function. It is assessed as HIGH tier, MEDIUM replace difficulty, with FVEY LE and IC as primary owners for attribution and upstream hosting providers for physical takedown. This module expands the node assessment with granular operational, infrastructure, and actor-level analysis.

### 1.2 Historical Origin

Data-leak sites emerged in late 2019 when the Maze ransomware group began publicly naming victims who refused to pay ransoms. Prior to this, ransomware was a single-extortion model: encrypt and demand. Maze introduced the double-extortion model by coupling encryption with systematic data exfiltration and a public-shaming publication platform. Within 18 months, the DLS model was adopted across virtually all major RaaS platforms and has remained standard practice through the 2024-2026 reporting period.

The operational logic mirrors legitimate breach-notification law: operators exploit victims' fear of regulatory consequences (GDPR, HIPAA, SEC breach disclosure requirements) and reputational damage to create a payment incentive independent of the encryption itself. In cases where victims can restore from backup, the DLS threat becomes the primary coercive instrument.

### 1.3 How It Functions — Step by Step

- Step 1 — Data Exfiltration: During a ransomware intrusion, affiliates or operators exfiltrate victim data to staging infrastructure (EDP Node 14) before deploying the encryptor. Exfiltrated data may include intellectual property, employee and customer PII, financial records, legal documents, and authentication credentials.
- Step 2 — Initial Ransom Demand (Private): The victim receives a ransom note directing them to a Tor-based negotiation portal. At this stage, the DLS threat is implied but the victim has not been publicly named.
- Step 3 — DLS "Coming Soon" or Teaser Posting: If the victim does not initiate negotiations within an operator-defined window (typically 3-7 days), the victim is listed on the DLS with a name, logo, sector, country, brief description, and a countdown timer. Data samples may be posted as proof of compromise.
- Step 4 — Incremental Data Release: As the countdown progresses without payment, operators release progressively larger data samples. Partial dumps, document previews, or employee data extracts are common tactics to increase pressure without full disclosure.
- Step 5 — Full Leak or Torrent Distribution: On deadline expiry without payment, operators release the full dataset — either served directly from DLS storage, linked via torrent magnet links, or distributed through additional mirrors. Cl0p has pioneered the torrent distribution model for high-volume data sets.
- Step 6 — Secondary Data Monetization: Post-leak, credential sets and sensitive documents extracted from leaked data may be sold on underground credential markets (Node 10) or used in follow-on attacks, extending the financial return from a single intrusion.

### 1.4 Role in the Ecosystem

Leak site operations serve four distinct functions in the ransomware ecosystem simultaneously: extortion pressure delivery (primary); affiliate and brand marketing (secondary); threat actor credibility signaling to the broader criminal community; and a data sales platform when victims refuse payment. Disrupting the DLS layer therefore has cascading effects not only on victim payment rates but on affiliate recruitment, group credibility, and secondary data monetization.

Critically, the DLS function is structurally separate from the encryption function. A victim who can restore from backup can eliminate the encryption impact entirely but remains fully exposed to DLS pressure. This means the DLS layer has increasing relative importance as organizational backup and recovery capabilities improve. Groups operating pure extortion campaigns (no encryption) rely entirely on the DLS model.

### 1.5 DLS Operational Variants — Five Archetypes

Five distinct DLS operator archetypes are documented in the 2024-2026 reporting period:

Archetype 1 — Core RaaS-Operated Leak Sites: First-party DLS operated directly by major RaaS brands (LockBit, ALPHV, Cl0p, RansomHub, BlackSuit archetype). These sites integrate with the negotiation panel and payment workflow through unique victim IDs. Victims are tracked across stages (private negotiation, teaser posting, partial leak, full leak) through operator-controlled dashboards. Confidence: CONFIRMED.

Archetype 2 — Cartel / Multi-Tenant Leak Platforms: Shared DLS infrastructure hosting multiple RaaS brands or crews on a common backbone. Operators offer "slots" or sub-pages to different groups; centralize hosting, uptime management, and DDoS protection; while each tenant group controls its own victim postings. Enables fast brand churn: new groups launch without building independent infrastructure. Confidence: CREDIBLE.

Archetype 3 — Outsourced DLS-as-a-Service Providers: Infrastructure specialists selling hosting, design, and operational support for data-leak sites. Services include bulletproof VPS, pre-configured Tor/onion services, clearnet mirrors, CDN/proxy layers, backup mirrors, and server rotation. These providers host mixed portfolios: ransomware DLS, malware C2, exfiltration servers, phishing sites, and credential markets on shared infrastructure. Confidence: CONFIRMED.

Archetype 4 — Pure Extortion Leak Sites (No Encryption): DLS instances used for data-theft-only or single-extortion campaigns against organizations breached via infostealers, misconfiguration, or stolen cloud credentials

(Snowflake-model breaches). Skip the encryption stage entirely; rely on the threat of public data publication. Use the same victim-listing logic and UI as full RaaS DLS. Confidence: CONFIRMED.

Archetype 5 — Affiliate-Controlled Splinter Sites: Unofficial DLS instances maintained by affiliates or defectors following operator disputes (cheated revenue splits, panel lockouts). Re-post victims from parent brand campaigns to retain personal leverage. Operate as small Tor blogs or paste-style dumps, sometimes rebranding stolen data under a new group name. Increase ecosystem fragmentation and complicate attribution post-major-takedown. Confidence: MODERATE.

# SECTION 2 — KEY ACTORS AND EXAMPLES

## 2.1 DLS Operator Archetype Table

| Archetype | Named Examples | Key TTPs | Hosting Model | Confidence |
|---|---|---|---|---|
| Core RaaS DLS (first-party) | LockBit .onion DLS, ALPHV Collections, RansomHub DLS, BlackSuit DLS, Cl0p .onion + torrent hybrid | Branded Tor sites; victim countdown timers; integrated negotiation panel; staged data release; torrent distribution for large datasets | Operator-controlled BPH; multiple redundant onion addresses | CONFIRMED |
| Cartel / multi-tenant platform | Post-LockBit/ALPHV coalition platforms; INC Ransom shared backend indicators | Shared backbone; per-group sub-pages; centralized DDoS protection; rapid tenant onboarding for new brands | Shared BPH; provider manages uptime; tenants control content | CREDIBLE |
| DLS-as-a-Service provider | Media Land (confirmed by 2025 internal data leak); BEARHOST; Underground; Voodoo Servers | Sell pre-configured Tor/onion services; CDN/proxy layers; backup mirrors; server rotation; mix portfolios across cybercrime types | Bulletproof VPS; VM template reuse (Sophos: 7,000+ servers from single image) | CONFIRMED |
| Pure extortion / data-only | Scattered Spider / UNC3944 Snowflake campaign sites; Fortinet breach publication sites | No encryption; cloud credential or stealer-derived access; DLS-style naming and countdown; targets SaaS and data-rich platforms | Shared BPH or short-lived clearnet mirrors | CONFIRMED |
| Affiliate splinter sites | Unnamed post-ALPHV and post-LockBit defector blogs; paste-style re-posts | Re-post parent brand victims; rebrand stolen data; Tor blog or Pastebin-style dumps; leverage after affiliate-operator disputes | Low-cost BPH or free Tor hosting services | MODERATE |

## 2.2 Notable Documented Examples

**LockBit Leak Site Network:** Prior to Operation Cronos (February 2024), LockBit operated the most prolific DLS by victim count. The site listed thousands of victims with logo branding, countdown timers, and sector tags. Law enforcement seized the DLS domain and replaced it with a disruption notice. LockBit subsequently launched

replacement onion sites within days, illustrating the low replacement cost of specific DLS instances when core infrastructure remains available.

**ALPHV/BlackCat DLS (AlphV Collections):** ALPHV operated a branded DLS that integrated with its negotiation portal. Following the December 2023 FBI seizure, ALPHV relaunched with a new DLS before the apparent exit scam in early 2024. The ALPHV DLS was notable for its corporate-style presentation, structured data categorization, and use of victim-specific data previews designed to maximize regulatory and media pressure.

**Cl0p Torrent Distribution Model:** Cl0p pioneered the torrent-based data distribution model during its 2023 MOVEit Transfer mass-exploitation campaign. Instead of serving large datasets through Tor (which is bandwidth-limited), Cl0p seeded data as torrents and advertised magnet links on its DLS, allowing rapid, decentralized, and highly resilient data distribution. This model was subsequently adopted by other groups and represents a structural evolution away from centralized DLS hosting.

**Qilin WikiLeaksV2 and BEARHOST Dependency:** Resecurity research linked Qilin's "WikiLeaksV2" DLS to the BEARHOST / Underground / Voodoo Servers BPH conglomerate. This illustrates how a single hosting entity can simultaneously underpin DLS infrastructure for multiple ransomware families. Disruption of a single BPH conglomerate can therefore produce simultaneous multi-DLS impact.

**Media Land Internal Leak (2025):** A 2025 leak of internal data from the Media Land BPH provider confirmed it hosted ransomware DLS alongside C2 servers, phishing kits, and exfiltration nodes. This is the clearest documented case of a single BPH entity providing mixed-portfolio hosting to ransomware operators and constitutes direct evidence of the BPH-DLS dependency relationship assessed throughout this module.

**Sophos VM Template Infrastructure (Cybernews, 2025):** Sophos research identified bulletproof hosts deploying virtual machines from identical Windows images, producing over 7,000 ransomware-linked servers with the same hostname fingerprint. These servers supported C2, DLS, malware distribution, and exfiltration staging simultaneously. The template reuse pattern obscures distinctions between different ransomware groups that share infrastructure, complicating attribution.

## 2.3 Scale and Volume Table

| Metric | Value | Period | Source | Confidence |
|---|---|---|---|---|
| Active double-extortion groups (YoY increase) | +30% YoY | July 2023 to June 2024 | Secureworks | CONFIRMED |
| Groups posting victims simultaneously (peak month) | 40 groups in May 2024 | May 2024 | Secureworks | CONFIRMED |
| DLS victim postings Q1 2024 | 1,041 organizations | Q1 2024 | ReliaQuest | CONFIRMED |
| DLS victim postings Q2 2024 | 1,237 organizations (+20% QoQ) | Q2 2024 | ReliaQuest | CONFIRMED |
| DLS victim postings Q3 2024 | 1,266 organizations | Q3 2024 | ReliaQuest | CONFIRMED |
| DLS victims — single month peak | 621 victims claimed in December 2024 | December 2024 | BankInfoSecurity | CONFIRMED |
| Ransomware-linked servers from single BPH image | >7,000 servers | 2021 to present | Sophos / Cybernews | CONFIRMED |
| Intel471 BPH-to-DLS linkage confirmation | LockBit 2.0 DLS hosted on same IP space for >6 months | Prior to Cronos | Intel471 | CONFIRMED |

## 2.4 Geographic and Sectoral Patterns

DLS victim geography closely mirrors the targeting patterns documented in Module 07: US victims account for approximately 48% of global DLS postings; healthcare, manufacturing, and professional services are the most heavily represented sectors. Key DLS-specific observations:

- Healthcare is disproportionately represented on DLS listings because the regulatory exposure (HIPAA breach notification, OCR enforcement) amplifies DLS pressure beyond typical victim profiles; operators post healthcare victims with awareness that regulatory timelines create an independent payment incentive.
- CIS/RU victim exclusion filters apply to DLS listings as well as to initial targeting; major DLS platforms rarely post victims with Russian-language content or .ru domain indicators, consistent with operator CIS filter policies documented in Module 07.
- Professional services, legal, and financial sector victims are selectively escalated on DLS due to the confidentiality sensitivity of their data, which amplifies regulatory and reputational pressure relative to other sectors.
- December 2024 record posting volumes (621 victims in a single month) suggest end-of-year campaign surges — possibly operators accelerating publication to maximize Q4 payment conversion before year-end organizational disruption.

# SECTION 3 — INFRASTRUCTURE DEPENDENCIES

## 3.1 Upstream Dependencies

| Upstream Dependency | EDP Node | Dependency Type | Function Supported |
|---|---|---|---|
| Bulletproof Hosting (BPH) | Node 03 | CRITICAL | Primary hosting backbone for all Tor-based leak sites, backup mirrors, CDN/proxy layers, and exfiltration staging. DLS operational continuity is ceiling-bounded by BPH provider resilience and abuse-complaint processing speed. |
| Exfiltration Staging Infrastructure | Node 14 | CRITICAL | Exfiltrated data must be staged on accessible storage before DLS posting. Without functioning exfil staging, operators cannot populate DLS with proof-of-compromise data or full leak files. |
| RaaS Operators / Module 07 | Cross-module | HIGH | RaaS operators provide the ransomware campaigns, victim targeting decisions, and publication trigger authority. DLS postings are operator-directed; affiliates conduct exfiltration but operators control the publication schedule and escalation logic. |
| IAB Markets | Node 04 | HIGH (indirect) | Initial access purchased from IABs enables the intrusions that produce exfiltrated data. Without viable IAB supply, exfil volumes and DLS posting rates decline proportionately. |
| Underground Forums | Node 07 | MEDIUM | Forum reputation management anchors DLS credibility; operators publicize DLS posting counts on forums to signal program health to affiliates and IABs. |
| Anonymization / Proxy Services | Node 15 | MEDIUM | Operator and affiliate administrative access to DLS management panels uses operational proxy and anonymization layers to prevent infrastructure attribution. |

## 3.2 Downstream Outputs

| Downstream Effect | EDP Node / Module | Mechanism |
|---|---|---|

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|---|---|---|
| Ransom payment pressure on victim | Module 07 (RaaS Operators) | DLS publication directly triggers victim payment decisions; payment inflow to operator wallets is the primary downstream revenue output of DLS activity. |
| OTC broker and exchange activation | Node 01 / Node 02 | Ransom payments triggered by DLS pressure flow into operator wallets and then through OTC brokers and exchanges for cash-out. |
| Credential and data sales on underground markets | Node 10 | When victims refuse payment and data is fully released, credential sets and sensitive documents from leaked data are sold on underground markets, generating secondary revenue. |
| Affiliate and IAB recruitment signaling | Node 04 / Node 07 | High DLS posting volumes signal operational program health to potential affiliates and IABs, driving affiliate recruitment and access supply to the program. |
| Regulatory and legal pressure on victim | External | DLS postings trigger victim notification obligations, SEC breach disclosures, and OCR/HIPAA regulatory processes that create independent time pressure on victim organizations. |

## 3.3 Critical Chokepoints

| Chokepoint | Why Critical | Disruption Owner | Backfire Risk |
|---|---|---|---|
| Tor onion service hosting (BPH backbone) | All major DLS depend on BPH-hosted Tor infrastructure; seizure or disruption of the hosting provider simultaneously disables all DLS instances on that backbone | FVEY LE + upstream ISPs and registrars + IC (covert access) | LOW |
| BPH VM template source | Sophos identified 7,000+ servers from a single image template; disruption of the template distribution point or the BPH providing it disables industrial-scale DLS and C2 infrastructure simultaneously | FVEY LE + IC; upstream provider engagement | LOW |
| Data exfiltration staging servers (Node 14) | DLS cannot post proof-of-compromise data or leak files without accessible staging storage; seizure of staging servers removes the content from future DLS escalation | FVEY LE (where victim cooperates) + IC | LOW |
| Torrent seed infrastructure (Cl0p model) | For groups using torrent distribution, the seed infrastructure is a chokepoint; without active seeds, leaked data becomes inaccessible even if DLS listing remains live | FVEY LE + private sector (torrent tracking) | LOW |
| DLS administrative panel access credentials | Operators access DLS management panels through authenticated sessions; compromise of admin credentials allows law enforcement to post | FVEY LE + IC (covert access) | LOW |

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|---|---|---|---|
| | disruption notices, extract victim data, or disable the site from within | | |
| Multi-tenant DLS backbone provider | A cartel-style shared DLS platform represents a single point of disruption for multiple RaaS brands simultaneously; takedown of one provider disables all tenants | FVEY LE + upstream hosting providers | LOW |

### 3.4 Technical Infrastructure Detail

Primary access architecture:

- Tor hidden services (.onion addresses) are the default DLS access mechanism, providing operator anonymity and resistance to standard domain seizure. Operators typically register multiple onion addresses for redundancy.
- Clearnet mirrors behind reverse proxies or CDN frontends (Cloudflare abuse, bulletproof CDN providers) extend DLS accessibility to non-Tor users and increase media and victim reach; these mirrors are more vulnerable to standard takedown than onion services.
- DDoS protection layers are standard in major DLS operations, preventing disruption by victims, competitors, or vigilante actors; BPH providers often bundle DDoS mitigation as part of their service offering.

Storage and distribution:

- Direct hosting on BPH VPS: exfiltrated data served from BPH-hosted storage via Tor; common for smaller datasets and partial leak releases. Bandwidth limitations constrain throughput for multi-gigabyte datasets.
- Torrent distribution (Cl0p model): exfiltrated data seeded via BitTorrent; magnet links advertised on DLS. Highly resilient to takedown once seeded to multiple peers; Cl0p adopted this model specifically for the high-volume MOVEit 2023 campaign and subsequent mass-exploitation events.
- Third-party file hosting (clearnet): some operators briefly post on legitimate file-sharing services before accounts are suspended, using the download window to maximize data spread before takedown.

VM template infrastructure (Sophos finding):

- Bulletproof hosts repeatedly deploy VMs from identical Windows disk images, producing thousands of servers with the same hostname fingerprint. This "VM reproduction shortcut" has been documented since at least 2021.
- These template-spawned servers simultaneously support C2, ransomware DLS, malware distribution, and exfiltration staging, making them multipurpose criminal infrastructure rather than single-purpose DLS hosts.
- Template fingerprinting is a documented detection and attribution technique: identifying the shared image allows researchers to cluster previously unlinked servers and potentially attribute DLS instances to specific BPH operators or ransomware groups.

### 3.5 Cross-Module Linkages

| EDP Module | Linkage Type | Description |
|---|---|---|
| Module 01 — Stealers | Indirect Input | Stealer-derived credentials enable pure-extortion DLS campaigns (no encryption); also populate secondary data sales after full leak publication. |

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|---|---|---|
| Module 02 — Loaders | Indirect Input | Loader-delivered ransomware payloads enable the intrusions that produce exfiltrated data for DLS population. |
| Module 05 — IABs | Indirect Input | IAB-supplied initial access enables intrusions; exfiltration volume is a function of access quality; DLS posting rates correlate with IAB market health. |
| Module 07 — RaaS Operators | Primary Driver | Operators direct DLS publication schedules, escalation logic, and deadline enforcement; DLS is the execution layer of operator-defined double-extortion policy. |
| Module 09 — BPH | Critical Infrastructure | BPH providers host virtually all DLS infrastructure; BPH resilience is the primary determinant of DLS operational continuity. |
| Module 10 — Underground Forums | Reputation Channel | Operators advertise DLS posting volumes on forums as brand-health signals; forums also serve as secondary distribution channels for DLS links. |
| Module 11 — Crypto Mixers | Downstream | DLS pressure drives ransom payments; those payments are routed through mixers for obfuscation before affiliate/operator cash-out. |
| Module 12 — OTC Brokers | Downstream | Large ransom payments triggered by DLS pressure are the primary input to OTC broker cash-out operations. |

# SECTION 4 — DISRUPTION LEVERAGE POINTS

## 4.1 Primary Disruption Levers

| Lever | Mechanism | Owner | Best Method | Expected Effect | Backfire |
|---|---|---|---|---|---|
| BPH infrastructure disruption (Node 03) | Degrade or seize the BPH providers hosting DLS backbone; force migration of onion services and storage; engage upstream ISPs and registrars | FVEY LE + IC + upstream ISPs | Coordinated upstream provider engagement; server seizure through mutual legal assistance; multi-country joint operation | Multi-DLS simultaneous disruption if shared backbone; forces infrastructure migration costs; degrades uptime during migration window | LOW |
| VM template fingerprint targeting | Identify the shared Windows image used by BPH to spawn DLS/C2 servers; block or disrupt the template distribution or provisioning pipeline; alert cloud providers hosting image repositories | FVEY IC + private sector (Sophos, cloud providers) | Share template fingerprints with cloud and VPS providers; coordinated blocking; use Sophos-identified fingerprints as threat intel feed | Simultaneous disruption of 7,000+ fingerprint-matched servers; highest-leverage single technical action against DLS infrastructure | LOW |
| DLS domain seizure and disruption-notice replacement | Seize or disable specific onion/domain addresses; replace with law-enforcement notice | FVEY LE (NCA, FBI, Europol) | Joint LE operation with hosting provider cooperation or covert server access; replace | Psychological impact on affiliates and victim community; disrupts active | LOW |

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|---|---|---|---|---|---|
| | (Operation Cronos model) | | DLS landing page | negotiations; forces operator relaunch | |
| Exfiltration staging server seizure (Node 14) | Identify and seize staging servers holding exfiltrated data prior to DLS posting; eliminates content for future escalation; provides victim data recovery | FVEY LE (where victim cooperates) | Victim-cooperative forensics; IP tracing from exfil traffic; mutual legal assistance | Prevents further escalation for active campaigns; recovers victim data; degrades operator leverage | LOW |
| Torrent seed disruption | For groups using torrent distribution (Cl0p model), identify and remove active seeds; engage torrent tracker operators; accelerate peer-to-peer disruption | FVEY LE + private sector (torrent monitoring) | Tracker engagement; seed node identification and takedown requests; peer monitoring | Limits accessible leak data even when DLS listing survives; reduces data spread velocity | LOW |
| Victim rapid notification program | Notify victim organizations of active DLS postings and impending deadlines; provide sector-specific guidance on non-payment and breach disclosure; reduce payment rate by reducing information asymmetry | CISA + FBI + sector-specific agencies (HHS for healthcare) | Automated DLS monitoring feeding victim notification system; sector-specific rapid-response protocols | Reduces victim payment rate by removing uncertainty; normalizes non-payment response; degrades DLS extortion leverage over time | LOW |
| Clearnet mirror and CDN takedown | Identify and request removal of clearnet DLS mirrors behind CDN providers; abuse report to CDN operators; degrade accessibility for non-Tor users | Private sector (CDN operators: Cloudflare, Akamai, etc.); FVEY LE support | Abuse report escalation; FVEY LE engagement with major CDN providers for ransomware DLS mirror removal | Reduces DLS reach for media, journalists, and non-Tor users; limits secondary amplification of DLS content | LOW |

## 4.2 Compounding Actions

- Simultaneous BPH backbone seizure and DLS disruption-notice replacement: The Operation Cronos model applied specifically to DLS infrastructure. Seizing the BPH infrastructure hosting the DLS while replacing the DLS landing page with a law-enforcement notice delivers maximum psychological impact to the affiliate community simultaneously with maximum operational disruption.
- VM template fingerprint sharing as a force multiplier: If Sophos-identified template fingerprints are shared with major cloud and VPS providers as a threat intelligence feed, those providers can proactively block provisioning of template-matched VMs. This is a proactive, non-operational disruption action with no backfire risk that could prevent thousands of new DLS instances from being launched.

- Victim notification concurrent with DLS disruption: Notifying active DLS victims of law-enforcement action removes their payment incentive during the disruption window, preventing operators from collecting ransom even if they quickly relaunch on backup infrastructure.
- Staging server seizure before full leak deadline: Law enforcement with access to exfiltration staging server infrastructure can prevent full data release even if the DLS listing itself survives. This breaks the escalation chain and eliminates the final leverage point for operators who have already posted victims.
- Multi-tenant DLS provider targeting as ecosystem-wide action: Identifying and disrupting a cartel-style shared DLS backbone simultaneously disrupts all tenant groups without requiring individual group attribution, compressing the per-group disruption cost substantially.

# SECTION 5 — RESILIENCE AND REPLACE DIFFICULTY

## 5.1 Replace Difficulty Assessment

| Level | Assessment | Rationale |
|---|---|---|
| Specific DLS instance (single brand, single onion address) | VERY LOW | Individual onion addresses can be regenerated and re-published within hours. LockBit relaunched DLS infrastructure within days of Operation Cronos. The specific address is trivially replaceable. |
| DLS operational capability for a specific brand | LOW-MEDIUM | Rebuilding integrated DLS (with negotiation panel, victim tracking, payment portal) requires more effort and time than simple address replacement; estimated days to weeks if BPH infrastructure remains available. |
| BPH hosting backbone underlying DLS | MEDIUM-HIGH | BPH providers are harder to replace; operators must identify a new provider, migrate infrastructure, and re-establish onion addresses. This process takes days to weeks and introduces operational exposure during migration. |
| VM template provisioning pipeline | HIGH | The Sophos-identified template provisioning model requires a specific BPH operational pattern; disrupting the template source or the provider using it cannot be immediately replaced with equivalent industrial-scale capability. |
| DLS-as-a-Service provider ecosystem | MEDIUM | The DLS-as-a-Service market has multiple providers (Media Land, BEARHOST, Voodoo Servers, others); disruption of one drives migration to alternatives. Full ecosystem disruption would require simultaneous action against multiple providers. |
| DLS function overall (ecosystem level) | LOW | The DLS function is trivially replaceable at the ecosystem level; any actor with BPH access and basic web development capability can launch a functional DLS. The function itself cannot be disrupted without comprehensive upstream BPH and infrastructure pressure. |

## 5.2 Redundancy and Structural Resilience

- Multiple redundant onion addresses: Major operators maintain 3-10 backup onion addresses per DLS; a single address seizure has minimal operational effect. Only full hosting backbone disruption achieves meaningful uptime impact.
- Mirror infrastructure: Clearnet mirrors, CDN-backed proxies, and Tor2web gateways provide additional redundancy layers. Even if the primary onion address is seized, mirrors may remain accessible.

- Low technical barrier to DLS construction: A functional DLS requires only a Tor-accessible web server, basic HTML/PHP, and BPH hosting. Pre-configured DLS templates are available as-a-service. There is no meaningful technical barrier to entry for new DLS operators.
- Torrent distribution model eliminates DLS hosting dependency for data delivery: Once data is seeded to a torrent network, the DLS can be taken down without preventing victims from accessing leaked data. This is the structural evolution that makes Cl0p-style operations most resilient to DLS takedown.
- BPH provider diversity: The BPH market (Node 03) has sufficient depth that disruption of any single provider drives migration rather than elimination. This constrains the impact of DLS disruption that relies on BPH backbone takedown.

### 5.3 Historical Reconstitution Table

| Event | DLS Impact | Reconstitution Time | Outcome |
|---|---|---|---|
| Operation Cronos — LockBit DLS seizure (Feb 2024) | Primary onion addresses seized; law-enforcement disruption notice posted | Days (new onion addresses announced within 72 hours) | LockBit relaunched DLS on backup infrastructure; brand activity reduced but not eliminated; affiliates partially migrated to RansomHub |
| ALPHV/BlackCat FBI seizure (Dec 2023) | ALPHV DLS and negotiation portal seized; decryptor published | ~2 weeks to new DLS; then exit scam | ALPHV operators relaunched briefly before conducting exit scam; DLS function migrated to RansomHub for displaced affiliates |
| Hive FBI disruption (Jan 2023) | Hive DLS and negotiation panel infiltrated; decryptors distributed to victims; infrastructure seized | No reconstitution (group disbanded) | Unique case: FBI maintained covert access for 7 months before public seizure; decryptors distributed to 300+ victims; estimated $130M in payments avoided. Hive did not reconstitute. |
| Operation Duck Hunt — Qakbot takedown (Aug 2023) | Not a DLS takedown; loader takedown affected affiliate access supply | DLS unaffected; access supply disrupted | Illustrates that non-DLS disruptions upstream can indirectly degrade DLS posting rates by reducing affiliate operational capacity. |

### 5.4 Durability Assessment

| Factor | Rating | Notes |
|---|---|---|
| Technical barrier to DLS operation | VERY LOW | Pre-configured DLS-as-a-service and BPH availability make DLS launch accessible to any operator with basic technical capability. |
| BPH market depth (hosting resilience) | HIGH | Sufficient BPH provider diversity to absorb disruption of individual providers without ecosystem-level impact. |
| Torrent distribution model resilience | VERY HIGH | Once data is seeded to torrent network, DLS takedown cannot prevent data access; torrent model structurally defeats hosting-level disruption. |
| Law-enforcement DLS disruption track record | LOW-MEDIUM | LE has achieved temporary DLS disruption; no documented case of permanent DLS function elimination for a major group (Hive partial exception). |

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|---|---|---|
| Ecosystem-level DLS function durability | HIGH | DLS as a function is essentially permanent given low technical barriers and BPH availability; disruption produces temporary effects and brand migration, not functional elimination. |

# SECTION 6 — INDICATORS AND KPIs

## 6.1 Health Indicators — Normal vs. Under Pressure

| Indicator | Normal / Stable State | Under Pressure |
|---|---|---|
| Monthly DLS victim postings | 600-1,266 victims/month across all groups (2024 range) | Sustained drop below 400/month would indicate meaningful disruption; drop below 200/month would indicate severe ecosystem disruption |
| Active DLS count (unique groups posting) | 30-40 active groups posting per month | Drop to fewer than 15 active DLS groups per month |
| DLS uptime following LE action | Relaunched within 72 hours (LockBit model) | Relaunch taking >2 weeks or no relaunch indicates BPH infrastructure disruption rather than address-only takedown |
| New DLS launches per quarter | 10-20 new DLS brands per quarter (fragmentation trend) | Drop to <5 new launches per quarter; indicates BPH market pressure or ecosystem cooling |
| Torrent seed activity (Cl0p and similar) | Continuous seeding of new victim datasets | Seed count declining; magnet links producing no accessible data — indicates effective seed disruption |
| BPH provider availability (Node 03) | Established BPH providers advertising DLS hosting on forums | Providers going dark; forum advertising declining; multiple providers reporting law-enforcement engagement |
| Victim payment rate trends (downstream) | Decreasing non-payment trend (H2 2024: 53% gap) | Further decline in payment rate to <30% of demanded amount indicates DLS pressure losing effectiveness |

## 6.2 Disruption KPIs

| KPI | Baseline | Disruption Target (18-month) | Collection Method |
|---|---|---|---|
| Monthly DLS victim postings | ~1,050 avg/month (Q1-Q3 2024) | <500/month sustained | Leak-site aggregator monitoring (Secureworks CTU, Corvus, Mandiant, Flashpoint) |
| DLS uptime following LE disruption action | 72 hours to relaunch (LockBit standard) | >30 days to relaunch following any major DLS takedown | DLS monitoring; forum intelligence on relaunch announcements |
| Active DLS brands per month | 30-40 active groups | <20 active groups per month | Aggregator monitoring; Secureworks/Corvus quarterly reports |
| BPH provider advertising DLS-as-a-Service | Multiple providers actively advertising on XSS/RAMP | Visible reduction in DLS hosting advertising on major forums | Forum monitoring (Intel471, Flashpoint, Recorded Future) |

| | | | |
|---|---|---|---|
| VM template fingerprint block rate | 0% (no current blocking program) | >50% of Sophos-identified template fingerprints blocked by major cloud/VPS providers | Coordination tracking with cloud providers; Sophos research updates |
| Hive-model operations (covert access prior to takedown) | 1 documented case (Hive, 2023) | 2+ additional covert-access operations within 18 months | LE operational outputs; DOJ/NCA press releases |
| Victim rapid-notification coverage | Estimated <20% of DLS-listed victims notified by LE within 48 hours | >60% of DLS-listed victims notified within 48 hours | CISA/FBI victim notification program metrics |

### 6.3 Collection Methods

- Leak-site aggregation platforms (Secureworks CTU, Corvus/Travelers, Mandiant, Group-IB, Flashpoint) provide near-real-time victim posting data across all active DLS; this is the primary open-source indicator for DLS health and disruption assessment.
- Tor monitoring tools track onion address availability and uptime; law enforcement and private sector researchers maintain continuous DLS availability monitoring.
- Underground forum monitoring (Intel471, Flashpoint, Recorded Future) tracks DLS hosting advertisements, operator reputation management, and new DLS launch announcements.
- Torrent tracker monitoring can identify active seeds for leaked datasets; provides intelligence on distribution volume and data spread after full-leak publication.
- BPH provider leak/breach intelligence: The Media Land 2025 internal data leak is a model case; BPH provider compromise or internal leak provides direct mapping of DLS instances to hosting accounts.
- VM template fingerprint databases (Sophos, proprietary): Fingerprint-matching against known template images allows cluster identification of previously unlinked servers.

### 6.4 Baseline Data Table

| Metric | Value | Period | Source |
|---|---|---|---|
| DLS victim postings Q1 2024 | 1,041 | Q1 2024 | ReliaQuest |
| DLS victim postings Q2 2024 | 1,237 (+20% QoQ) | Q2 2024 | ReliaQuest |
| DLS victim postings Q3 2024 | 1,266 | Q3 2024 | ReliaQuest |
| Single-month peak (December 2024) | 621 victims claimed | December 2024 | BankInfoSecurity |
| Active double-extortion groups (YoY change) | +30% YoY | July 2023 to June 2024 | Secureworks |
| Peak simultaneous group activity | 40 groups posting in May 2024 | May 2024 | Secureworks |
| Ransomware servers from single BPH VM image | >7,000 servers | 2021 to present | Sophos / Cybernews |
| LockBit BPH-to-DLS linkage duration | >6 months same IP space | Pre-Cronos | Intel471 |
| Hive FBI covert access duration | 7 months before public seizure | 2022-2023 | DOJ |
| Hive: victim payments avoided via decryptor distribution | ~$130M estimated | 2022-2023 | DOJ / FBI |

### 6.5 Alert Thresholds

| Threshold Event | Trigger Level | Recommended Action |
|---|---|---|
| New DLS with healthcare-specific targeting surge | >30 healthcare victims posted within first 45 days of new DLS appearance | Immediate DLS profiling; HHS/OCR notification; CISA healthcare alert; rapid victim notification program activation |
| Single BPH provider hosting >10 active DLS brands | Intelligence indicating one BPH backbone hosting 10+ brands simultaneously | Prioritize that BPH provider for Node 03 disruption action; coordinated multi-DLS takedown opportunity |
| New torrent-model adopter emergence | New group seeding 50+ victim datasets via torrents within first 60 days | Immediate seed disruption protocol; tracker engagement; forensic preservation of seeded data for victim notification |
| DLS posting surge (monthly record) | Monthly total exceeds 700 victims across all groups | Escalate ecosystem-level monitoring; surge victim notification capacity; assess whether new BPH provider has entered market |
| BPH provider forum advertising disappearance | Established DLS-hosting provider stops advertising on major forums | May indicate LE action or provider exit; monitor for rapid migration signal; potential disruption window |

## SECTION 7 — SOURCES AND CONFIDENCE

### 7.1 Primary Sources

Operational and Ecosystem Reporting:

- Unit 42 / Palo Alto Networks — "Ransomware Retrospective 2024: Leak Site Analysis" and "Ransomware Review: First Half of 2024" (DLS history, Cl0p torrent model, victim-listing operational logic, DLS usage patterns across RaaS families).
- ReliaQuest — "Ransomware and Cyber Extortion Q1/Q2/Q3 2024" (quarterly DLS victim count data: 1,041 / 1,237 / 1,266; single-extortion campaign examples including Snowflake and Fortinet breach cases; group-specific DLS trend analysis).
- Secureworks CTU — "State of the Threat" annual and interim reporting (30% YoY increase in active double-extortion groups; 40 groups posting simultaneously in May 2024).
- BankInfoSecurity — "Ransomware Leak Sites Suggest Attacks Reached Record High" (621 victims claimed in December 2024; record monthly DLS activity analysis).

Infrastructure and Hosting Intelligence:

- Risky Biz — "Hackers Leak Data from Major Bulletproof Hosting Provider" (Media Land 2025 internal data leak confirming hosting of ransomware DLS, C2, phishing kits, and exfiltration nodes on shared infrastructure).
- Cybernews / Sophos — "Reused Windows Images Hid Ransomware Servers" (template-based VM provisioning; >7,000 ransomware-linked servers from single Windows image; implications for C2, DLS, and exfil staging infrastructure).
- Intel471 — "Bulletproof Hosting: A Critical Cybercriminal Service" (BPH role in ransomware DLS; LockBit 2.0 infrastructure hosted on same BPH IP space for >6 months; provider profiling).
- Resecurity — "Qilin Ransomware and the Ghost Bulletproof Hosting Conglomerate" (Qilin WikiLeaksV2 DLS dependency on BEARHOST/Underground/Voodoo Servers; ghost conglomerate BPH model and multi-DLS dependency chains).

Contextual and Supplementary:

- Analyst1 — "Ransomware and Extortion Activity in 2024" (DLS usage trends, affiliate splinter site patterns, fragmentation effects on DLS landscape).
- BlackFog — "State of Ransomware 2024" (contextual DLS usage statistics and extortion trend analysis).
- DOJ / FBI press releases — Hive disruption (January 2023): covert access duration, victim notification program, decryptors distributed, estimated payments avoided.
- NCA / Europol Operation Cronos — LockBit DLS seizure and disruption-notice replacement documentation.

## 7.2 Gaps and Uncertainties

- Cartel-style multi-tenant DLS platform internal structure: Attribution of which BPH backbone is hosting multi-tenant DLS instances for coalition groups is assessed as CREDIBLE based on structural analysis but not CONFIRMED with specific infrastructure evidence in open reporting.
- Torrent seeding infrastructure attribution: Once data is seeded to BitTorrent, precise attribution of seed infrastructure to specific RaaS operators is technically complex; current reporting identifies the Cl0p model but does not provide seed server attribution.
- Full scope of DLS-as-a-Service market: The documented providers (Media Land, BEARHOST, Voodoo Servers) represent the confirmed tip of the market; the full population of DLS hosting providers is unknown.
- Affiliate splinter site population: The total number of affiliate-operated splinter DLS instances is unknown; these are typically low-traffic and may not appear in standard aggregator monitoring.
- DLS victim count accuracy: DLS postings are operator-self-reported and may include exaggeration, duplicate listings, or victims who have already paid. Aggregator counts are the best available proxy but are not independently verified victim counts.

## 7.3 Confidence Notes

| Claim / Finding | Confidence | Basis |
|---|---|---|
| DLS victim posting rates Q1-Q3 2024 (ReliaQuest data) | CONFIRMED | ReliaQuest quarterly reports; corroborated by Secureworks and Corvus monitoring |
| December 2024 monthly peak (621 victims) | CONFIRMED | BankInfoSecurity reporting on DLS aggregator data |
| Media Land hosting ransomware DLS (2025 leak) | CONFIRMED | Internal data leak; Risky Biz reporting on documented infrastructure |
| Sophos: 7,000+ servers from single BPH VM template | CONFIRMED | Sophos primary research; Cybernews reporting; reproducible technical finding |
| Intel471: LockBit DLS on same BPH IP space >6 months | CONFIRMED | Intel471 infrastructure profiling; corroborated by Operation Cronos attribution |
| Qilin WikiLeaksV2 dependency on BEARHOST conglomerate | CREDIBLE | Resecurity single-source analysis; strong structural inference; not independently corroborated |
| Cartel-style multi-tenant DLS platform existence | CREDIBLE | Structural inference from post-disruption fragmentation patterns; no specific provider publicly named with CONFIRMED attribution in open reporting |
| Affiliate splinter site operational patterns | CREDIBLE | Analyst1 and SC World reporting on post-operator-dispute re-posting behavior; limited open-source documentation of specific instances |

| | | |
|---|---|---|
| Torrent model adoption beyond Cl0p | ANALYST INFERENCE | Cl0p torrent model is CONFIRMED; broader adoption across other groups is inferred from operational logic but not documented with named examples in provided sources |

# SECTION 8 — ANALYST ASSESSMENT

## 8.1 Key Takeaway

Leak site operations are the enforcement mechanism of double extortion — the layer that converts data theft into sustained, escalating payment pressure. Without functional DLS infrastructure, ransomware collapses to single extortion (encryption only), which historically produces lower payment rates and is increasingly defeated by improved victim backup and recovery posture. The DLS layer is therefore growing in relative importance to operator revenue as organizational recovery capabilities improve.

The 2024-2026 baseline data confirms accelerating DLS activity: victim postings increased from 1,041 in Q1 2024 to 1,266 in Q3, with a single-month peak of 621 in December 2024. This growth occurs alongside the two most significant law-enforcement operations against major DLS operators in the sector's history. The resilience of DLS volume despite Operation Cronos and the ALPHV seizure confirms that brand-level DLS disruption does not translate to ecosystem-level DLS volume reduction.

The Sophos VM template finding is the most analytically significant infrastructure intelligence in this module. The identification of 7,000+ ransomware-linked servers spawned from a single Windows image represents a previously unquantified force-multiplication opportunity: distributing that fingerprint as a threat-intelligence feed to cloud and VPS providers could disable industrial-scale DLS and C2 infrastructure simultaneously without requiring individual group attribution or law-enforcement operations.

## 8.2 Priority Recommendations

**Recommendation 1 — Operationalize the VM Template Fingerprint as a Disruption Vector:** The Sophos finding that a single Windows image template underlies 7,000+ ransomware-linked servers is an unexploited disruption opportunity. Formalizing the sharing of these fingerprints with major cloud providers (AWS, Azure, GCP), VPS marketplaces, and upstream hosting registries as a threat-intelligence feed — similar to existing malware hash-sharing programs — would produce proactive, pre-operational disruption of DLS and C2 infrastructure at scale. This is the highest-leverage technical action available against DLS infrastructure that does not require law-enforcement operations or international coordination.

**Recommendation 2 — Prioritize BPH Backbone Disruption Over Individual DLS Takedown:** Individual DLS address seizures (LockBit model) produce days-long disruption before relaunch. BPH backbone disruption — targeting the hosting provider rather than the hosted site — forces full infrastructure migration and imposes weeks-long operational disruption while simultaneously affecting all DLS instances on that backbone. Resources currently allocated to individual DLS monitoring and seizure should be rebalanced toward Node 03 (BPH) identification and upstream provider engagement. The multi-tenant DLS model makes this rebalancing particularly high-yield: one backbone disruption can simultaneously take down multiple brands.

**Recommendation 3 — Expand the Hive Covert-Access Model:** The Hive operation is the only documented case of full DLS function elimination for a major group. The key mechanism was 7 months of covert access that allowed the FBI to provide decryptors to 300+ victims and avoid an estimated $130M in ransom payments — all before public seizure. The covert-access model defeats operator reconstitution by removing the payment incentive without alerting the operator to law-enforcement presence. Expanding this model to additional active DLS operators, while maintaining extended covert access periods before public seizure, represents the highest-impact disruptive approach to the DLS layer that current operational methods support.

**Recommendation 4 — Institutionalize Victim Rapid-Notification for DLS-Listed Organizations:** Current victim notification following DLS listing is estimated to reach fewer than 20% of posted victims within 48 hours. A

systematic, automated DLS monitoring-to-victim-notification pipeline — feeding CISA, FBI, and sector-specific agencies (HHS/OCR for healthcare) — would reduce victim information asymmetry and normalize non-payment as the organizational default. This is a supply-side intervention: rather than disrupting the DLS infrastructure itself, it degrades the effectiveness of DLS pressure by ensuring victims receive immediate expert guidance on non-payment options and breach disclosure requirements.

### 8.3 Connection to EDP Disruption Playbook

- Phase A (Nodes 01, 02, 03): Node 03 (BPH) is the critical infrastructure layer for DLS operations. Phase A BPH disruption is simultaneously DLS disruption. Every action against Node 03 directly degrades Node 06. The sequencing logic is clear: Phase A BPH actions should be designed to include DLS backbone targeting as an explicit objective, not an incidental effect.
- Phase B (Nodes 04, 07, 08): Forum disruption (Node 07) degrades DLS credibility and affiliate recruitment that DLS posting volumes sustain. Mixer disruption (Node 08) intercepts the ransom payments that DLS pressure generates. Phase B actions compound Phase C DLS disruption by reducing both the demand for DLS services (affiliate recruitment) and the financial output (payment routing).
- Phase C (Nodes 05, 06, 09): Node 06 is a direct Phase C target. The DLS takedown sequence — BPH backbone disruption (from Phase A) followed by domain seizure and disruption-notice replacement, concurrent with victim rapid notification and decryptor provision — is the ideal Phase C DLS operation. Exfil staging server seizure (Node 14) supplements by preventing escalation even when DLS infrastructure survives.

### 8.4 Node 06 Dependency Map Assessment

The current Dependency Map assessment for Node 06 is:

- Tier: HIGH
- Replace Difficulty: MEDIUM
- Primary Owner: FVEY LE + IC (attribution); upstream hosting providers (takedown)
- Backfire: LOW

This module's analysis supports the existing assessment with two refinements:

| Dimension | Current Map Assessment | Module 08 Refined Assessment | Basis |
|---|---|---|---|
| Replace Difficulty | MEDIUM | MEDIUM (confirmed), with important sub-distinction: individual DLS address is VERY LOW; DLS-as-a-function is LOW; BPH backbone dependency is MEDIUM-HIGH. The current single-level rating obscures strategically important variation. | Section 5.1 replace-difficulty table; reconstitution history analysis |
| Primary Owner | FVEY LE + IC (attribution); upstream hosting providers (takedown) | Add: private sector (cloud providers, CDN operators) as a proactive disruption owner via VM template fingerprint blocking and clearnet mirror takedown. Current framing is too LE-centric for the most actionable disruption methods. | VM template finding (Sophos); CDN abuse-report takedown model |
| Tier Sufficiency | HIGH | HIGH confirmed. DLS is growing in relative importance as encryption-recovery capability improves; its effective tier is trending upward over time. Recommend flagging for potential CRITICAL reclassification in next Dependency Map revision. | Module 07 cross-reference; increasing non-payment rate analysis |

## 8.5 Follow-On Research Priorities

| Research Question | Priority | Rationale | Suggested Source / Method |
|---|---|---|---|
| Full mapping of DLS-as-a-Service provider market: how many active providers exist beyond Media Land, BEARHOST, and Voodoo Servers? | HIGH | Current open-source data identifies three providers; full market depth is unknown. Knowing the full provider population is prerequisite for comprehensive BPH-as-DLS-backbone disruption planning. | Intel471 and Flashpoint forum monitoring for hosting advertisements; IC collection against known providers |
| Torrent adoption rate: which active groups beyond Cl0p are using torrent distribution, and for what victim categories? | HIGH | If torrent adoption is widespread, DLS hosting-level disruption becomes structurally insufficient; torrent-specific disruption protocols would require development. | DLS monitoring for torrent/magnet link postings; Corvus/Secureworks dataset analysis |
| VM template fingerprint database completeness: has Sophos identified the full population of template variants, or are additional templates in use? | HIGH | The 7,000-server finding may represent a subset of the full template-based server population; full scope assessment is required before cloud-provider fingerprint-blocking is operationalized. | Collaborative research with Sophos; expand fingerprint database via shared threat-intelligence program |
| Multi-tenant DLS provider attribution: which specific BPH entity is providing the shared backbone for coalition-style multi-tenant DLS platforms? | MEDIUM | Multi-tenant takedown opportunity cannot be operationalized without confirmed provider attribution; current evidence is structural inference only. | IC collection; Resecurity and Intel471 infrastructure profiling; law-enforcement operational intelligence |
| Pure extortion DLS growth rate: are data-theft-only (no-encryption) campaigns growing as a share of total DLS postings? | MEDIUM | If pure extortion is growing, it indicates the DLS layer is decoupling from the encryption layer, which changes the disruption logic and the value of decryptor provision as a counter. | ReliaQuest quarterly data; Coveware victim-side TTP analysis on encryption vs. data-only incidents |

## 8.6 Module 08 Assessment Summary

Node 06 (Leak-Site Hosting Stack) is correctly placed at HIGH tier in the EDP Dependency Map. Its disruption logic is well-defined: BPH backbone (Node 03) is the primary structural lever; individual DLS address takedowns are low-value cosmetic actions; the Hive covert-access model is the highest-impact LE method available; and the VM template fingerprint is an unexploited force-multiplication opportunity that can be operationalized through private sector coordination without law-enforcement operations.

The trend line for DLS operations is upward: victim postings grew quarter-over-quarter throughout 2024, reached a single-month record in December 2024, and the pure-extortion variant is expanding the DLS model beyond the traditional ransomware-operator market. Disruption investment in Node 06 infrastructure must be calibrated against this growth trajectory. Static investment produces declining disruptive effect; scaling disruption capacity commensurate with DLS growth is the minimum condition for maintaining current leverage ratios.