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TOP SECRET//SI//REL TO USA, FVEY

(U) TURMOIL/APEX/APEX High Level Description Document

TOP SECRET//SI//REL TO USA, FVEY

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[\[edit\]](#) **(S//SI//REL) APEX: Active-Passive**

KEYHOLE//ORCON/PROPIN/RELIDO/REL TO USA, FVEY *
~~Integration with TURMOIL~~

DC Radar Task 4, Modernizing VoIP and VPN

[\[edit\]](#) (U) Motivation

(TS//SI//REL) [APEX](#) describes the cross-organizational effort to achieve a capability for shaping of TAO active collection from [HAMMERMILL](#) routers to [TURMOIL](#), a midpoint passive collector. The collection missions for this effort are targeted VoIP collection ([HAMMERCHANT](#)) and collection of [IPSec VPN](#) traffic ([HAMMERSTEIN](#)). The desire to have the active-passive integration capability is driven by three key motivations: scaling the exploitation of streaming content, enhancing the likelihood of success for the VPN capability, and eventually creating new capabilities that can't be achieved separately. In specific:

- Routers exfiltrate content in real-time as a packet stream rather than as a file. Current TAO backend collectors for HAMMERMILL are expected to be strained with a large number of streaming packet exfil sessions. The current backend capacity to receive HAMMERMILL streams is expected to limit the number of simultaneous VoIP or VPN streams that can be received.
- The capability to decrypt selected IPSEC/[ESP](#) streams is built into TURMOIL, as is the capability to route back to CES the IPSEC key exchanges necessary to recover selected keys. Directing IPSEC VPN traffic to TURMOIL puts it where it can be most efficiently used.
- Integration with TURMOIL and TURBINE will enable HAMMERMILL missions to leverage TURMOIL selection and targeting rather than operating stand-alone. This would make implants lighter, and less complex, at the expense of possibly more exfilled traffic.

(TS//SI//REL) The end-state goal of the APEX development is to

- Achieve the real-time exfil of HAMMERMILL active collection and direct it to a TURMOIL passive collector that can recognize the traffic, unwrap the packets from the TAO protocol, and restore the packets to their original state.
- Perform appropriate processing/forwarding of the unwrapped content to corporate repositories, and optionally perform further target identification and traffic selection in TURMOIL
- Engage TURBULENCE storage and analytic processes for delivery of content to analysts
- Enable TURBINE dynamic control of both HAMMERMILL and TURMOIL, allowing near-real-time implant tasking based on feedback from TURMOIL.

[\[edit\]](#) (U) Background

[[edit](#)] (U) IPSEC VPN/IKE/ESP Protocols

(TS//SI//REL) [IPSec](#) describes a suite of protocols for creation of VPN tunnels between devices. [IKE](#) is the protocol used to exchange cryptographic parameters and establish a secure tunnel. [ESP](#) is the protocol that performs the packet-by-packet encryption. A wide variety of algorithms of varying strengths may be used within IPSEC. CES generally requires the packets from both sides of an IKE exchange and knowledge of the associated pre-shared key (PSK) in order to have a chance of recovering a key for the corresponding cipher (ESP). A major goal of APEX is to access two sides of key exchanges for traffic of interest.

[[edit](#)] (U) HAMMERMILL/HAMMERCHANT/HAMMERSTEIN

(TS//SI//REL) [HAMMERMILL](#) is the base capability for implants on a family of routers. Built on HAMMERMILL are a suite of mission applications for collection of various types of traffic. HAMMERMILL uses FASHIONCLEFT to exfil a copy of targeted data as a packet stream.

(TS//SI//REL) HAMMERMILL 2.0 is deployed and is commanded by a custom command interface. Targeting information must be delivered via these manually initiated commands to the HAMMERMILL application. HAMMERMILL 2.5 is designed to accept command and control via CHIMNEYPOOL messages and is awaiting testing.

(TS//SI//REL) [HAMMERSTEIN](#) is a HAMMERMILL application module that is tasked to collect all packets that match a 5-tuple filter of source and destination IP address, source and destination port, and protocol. HAMMERSTEIN can collect IKE and ESP based on a 5-tuple filter. [HAMMERCHANT](#) is an application module that identifies VoIP (H.323/SIP) signaling passing through the router, extracts the user identifiers, and collects the call if one of the users corresponds to an entry on its target list.

[[edit](#)] (U) FASHIONCLEFT Protocol/CDR

(TS//SI//REL) [FASHIONCLEFT](#) is the protocol used by HAMMERMILL and other TAO implants to deliver collected data back to the TAO Common Data Receptor (CDR). FASHIONCLEFT precedes an exfil session with a strongly encrypted Session Announcement that describes the parameters of the exfil session.

[[edit](#)] (S//SI//REL) TURMOIL Existing Capability - VPN

(TS//SI//REL) TURMOIL is a passive filtering and collection device targeting high-speed networks. Within TURMOIL are existing (passive) IPSEC processing capabilities, processing IKE and ESP packets identified by the TURMOIL front-end filtering.

(TS//SI//REL) The passive VPN metadata generation capability receives IKE packets from TURMOIL's front-end packet filtering and creates a metadata record for each key exchange seen, destined eventually for the [TOYGRIPPE](#) database. This process can be deployed anywhere a TURMOIL is deployed.

(TS//SI//REL) The "PIQ blade" processes targeted IKE and ESP. This capability cannot be deployed to all TURMOIL sites, only to those that meet CES security constraints.

(TS//SI//REL) The PIQ blade performs two main tasks. It checks the IKE source and destination addresses against a target list stored in KEYCARD. If one of these is targeted, it sends the key exchange packets back in near-real-time to CES databases via a connection directly to the CES Attack Orchestrator (AO).

(TS//SI//REL) The PIQ blade also receives ESP traffic. When a new targeted tunnel is observed, the PIQ blade asks the AO if a key is available and buffers the ESP traffic as long as it can while waiting for a key. If a key is returned, the ESP is decrypted and the underlying IP packets are made available for other application processing in TURMOIL. Because ESP encrypts packet-by-packet, the PIQ blade can begin decryption of a session when a key arrives, even if the earliest packets have fallen out of the buffer.

[\[edit\]](#) (S//SI//REL) TURMOIL Existing Capability - VoIP

(S//SI//REL) TURMOIL also contains existing capability for processing VoIP traffic, including [SIP](#) and [H.323](#). Capabilities for other VoIP protocols are in development. The passive capability relies on seeing the signaling setting up a call, extracting identifiers related to the calling and called parties, looking up these identities for targeting information (via a KEYCARD lookup), and collecting targeted traffic. TURMOIL also has the capability to generate metadata records for all calls, not just targeted ones, for the FASCIA database.

[\[edit\]](#) (U) TURBINE

(TS//SI//REL) TURBINE is focused on command and control of covert implants. It can execute automated workflows and is designed to communicate with TURMOIL as well as other devices, enabling integration of active and passive information in near-real-time. TURBINE communicates with covert implants via [CHIMNEYPOOL](#) messages over a covert infrastructure, and with TURMOIL and other devices via [ISLANDTRANSPORT](#).

[\[edit\]](#) (TS//SI//REL) TOYGRIPPE and METROTUBE VPN Analytic

(TS//SI//REL) The TURMOIL component that creates metadata records from all IKE key exchanges forwards files of these metadata records to the PRESSUREWAVE database. METROTUBE is a framework for hosting analytic processes that operate on items in PRESSUREWAVE. The VPN Analytic is a METROTUBE-hosted process that is triggered when a new file of VPN

metadata arrives in PRESSUREWAVE. This process extracts the file, converts the records into a format that TOYGRIPPE ingests, and forwards the result to TOYGRIPPE. To support APEX, all three of the components manipulating the metadata - the TURMOIL metadata extractor, the VPN analytic and the TOYGRIPPE database - require modification to support the additional information about the data source that APEX provides (see [Analytic Challenges from APEX](#) [▣]).

[[edit](#)] (U) APEX

(TS//SI//REL) Currently HAMMERMILL exfls its packets by sending both the FASHIONCLEFT session announcement and the exfilled packet stream to one of the Common Data Receptor addresses. APEX changes the operation of HAMMERMILL exfil.

[[edit](#)] (TS//SI//REL) HAMMERMILL exfil operation in APEX

- The destination address for HAMMERMILL exfil is set to direct the traffic to a link that a TURMOIL can see.
- The TURMOIL APEX components are configured with the HAMMERMILL destination address and any ports needed to identify potential HAMMERMILL traffic with a 5-tuple filter. The APEX components are also provided with parameters needed to decrypt the FASHIONCLEFT protocol and reconstruct the exfilled packets to their original form.
- The APEX code unwraps the FASHIONCLEFT protocol, reconstructs the packets and directs them to an application-specific process (currently VoIP or VPN). This process is responsible for properly handling the application metadata delivered in the Session Announcement (e.g. to/from phone numbers for VoIP), the exfilled packets, and the configuration information in the TURMOIL configuration file to mark and direct datato the appropriate path for further processing.

[[edit](#)] (S//SI//REL) Follow-on processing paths within TURMOIL

(TS//SI//REL) After APEX unwraps FASHIONCLEFT, the reconstructed packets can be directed to one of two follow-on processing paths within TURMOIL, depending on the nature of the application: recirculation or forwarding.

(TS//SI//REL) The recirculation path presents the APEX-unwrapped packets and metadata to the TURMOIL filtering components as if they arrived on TURMOIL's passive input. The recirculated packets can then engage TURMOIL's passive processing and selection.

(TS//SI//REL) The forwarding path bundles the reconstructed packets together with appropriate metadata and sends the bundle home through the normal TURMOIL forwarding path to PRESSUREWAVE, where further analytic processes may be run to prepare the data for corporate consumption.

[\[edit\]](#) (S//SI//REL) APEX mission applications

(TS//SI//REL) Initial APEX missions are collection via TURMOIL of HAMMERSTEIN exfil of VPN traffic, and HAMMERCHANT exfil of targeted VoIP.

(TS//SI//REL) HAMMERSTEIN IPSEC exfil is an example of traffic for which there is an existing TURMOIL passive application. By recirculating the packets, the passive VPN applications will be engaged to perform their normal functions, though the packet stream will carry additional metadata related to the APEX processing.

(TS//SI//REL) HAMMERCHANT exfil is an example of traffic that is pre-selected and needs no further selection processing. Furthermore, the VoIP signaling is not exfilled along with the collection; information such as calling party and called party are carried as metadata in the FASHIONCLEFT Session Announcement. Recirculation cannot engage the passive VoIP components to perform formatting for the backend databases because these passive processes rely on seeing the SIP or H.323 signaling. The APEX process will take the HAMMERCHANT sessions, extract needed metadata from the Session Announcements to attach to the session, and forward directly back to the PRESSUREWAVE repository for analytic processing.

(TS//SI//REL) The initial APEX proof-of-concept missions - HAMMERSTEIN for VPN and HAMMERCHANT - will develop and demonstrate both of these paths

[\[edit\]](#) (U) APEX Command/ Control Development

(TS//SI//REL) To enable APEX, both TURMOIL and TURBINE must be supplied with configuration information and tasking. TURMOIL must have at minimum an implant ID, the address that this particular implant will put in the destination address of all its packets (and possibly ports), a key to unwrap the FASHIONCLEFT protocol, a TAO case notation to assign to the exfil, and appropriate TAO classification markings for the exfil. Other configuration metadata for the implant (PDDG, SIGAD, zip codes, etc.) may also be required.

(TS//SI//REL) In its end-state, command and control of both the HAMMERMILL implant and the TURMOIL APEX components will be performed through TURBINE. TURBINE will be responsible for configuring the implant with an address to send its traffic to and configuring a receiving TURMOIL with the parameters it needs to identify and process that mission's traffic. TURBINE will be able to receive information from TURMOIL processing of exfilled traffic, evaluate using a workflow, and deliver updated tasking to HAMMERMILL. Development to this end-state will occur in three phases:

- **C&C phase 1:** manual configuration: HAMMERMILL is configured via its existing command interface. Simultaneously TURMOIL APEX is provided a configuration file for this HAMMERMILL mission. A human is

responsible for keeping the two in sync.

- **C&C phase 2:** semi-automatic configuration for an already established presence: TURBINE receives the parameters for a mission and in an automated fashion configures both the HAMMERMILL implant and the corresponding TURMOIL APEX components. The TURBINE-HAMMERMILL interface will use CHIMNEYPOOL RPC commands, and the TURBINE-TURMOIL interface will use ISLANDTRANSPORT. HAMMERMILL 2.5 is the HAMMERMILL version that can receive CHIMNEYPOOL commands and is required for phase 2. HAMMERMILL 2.5 will be available only for low-end MIPS platforms.
- **C&C phase 3:** dynamic targeting for an already established presence: TURBINE sets initial configuration parameters as in Phase 2. Exfilled traffic is evaluated by TURMOIL components for potential additional targeting information. TURMOIL messages to TURBINE to dynamically target a particular flow through the router. An example is receiving an IKE key exchange (and possibly a few initial packets), evaluating the IP addresses to decide if the VPN being set up corresponds to a target, and messaging back to HAMMERMILL to capture and exfil the corresponding ESP.

(TS//SI//REL) Phase 3 of control must be managed so that router exfil does not exceed the tolerable bandwidth limits set by OPSEC and operational concerns. TURBINE may need to implement additional workflows in support of Phase 3 to monitor and control exfil volume. These workflows will have to be designed to fit the metrics and monitoring information that HAMMERMILL and APEX are capable of providing.

[\[edit\]](#) (S//SI//REL) APEX Application development

[\[edit\]](#) (TS//SI//REL) VPN phases

(TS//SI//REL) The development of the VPN process via APEX will proceed in a phased fashion.

- **VPN phase 1:** IKE metadata only: IKE packets are exfiled to TURMOIL and unwrapped by APEX, recirculated and presented to the VPN processing components. Metadata is extracted from each key exchange for the CES TOYGRIPPE metadata database. This database is used by SIGDEV analysts to identify potential targets for further exploitation.
- **VPN phase 2:** Targeted IKE forwarding: In addition to the metadata generation, the IKE addresses are looked up in KEYCARD. If either IP address is targeted, the key exchange packets are forwarded to the CES Attack Orchestrator.
- **VPN phase 3:** Static (manual) tasking of ESP: HAMMERSTEIN may be statically (manually) tasked to forward targeted ESP. The exfiltrated ESP

packets are unwrapped by APEX, recirculated and presented to the VPN processing components for potential decryption.

- **VPN phase 4:** ESP dynamic targeting: Based on the value returned by KEYCARD, the ESP for a particular VPN may be targeted as well. TURMOIL will send HAMMERSTEIN (via TURBINE) the parameters for capturing the ESP for the targeted VPN.

[\[edit\]](#) (TS//SI//REL) VoIP phases

(TS//SI//REL) HAMMERCHANT currently maintains its own list of targeted VoIP entities. It extracts identities from SIP or H.323 signaling, checks against its target list, and exfils only the voice content for targeted calls. This model could be expanded in the future using HAMMERSTEIN.

- **VoIP phase 1:** HAMMERCHANT Collect: HAMMERCHANT targeted VoIP RTP exfil is captured by TURMOIL. An APEX forwarding component bundles the voice packets into a file, attaches appropriate metadata, and delivers to PRESSUREWAVE. A variant of the passive VoIP analytic will be triggered to prepare the exfil for corporate delivery.
- **VoIP phase 2:** HAMMERCHANT Survey: HAMMERCHANT monitors all VoIP SIP and H.323 signaling and exfiltrates all call signaling metadata to TURMOIL. An APEX component puts the call signaling metadata into an ASDF record and publishes it to the TURMOIL AsdfReporter component.
- **VoIP phase 3:** HAMMERSTEIN: VoIP signaling is captured by HAMMERSTEIN using port information. The signaling is exfled to TURMOIL and unwrapped. This signaling is then presented to the normal TURMOIL VoIP processes. The metadata process will create metadata records for FASCIA. The collection process will extract identifiers from the signaling and check against KEYCARD to decide if the identifiers are targeted. If either calling party identifier or called party identifier is targeted for active exfil, then an extended TURMOIL VoIP component will extract the ports for the voice conversations and will send this information as a 5-tuple filter to HAMMERSTEIN, via TURBINE.

(TS//SI//REL) Implementation of the VoIP Phase 2 and 3 processes will be driven by mission need. The VoIP Phase 3 process should be advantageous in allowing HAMMERMILL to potentially expand beyond SIP and H.323 VoIP collection without additional code development in the implant, leveraging passive processing code.

[\[edit\]](#) (TS//SI//REL) Dataflow phases

- **Dataflow Phase 1:** Dataflow tested: Collected IKE is sent to CES database. Collected targeted data is deposited into PRESSUREWAVE and analysts can query and view the data.

- **Dataflow Phase 2:** Migrate additional HAMMERSTEIN voice flows to PRESSUREWAVE. Exfil all signaling via port selection and let the normal TURMOIL selection process select it.
- **Dataflow Phase 3:** Institutionalize APEX capability and continue to migrate other voice flows to PRESSUREWAVE.

[\[edit\]](#) Goals by Spin

[\[edit\]](#) (U) Spin 15 goals

(TS//SI//REL) The minimal goal for Spin 15 is to achieve **VPN phase 1** - IKE metadata extraction using **C&C phase 1** - manual configuration. The APEX VPN goal is complete when a CES / TAO VPN analyst validates the SRI and the IKE metadata content in TOYGRIPPE. See [TURMOIL Spin 15 Story/Requirements](#) [¶].

(TS//SI//REL) A highly desirable goal for Spin 15 is to achieve **VoIP phase 1** - HAMMERCHANT capture - with **C&C phase 1** - manual configuration. The APEX VoIP goal is complete when a VoIP analyst validates that RTP bundled by TURMOIL is correctly processed by the VoIP analytic and stored in CONVEYANCE.

[\[edit\]](#) (U) Spin 16 goals

(TS//SI//REL) The minimal goals for Spin 16 are

- to achieve **VPN phases 2 and 3** - targeted IKE forwarding and static tasking of ESP using **C&C phase 2** - semi-automatic configuration of HAMMERMILL and TURMOIL APEX components.
- to achieve **VoIP phase 1** - HAMMERCHANT targeted VoIP RTP exfil is captured by TURMOIL.
- to achieve **Dataflow phase 1** - Collected IKE is sent to CES database. Collected targeted data is deposited into PRESSUREWAVE and analysts can query and view the data.

[\[edit\]](#) (U) Spin 17 goals

(TS//SI//REL) The minimal goals for Spin 17 are

- to achieve **C&C phase 3 and VPN phase 4** - ESP dynamic targeting using TURBINE.
- to achieve **VoIP phase 2** - HAMMERCHANT Survey.
- to achieve **Dataflow Phase 2** - Migrate additional HAMMERSTEIN voice flows to PRESSUREWAVE.

[\[edit\]](#) (U) Spin 18 goals

(TS//SI//REL) The minimal goal for Spin 18 is to achieve **VoIP phase 3** - HAMMERSTIEN exfil'd VoIP signaling is processed by an extended TURMOIL VoIP component which will extract the ports for the voice conversations and will send this information as a 5-tuple filter to HAMMERSTEIN, via TURBINE.

[[edit](#)] (U) Spin 19 goals

(TS//SI//REL) The goal for Spin 19 is to institutionalize the APEX capability and continue to migrate other voice flows to PRESSUREWAVE.

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