F5 Networks

SSL Orchestrator 6.0 (15.0)

Lab Guide (Ravello Edition v3)

Participant Hands-on Lab Guide

Solutions for
an application world.

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WHAT IS THE F5 SSL ORCHESTRATOR?

F5 SSL Orchestrator (SSLO) provides an all-in-one appliance solution designed specifically to optimize the SSL infrastructure, provide security devices with visibility of SSL/TLS encrypted traffic, and maximize efficient use of that existing security investment. This solution supports policy-based management and steering of traffic flows to existing security devices, designed to easily integrate into existing architectures, and centralizes the SSL decrypt/encrypt function by delivering the latest SSL encryption technologies across the entire security infrastructure.

Multi-layered security

In order to solve specific security challenges, security administrators are accustomed to manually chaining together multiple point products, creating a bare-bones “security stack” consisting of multiple services. A typical stack may include components like Data Leak Prevention (DLP) scanners, Web Application Firewalls (WAF), Intrusion Prevention and Detection Systems (IPS and IDS), Malware Analysis tools, and more. In this model, all user sessions are provided the same level of security, as this “daisy chain” of services is hard-wired.

Dynamic service chaining

Dynamic service chaining effectively breaks the daisy chain paradigm by processing specific connections based on context provided by the Security Policy, that then allows specific types of traffic to flow through arbitrary chains of services. These service chains can include five types of services: layer 2 inline services, layer 3 inline services, receive-only services, ICAP services, and HTTP web proxy services.

Topologies

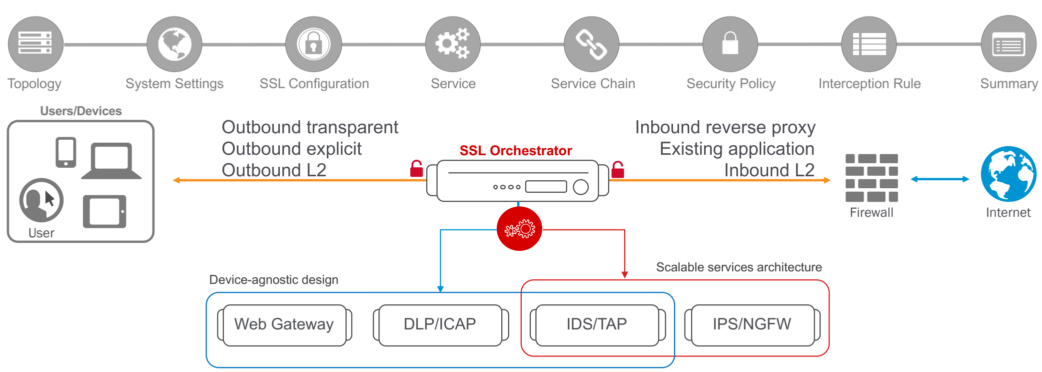
Different environments call for different network implementations. While some can easily support SSL visibility at layer 3 (routed), others may require these devices to be inserted at layer 2. SSL Orchestrator can support all of these networking requirements with the following topology options:

- Outbound transparent proxy
- Outbound explicit proxy
- Outbound layer 2
- Inbound reverse proxy
- Existing application
- Inbound layer 2

Security Policy

The SSLO Security Policy provides a rich set of context-aware methods to dynamically determine how best to optimize traffic flow through the security stack. Context can minimally come from the following:

- Source and destination address/subnet
- URL filtering and IP intelligence - Subscriptions
- Host and domain name
- Destination port
- IP geolocation
- Protocol



What's new in SSLO?

SSLO 4.0 provides significant architectural improvements over previous versions. Here are just a few of those updates:

- SSLO 4.0 replaces the complex iRules-based traffic classification and service chaining functions of previous versions with an Access per-request policy engine, providing much greater flexibility in traffic management options.
- SSLO 4.0 optimizes traffic flow through security services by replacing the complex "proxy hops" with a new "tee connector" – essentially a mid-proxy tap – that allows decrypted traffic to flow through security devices out-of-band from the main client-server proxy traffic. This is implemented as new "Service" and "Connector" profiles.
- SSLO 4.0 introduces new "split session" client and server SSL profiles, that are now responsible for carrying SNI signaling information across the inspection zone.
- SSLO 4.0 further optimizes traffic flow by reducing the amount of iRule data plane management, also making it easier to add customization iRules.
- SSLO 4.0 introduces three new network topologies. Along with the existing outbound transparent and explicit proxy flows, 4.0 now also supports inbound layer 3 (reverse proxy) inspection, and layer 2 transparent inbound and outbound topologies.

SSLO 4.0 also includes the following new functionality features:

- Explicit and transparent web proxy devices as an inline security service.
- Front-end explicit proxy authentication via APM integration (relies on existing SWG-Explicit access policy).
- FTPS (passive), SMTPS, POP3S, and IMAPS protocols inspection.
- ICAP advanced filtering via LTM CPM policy (relies on an existing CPM policy).
- URL filtering as a function of the Access per-request service chaining policy.
- Authentication headers - ability to define additional HTTP headers to pass to inline security services.
- vCMP support - ability to select existing VLANs for inbound and outbound to/from inline services.

SSLO 5.0 includes the following updates:

- Guided Configuration user experience, a complete refresh of the SSLO UI based on the Access Guided Configuration engine.
- Discreet "topology" definitions and the ability to define how SSLO listens for and processes traffic flows.
- Re-entrant, wizard-driven workflows. Based on the selected topology, SSLO 5.0 presents an intuitive workflow UI that walks the user through a simplified object creation process.

Note: Viprion chassis platform support is not available in SSLO 4.0 and 5.0.

WHAT'S NEW IN SSLO 6.0?

SSL Orchestrator 6.0 adds the following new features:

- **Transparent proxy captive portal authentication** – In transparent forward proxy mode, an APM authentication profile (SWG-Transparent) can now be applied to perform captive portal-based client authentication.

- **Reverse proxy (inbound SSLO) TLS 1.3 support** – TLS 1.3 can now be handled on both client and server side of SSLO for inbound SSLO topologies.

- **Service device monitor configuration** – It is now possible to define the monitors applied to inline service definitions.

- **Improved analytics dashboard** – SSLO now provides a separate analytics dashboard with enhanced statistical information.

- **Viprion chassis support** – SSLO can now function on Viprion platforms, in both vCMP and non-vCMP configurations.

- **Improved stability over previous versions**

This lab guide and corresponding Ravello lab environment are prepared for SSLO 6.0 on a BIG-IP 15.0 instance.

SSL ORCHESTRATOR LAB ENVIRONMENT

The lab environment for this guide has provided some prerequisite settings that you should be aware of. These are provided to make the demo simpler. All of the following would need to be configured manually in another environment.

- **Client side VLAN and subnet are pre-defined** – this is the VLAN that an internal client connects to for outbound traffic flows. SSLO does not define the client-side VLAN(s) and self-IP(s). A web server also exists on the client side VLAN to facilitate an inbound (reverse proxy) use case – external client to an internal set of websites.

- **Outbound side VLAN and subnet are pre-defined** – this is the VLAN that traffic egresses from SSLO to the Internet gateway. SSLO does not define the server-side VLAN(s) and self-IP(s).

- **ICAP service VLAN and subnet are pre-defined** – SSLO does not define the networking for this service type, so it has been pre-created in this lab.

- **CA certificate and private key are installed** – this is the CA certificate and private key that are used to re-issue (forge) remote server certificates to internal clients for outbound traffic flows.

- **Server certificate and private key are installed** – for the inbound (reverse proxy) traffic flow use case, SSL traffic is terminated at the F5, and re-encrypted on the way to the internal application environment. A wildcard server certificate is installed to facilitate using any name under the "*.f5labs.com*" sub-domain.

Note: It is a security best practice to isolate security devices within the protected network enclaves provided by SSLO. Customers will often desire NOT to move or change existing security services. However, while possible with SSLO 4.0 and beyond, passing this decrypted traffic to points on an existing network architecture could create multiple points of data exposure. Usernames, passwords, credit card numbers and other sensitive information could be exposed to other devices on that network. Each inline layer 3 security service definition includes an "Auto Manage" option. This option, enabled by default, provides internal network settings for security services to use, so that only the interface (and 802.1q VLAN tag as needed) is required to be defined for the inbound and outbound interfaces. Should customers opt to not follow security best practices, or simply need different networking settings, you can disable the Auto Manage option and define all of the required inbound and outbound networking setting manually.

SSL Orchestrator	BIG-IP management IP	10.10.0.110	
	Gateway IP/DNS	10.30.0.1	
	Login	admin:admin | root:default	
	Interfaces	Client VLAN	1.1
		Outbound VLAN	1.2
		Inline L3/HTTP services	1.3 (tagged)
		TAP service	1.4
		ICAP service	1.5
		Inline L2 service inbound	1.6
		Inline L2 service outbound	1.7

Inline layer 2 service	Login	student:agility

Inline layer 3 service	Login	student:agility		
	Interfaces	Inbound interface	1.3 tag 50	198.19.64.64/25
		Outbound interface	1.3 tag 60	198.19.64.130/25

Explicit proxy service	Login	student:agility		
	Interfaces	Inbound interface	1.3 tag 110	198.19.96.66/25
		Outbound interface	1.3 tag 120	198.19.96.136/25
	Services	Squid	Port 3128	

Receive-only service	Login	student:agility
	MAC address	12:12:12:12:12:12 (arbitrary if directly connected)

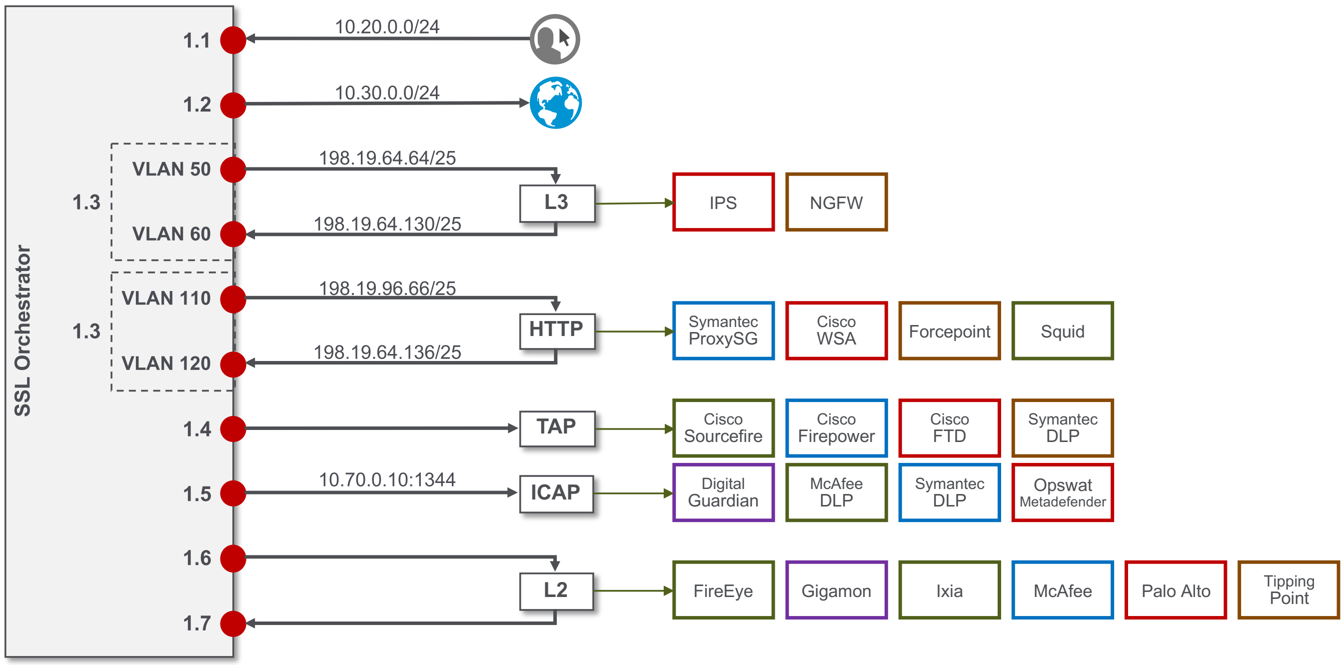
ICAP service	Login	student:agility
	IP Address:port	10.70.0.10:1344
	REQ/RES URLs	/squidclamav

Internal web server	Login	student:agility
	IP Addresses *.f5labs.com	10.20.0.90 10.20.0.91 10.20.0.92 (Apache2 instances listening on HTTPS port 443)

Outbound client	Login	student:agility
	IP address	10.20.0.60 (RDP and SSH)

Inbound client	Login	student:agility
	IP address	10.30.0.70 (RDP and SSH)

The following is a visual representation of this Ravello lab environment. The numbers inside the right edge of the SSL Orchestrator box indicate the port numbers assigned. The colored boxes to the right of the services indicate a few product examples for each respective service type.



LAB 1 – CREATE A TRANSPARENT FORWARD PROXY SSLO

The majority of enterprise forward proxy configurations will involve a single F5 platform performing the SSL visibility task. The SSL Orchestrator has been designed with that principle in mind and performs robust security service chaining of security devices attached to a single appliance. SSL Orchestrator 5.0 now makes configuration of a single-box deployment simple and intuitive. Please follow the steps below to create a transparent forward proxy SSL Orchestrator configuration.

Step 1: Review the lab environment and map out the services and endpoints

Review the "SSL Orchestrator Lab Environment" section above. This lab will attach one of each type of security service (HTTP, ICAP, L2, L3, TAP) to SSLO for an outbound forward proxy traffic flow. Afterwards, an internal client will be able to access remote (Internet) resources through SSLO, providing decrypted, inspectable traffic to the security services.

- The client is attached to a *10.20.0.0/24* network and is assigned the IP *10.20.0.60*. This network is attached to the BIG-IP 1.1 interface.

- The **L2 device** is an Ubuntu 14.04 LTS server configured to bridge its eth1 and eth2 interfaces. Its inbound VLAN (traffic to it) is attached to the BIG-IP *1.6* interface. Its outbound interface (traffic coming from it) is attached to the BIG-IP *1.7* interface.

- The **L3 device** is an Ubuntu 14.04 LTS server configured to route between its eth1.10 and eth1.20 (tagged) interfaces. Its inbound VLAN (traffic to it) is attached to the BIG-IP *1.3 (VLAN tag 50)* interface and has an IP of *198.19.64.64/25*. Its outbound interface (traffic coming from it) is attached to the BIG-IP *1.3 (VLAN tag 60)* interface and has an IP of *198.19.64.130/25*. Its default gateway is *198.19.64.245*, which will be a VLAN self-IP on the BIG-IP.

- The **TAP** device is an Ubuntu 14.04 LTS server configured with a single eth1 interface. That interface is attached to the BIG-IP *1.4* interface.

- The **DLP/ICAP** device is an Ubuntu 14.04 LTS server configured with a single eth1 interface. That interface is attached to the BIG-IP *1.5* interface and has an IP of *10.70.0.10 and listening on port 1344*. The box is running c-icap and Squid/Clamav.

- The **Explicit Proxy device** is an Ubuntu 14.04 LTS server configured with Squid. Its interfaces are eth1.30 and eth1.40 (tagged). Its inbound VLAN (traffic to it) is attached to the BIG-IP *1.3 (VLAN tag 110)* interface and has an IP of *198.19.96.66/25*. Its outbound interface (traffic coming from it) is attached to the BIG-IP *1.3 (VLAN tag 120)* interface and has an IP of *198.19.96.136/25*. Its default gateway is *198.19.96.245*, which will be a VLAN self-IP on the BIG-IP.

- The outbound network is attached to the BIG-IP *1.2* interface, in the *10.30.0.0/24* subnet, and has a gateway of *10.30.0.1*.

- In the lab, client inbound, Internet outbound, and DLP VLANs and self-IPs are already created.

Step 2: Fulfill the SSL Orchestrator prerequisites

There are a number of objects that SSL Orchestrator does not create and expects to exist before deploying the iApp. You must create the following objects before starting the iApp:

- **Import the CA certificate and private key** – in order to terminate and re-encrypt outbound SSL traffic, SSL Forward Proxy must re-issue, or rather "forge" a new server certificate to the client. In order to perform this re-issuance process, the BIG-IP must possess a certificate authority (CA) certificate and associated private key. *This lab environment already has a subordinate CA certificate and private key installed*.

- **Create the client inbound VLAN and self-IP** – create the VLAN and self-IP that connects the client to the BIG-IP. In this lab that's the *10.20.0.0/24* subnet and interface *1.1* on the BIG-IP. This lab environment already has this VLAN and self-IP created.

- **Create the Internet outbound VLAN and self-IP** – create the VLAN and self-IP that connects the BIG-IP to the outbound Internet router. In this lab that's the *10.30.0.0/24* subnet and interface *1.2* on the BIG-IP. *This lab environment already has this VLAN and self-IP created*.

- **Create the DLP VLAN and self-IP** – if it is desired to isolate the DLP/ICAP device, create the VLAN and self-IP that connects the DLP device to the BIG-IP. In this lab that's the *10.70.0.0/24* subnet and interface *1.5* on the BIG-IP. The DLP security device is listening on *10.70.0.10* and ICAP is listening on port *1344*. *This lab environment already has this VLAN and self-IP created*.

- **Create the default internet route for outbound traffic** – the iApp provides an option to leverage a defined gateway pool or use the system default route. If a gateway pool is not used, they system route table will need to have a default route used to reach Internet destination. *We'll use a gateway pool defined within SSLO*.

As a general rule, avoid using names with dashes (ex. sslo-demo-1) while creating objects in SSL Orchestrator. Underscores (ex. sslo_demo_1) and camel-casing (ex. ssloDemo1) are preferred.

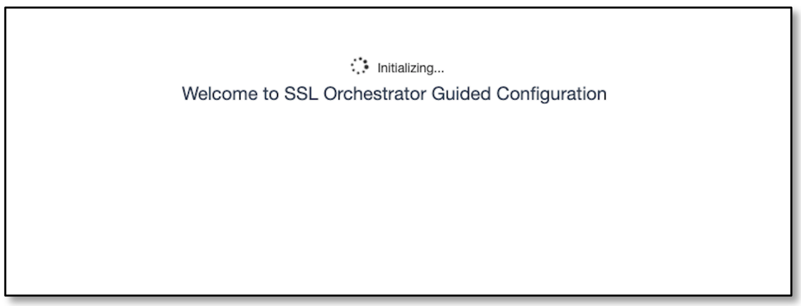
Step 3: Create the SSL Orchestrator deployment through Guided Configuration

The SSL Orchestrator Guided Configuration presents a completely new and streamlined user experience. This workflow-based architecture provides intuitive, re-entrant configuration steps tailored to the selected topology.

The following steps will walk through the Guided Configuration (GC) to build a simple transparent forward proxy.

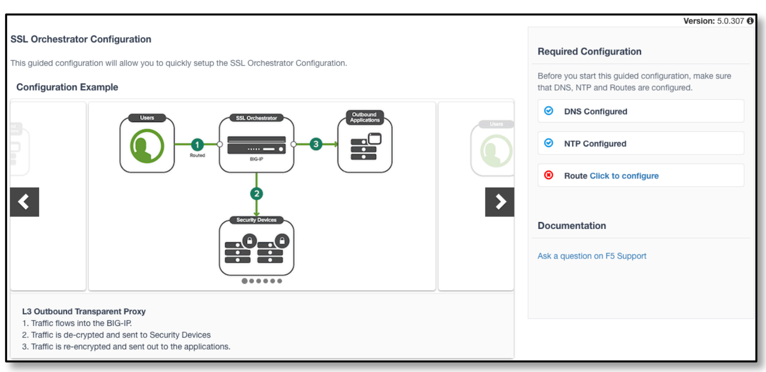
The following provides verbose details on each setting. For a more concise set of lab steps, without details, skip to the bottom of this lab (Lab 1).

- **Initialization** – if this is the first time accessing SSLO in a new BIG-IP build, upon first access, GC will automatically load and deploy the built-in SSLO package.



- **Configuration review and prerequisites** – take a moment to review the topology options and workflow configuration steps involved. Optionally satisfy any of the DNS, NTP and Route prerequisites from this page. Keep in mind, however, that aside from NTP, the SSLO GC will provide an opportunity to define DNS and route settings later in the workflow. No other configurations are required on this page, so click Next.

DNS settings have already been defined in this lab.



- **Topology Properties** – SSLO creates discreet configurations based on the selected topology. For example, in previous versions of SSLO, a transparent and explicit forward proxy might be defined together. In SSLO 5.0 and above, these are configured separately. An explicit forward proxy topology will ultimately create an explicit proxy listener and its relying transparent proxy lister, but the transparent listener will be bound only to the explicit proxy tunnel. If a subsequent transparent forward proxy topology is configured, it will not overlap the existing explicit proxy objects. The Topology Properties page provides the following options,

  The Protocol option presents four protocol types:

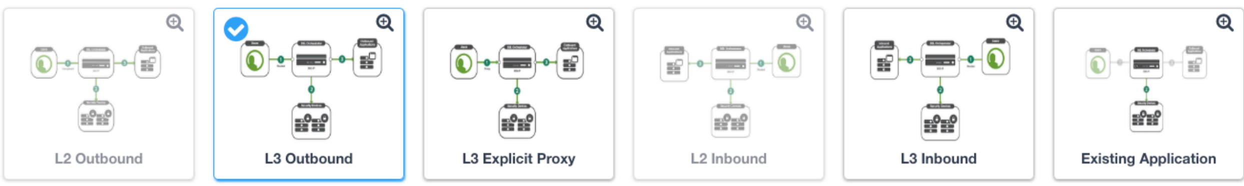
  - **TCP** – this option creates a single TCP wildcard interception rule for the L3 Inbound, L3 Outbound L3, and L3 Explicit Proxy topologies.
  - **UDP** – this option creates a single UDP wildcard interception rule for L3 Inbound and L3 Outbound topologies.
  - **Other** – this option creates a single any protocol wildcard interception rule for L3 Inbound and L3 Outbound topologies, typically used for non-TCP/UDP traffic flows.
  - **Any** – this option creates the TCP, UDP and non-TCP/UDP interception rules for outbound traffic flows.

  The SSL Orchestrator Topologies option page presents six topologies:

  - **L3 Explicit Proxy** – this is the traditional explicit forward proxy.
  - **L3 Outbound** – this is the traditional transparent forward proxy.
  - **L3 Inbound** – this is a reverse proxy "gateway" configuration. In its simplest form, this topology builds an SSLO environment designed to sit **in front of** another ADC or routed path. Advanced options allow it to define a pool for more directed traffic flow, but alone does not provide the same flexibility afforded a typical LTM reverse proxy virtual server. It also must perform re-encryption on egress. The primary use case for this topology is as a gateway SSL visibility solution, potentially sitting at a boundary edge in front of multiple internal ADC environments.
  - **L2 Inbound** – the layer 2 topology options insert SSLO as a bump-in-the-wire in an existing routed path, where SSLO presents no IP addresses on its outer edges. The L2 Inbound topology provides a transparent path for inbound traffic flows.
  - **L2 Outbound** – the layer 2 topology options insert SSLO as a bump-in-the-wire in an existing routed path, where SSLO presents no IP addresses on its outer edges. The L2 Outbound topology provides a transparent path for outbound traffic flows.

It is important to distinguish SSLO's layer 2 topology from those of other traditional layer 2 SSL visibility vendors. "True" layer 2 solutions like Blue Coat's SSL visibility appliance (SSLVA) limit the types of devices that can be inserted into the inspection zone to layer 2 and below, and devices must be directly connected to the appliance. SSLO's layer 2 topology only exists at the outer edges. Inside the inspection zone, full-proxy routing is still happening, so layer 3 and HTTP services can still function normally.

- **Existing Application** – this topology is designed to work with existing LTM applications. Whereas the L3 Inbound topology provides an inbound gateway function for SSLO, Existing Application works with LTM virtual servers that already perform their own SSL handling and client-server traffic management. The Existing Application workflow proceeds directly to service creation and security policy definition, then exits with an SSLO-type access policy and per-request policy that can easily be consumed by an LTM virtual server.



For this lab,

- **Name**: some name (ex. "demo")
- **Protocol**: Any – this will create separate TCP, UDP and non-TCP/UDP interception rules.
- **IP Family**: IPv4
- **Topology**: L3 Outbound
- Click Save & Next.

- **SSL Configurations** – this page defines the specific SSL settings for the selected topology, in this case a forward proxy, and controls both client-side and server-side SSL options. If existing SSL settings are available (from a previous workflow), it can be selected and re-used. Otherwise the SSL Configurations page creates new SSL settings for this workflow. For this lab, create a new SSL profile,

  - **Client-side SSL**

    - **Cipher Type** – cipher type can be a Cipher Group or Cipher String. If the former, select a previously-defined cipher group (from Local Traffic – Ciphers – Groups). If the latter, enter a cipher string that appropriately represents the client-side TLS requirement. For most environments, DEFAULT is optimal. For this lab, leave Cipher String selected.

    - **Certificate Key Chain** – the certificate key chain represents the certificate and private key used as the "template" for forged server certificates. While re-issuing server certificates on-the-fly is generally easy, private key creation tends to be a CPU-intensive operation. For that reason, the underlying SSL Forward Proxy engine forges server certificates from a single defined private key. This setting gives customers the opportunity to apply their own template private key, and optionally store that key in a FIPS-certified HSM for additional protection. The built-in "default" certificate and private key uses 2K RSA and is generated from scratch when the BIG-IP system is installed. The pre-defined default.crt and default.key can be left as is. Click Done.

    - **CA Certificate Key Chain** – an SSL forward proxy must re-sign, or "forge" remote server certificate to local clients using a local certificate authority (CA) certificate, and local clients must trust this local CA. This setting defines the local CA certificate and private key used to perform the forging operation. Click the pencil icon to Edit, then select subrsa.f5labs.com for both Certificate and Key, and click Done.

    SSL Settings minimally require RSA-based template and CA certificates but can also support Elliptic Curve (ECDSA) certificates. In this case, SSLO would forge an EC certificate to the client if the TLS handshake negotiated an ECDHE_ECDSA cipher. To enable EC forging support, add both an EC template certificate and key, and EC CA certificate and key.

    - **[Advanced] Bypass on Handshake Alert** – this setting allows the underlying SSL Forward Proxy process to bypass SSL decryption if an SSL handshake error is detected on the server side. It is recommended to leave this disabled.

    - **[Advanced] Bypass on Client Certificate Failure** – this setting allows the underlying SSL Forward Proxy process to bypass SSL decryption if it detects a Certificate request message from the server, as in when a server requires mutual certificate authentication. It is recommended to leave this disabled.

The above two Bypass options can create a security vulnerability. If a colluding client and server can force an SSL handshake error, or force client certificate authentication, they can effectively bypass SSL inspection. It is recommended that these settings be left disabled.

- **Server-side SSL**

  - **Cipher Type** – cipher type can be a Cipher Group or Cipher String. If the former, select a previously-defined cipher group (from Local Traffic – Ciphers – Groups). If the latter, enter a cipher string that appropriately represents the server-side TLS requirement. For most environments, DEFAULT is optimal.

  - **Trusted Certificate Authority** – browser vendors routinely update the CA certificate stores in their products to keep up with industry security trends, and to account for new and revoked CAs. In the SSL forward proxy use case, however, the SSL visibility product now performs all server-side certificate validation, in lieu of the client browser, and should therefore do its best to maintain the same industry security trends. BIG-IP ships with a CA certificate bundle that maintains a list of CA certificates common to the browser vendors. However, a more comprehensive bundle can be obtained from the F5 Downloads site. For this lab, select the built-in ca-bundle.crt.

  - **[Advanced] Expire Certificate Response** – SSLO performs validation on remote server certificates and can control what happens if it receives an expired server certificate. The options are **drop**, which simply drops the traffic, and **ignore**, which mirrors an expired forged certificate to the client. The default and recommended behavior for forward proxy is to drop traffic on an expired certificate.

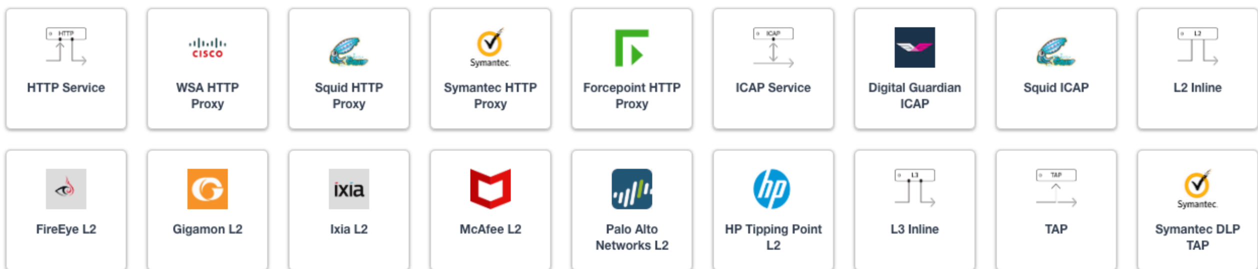
  - **[Advanced] Untrusted Certificate Authority** – SSLO performs validation on remote server certificates and can control what happens if it receives an untrusted server certificate, based on the Trusted Certificate Authority bundle. The options are **drop**, which simply drops the traffic, and **ignore**, which allows the traffic and forges a good certificate to the client. The default and recommended behavior for forward proxy is to drop traffic on an untrusted certificate.

  - **[Advanced] OCSP** – this setting selects an existing or can create a new OCSP profile for server-side Online Certificate Status Protocol (OCSP) and OCSP stapling. With this enabled, if a client issues a Status_Request message in its ClientHello message (an indication that it supports OCSP stapling), SSLO will issue a corresponding Status_Request message in its server-side TLS handshake. SSLO will then forge the returned OCSP stapling response back to the client. If the server does not respond with a staple but contains an Authority Info Access (AIA) field that points to an OCSP responder URL, SSLO will perform a separate OCSP request. The returned status is then mirrored in the stapled client-side TLS handshake.

  - **[Advanced] CRL** – this setting selects an existing or can create a new CRL profile for server-side Certificate Revocation List (CRL) validation. With this enabled, SSLO attempts to match server certificates to locally-cached CRLs.

- Click Save & Next.

- **Services List** – the Services List page is used to define security services that attach to SSLO. The 5.0 SSLO Guided Configuration now includes a services catalog that contains common product integrations. Beneath each of these catalog options is one of the five basic service types. The service catalog also provides "generic" security services. Depending on screen resolution, it may be necessary to scroll down to see additional services.



This lab will create one of each type of security service. Click Add Service, then either select a service from the catalog and click Add, or simply double-click the service to go to its configuration page.

- **Inline layer 2 service** – select the FireEye Inline Layer 2 service from the catalog and click Add, or simply double-click the FireEye Inline Layer 2 service, or any other Inline Layer 2 service in the catalog.
    - **Name** – provide a unique name to this service (example "FireEye").
    - **Network Configuration** – paths define the network interfaces that take inspectable traffic to the inline service and receive traffic from the service. Click Add.
        - **Ratio** – inline security services are natively load balanced, so this setting defines a ratio, if any for the load balanced pool members. Enter 1.
        - **From BIGIP VLAN** – this is the interface taking traffic to the inline service. Select the Create New option, enter a unique name (ex. FireEye_in), select the F5 interface connecting to the inbound side of the service, and add a VLAN tag value if required. For this lab, select interface 1.6.
        - **To BIGIP VLAN** – this is the interface receiving traffic from the inline service. Select the Create New option, enter a unique name (ex. FireEye_out), select the F5 interface connecting to the outbound side of the service, and add a VLAN tag value if required. For this lab, select interface 1.7.
        - Click Done.

- **Device Monitor** – new in 6.0, security service definitions can now specify custom monitors. For this lab, leave it set to the default /Common/gateway_icmp.

- **Service Action Down** – SSLO also natively monitors the load balanced pool of security devices, and if all pool members fail, can actively bypass this service (**Ignore**), or stop all traffic (**Reset**, **Drop**). For this lab, leave it set to Ignore.

- **Enable Port Remap** – this setting allows SSLO to remap the port of HTTPS traffic flowing across this service. This is advantageous when a security service defines port 443 traffic as encrypted HTTPS and natively ignores it. By remapping HTTPS traffic to, say, port 8080, the security service will inspect the traffic. For this lab, enable (check) this option and enter a port value value (ex. 8080).

- **iRules** – SSLO now allows for the insertion of additional iRule logic at different points. An iRule defined at the service only affects traffic flowing across this service. It is important to understand, however, that these iRules must not be used to control traffic flow (ex. pools, nodes, virtuals, etc.), but rather should be used to view/modify application layer protocol traffic. For example, an iRule assigned here could be used to view and modify HTTP traffic flowing to/from the service. Additional iRules are not required, however, so leave this empty.

- Click Save.

- **Inline layer 3 service** – select the Generic Inline Layer 3 service from the catalog and click Add, or simply double-click the Generic Inline Layer 3 service.

  - **Name** – provide a unique name to this service (example "IPS").

  - **IP Family** – this setting defines the IP family used with this layer 3 service. Leave it set to IPv4.

  - **Auto Manage Addresses** – when enabled the Auto Manage Addresses setting provides a set of unique, non-overlapping, non-routable IP addresses to be used by the security service. If disabled, the To and From IP addresses must be configured manually. It is recommended to leave this option enabled (checked).

  In environments where SSLO is introduced to existing security devices, it is a natural tendency to not want to have to move these devices. And while SSLO certainly allows it, by not moving the security devices into SSLO-protected enclaves, customers run the risk of exposing sensitive decrypted traffic, unintentionally, to other devices that may be connected to these existing networks. It is therefore <u>highly</u> recommended, and a security best practice, to remove SSLO-integrated security devices from existing networks and place them entirely within the isolated enclave created and maintained by SSLO.

  - **To Service Configuration** – the "To Service" defines the network connectivity from SSLO to the inline security device.

- **To Service** – with the Auto Manage Addresses option enabled, this IP address will be pre-defined, therefore the inbound side of the service must match this IP subnet. With the Auto Manage Addresses option disabled, the IP address must be defined manually. For this lab, leave the 198.19.64.7/25 address intact.

- **VLAN** – select the Create New option, provide a unique name (ex. IPS_in), select the F5 interface connecting to the inbound side of the service, and add a VLAN tag value if required. For this lab, select interface 1.3 and VLAN tag 50.

▪ **Service Down Action** – SSLO also natively monitors the load balanced pool of security devices, and if all pool members fail, can actively bypass this service (**Ignore**), or stop all traffic (**Reset**, **Drop**). For this lab, leave it set to Ignore.

▪ **Security Devices - L3 Devices** – this defines the inbound-side IP address of the inline layer 3 service, used for routing traffic to this device. Multiple load balanced IP addresses can be defined here. Click Add, enter 198.19.64.64, then click Done.

▪ **Device Monitor** – new in 6.0, security service definitions can now specify custom monitors. For this lab, leave it set to the default /Common/gateway_icmp.

▪ **From Service Configuration** – the "From Service" defines the network connectivity from the inline security device to SSLO.

- **From Service** – with the Auto Manage Addresses option enabled, this IP address will be pre-defined, therefore the outbound side of the service must match this IP subnet. With the Auto Manage Addresses option disabled, the IP address must be defined manually. For this lab, leave the 198.19.64.245/25 address intact.

- **VLAN** – select the Create New option, provide a unique name (ex. IPS_out), select the F5 interface connecting to the outbound side of the service, and add a VLAN tag value if required. For this lab, select interface 1.3 and VLAN tag 60.

▪ **Enable Port Remap** – this setting allows SSLO to remap the port of HTTPS traffic flowing across this service. This is advantageous when a security service defines port 443 traffic as encrypted HTTPS and natively ignores it. By remapping HTTPS traffic to, say, port 8181, the security service will inspect the traffic. For this lab, enable (check) this option and enter a port value value (ex. 8181).

▪ **Manage SNAT Settings** – SSLO now defines an option to enable SNAT (source NAT) across an inline layer 3/HTTP service. The primary use case for this is horizontal SSLO scaling, where independent SSLO devices are scaled behind a separate load balancer but share the same inline layer 3/HTTP services. As these devices must route back to SSLO, there are now multiple SSLO devices to route back to. SNAT allows the layer 3/HTTP device to know which SSLO sent the packets for proper routing. SSLO scaling also requires that the Auto Manage option be disabled, to provide separate address spaces on each SSLO. For this, leave it set to None.

- **iRules** – SSLO now allows for the insertion of additional iRule logic at different points. An iRule defined at the service only affects traffic flowing across this service. It is important to understand, however, that these iRules must not be used to control traffic flow (ex. pools, nodes, virtuals, etc.), but rather should be used to view/modify application layer protocol traffic. For example, an iRule assigned here could be used to view and modify HTTP traffic flowing to/from the service. Additional iRules are not required, however, so leave this empty.

- Click Save.

- **Inline HTTP service** – an inline HTTP service is defined as an explicit or transparent proxy for HTTP (web) traffic. Select the WSA HTTP Proxy service from the catalog and click Add, or simply double-click the WSA HTTP Proxy service, or any other HTTP Proxy service in the catalog.

  - **Name** – provide a unique name to this service (example "Proxy").

  - **IP Family** – this setting defines the IP family used with this layer 3 service. Leave it set to IPv4.

  - **Auto Manage Addresses** – when enabled the Auto Manage Addresses setting provides a set of unique, non-overlapping, non-routable IP addresses to be used by the security service. If disabled, the To and From IP addresses must be configured manually. It is recommended to leave this option enabled (checked).

  In environments where SSLO is introduced to existing security devices, it is a natural tendency to not want to have to move these devices. And while SSLO certainly allows it, by not moving the security devices into SSLO-protected enclaves, customers run the risk of exposing sensitive decrypted traffic, unintentionally, to other devices that may be connected to these existing networks. It is therefore highly recommended, and a security best practice, to remove SSLO-integrated security devices from existing networks and place them entirely within the isolated enclave created and maintained by SSLO.

  - **Proxy Type** – this defines the proxy mode that the inline HTTP service is in. For this lab, set this option to Explicit.

  - **To Service Configuration** – the "To Service" defines the network connectivity from SSLO to the inline security device.

    - **To Service** – with the Auto Manage Addresses option enabled, this IP address will be pre-defined, therefore the inbound side of the service must match this IP subnet. With the Auto Manage Addresses option disabled, the IP address must be defined manually. For this lab, leave the 198.19.96.7/25 address intact.

    - **VLAN** – select the Create New option, provide a unique name (ex. Proxy_in), select the F5 interface connecting to the inbound side of the service, and add a VLAN tag value if required. For this lab, select interface 1.3 and VLAN tag 110.

- **Service Down Action** – SSLO also natively monitors the load balanced pool of security devices, and if all pool members fail, can actively bypass this service (**Ignore**), or stop all traffic (**Reset**, **Drop**). For this lab, leave it set to Ignore.

- **Security Devices - HTTP Proxy Devices** – this defines the inbound-side IP address of the inline HTTP service, used for passing traffic to this device. Multiple load balanced IP addresses can be defined here. For a transparent proxy HTTP service, only an IP address is required. For an explicit proxy HTTP service, the IP address and listening port is required. Click Add, enter 198.19.96.66 for the IP Address, and 3128 for the Port, then click Done.

- **Device Monitor** – new in 6.0, security service definitions can now specify custom monitors. For this lab, leave it set to the default /Common/gateway_icmp.

- **From Service Configuration** – the "From Service" defines the network connectivity from the inline security device to SSLO.

    - **From Service** – with the Auto Manage Addresses option enabled, this IP address will be pre-defined, therefore the outbound side of the service must match this IP subnet. With the Auto Manage Addresses option disabled, the IP address must be defined manually. For this lab, leave the 198.19.96.245/25 address intact.

    - **VLAN** – select the Create New option, provide a unique name (ex. Proxy_out), select the F5 interface connecting to the outbound side of the service, and add a VLAN tag value if required. For this lab, select interface 1.3 and VLAN tag 120.

- **Manage SNAT Settings** – SSLO now defines an option to enable SNAT (source NAT) across an inline layer 3/HTTP service. The primary use case for this is horizontal SSLO scaling, where independent SSLO devices are scaled behind a separate load balancer but share the same inline layer 3/HTTP services. As these devices must route back to SSLO, there are now multiple SSLO devices to route back to. SNAT allows the layer 3/HTTP device to know which SSLO sent the packets for proper routing. SSLO scaling also requires that the Auto Manage option be disabled, to provide separate address spaces on each SSLO. For this, leave it set to None.

- **Authentication Offload** – when an Access authentication profile is attached to an explicit forward proxy topology, this option will present the authenticated username value to the service as an X-Authenticated-User HTTP header. For this lab, leave it disabled (unchecked).

- **iRules** – SSLO now allows for the insertion of additional iRule logic at different points. An iRule defined at the service only affects traffic flowing across this service. It is important to understand, however, that these iRules must not be used to control traffic flow (ex. pools, nodes, virtuals, etc.), but rather should be used to view/modify application layer protocol traffic. For example, an iRule assigned here could be used to view and modify HTTP traffic flowing to/from the service. Additional iRules are not required, however, so leave this empty.

- Click Save.

- **ICAP service** – an ICAP service is an RFC 3507-defined service that provides some set of services over the ICAP protocol. Select the Squid ICAP service from the catalog and click Add, or simply double-click the Squid ICAP service, or any other ICAP service in the catalog.

  - **Name** – provide a unique name to this service (example "DLP").

  - **IP Family** – this setting defines the IP family used with this layer 3 service. Leave it set to IPv4.

  - **ICAP Devices** – this defines the IP address of the ICAP service, used for passing traffic to this device. Multiple load balanced IP addresses can be defined here. Click Add, enter 10.70.0.10 for the IP Address, and 1344 for the Port, and then click Done.

  - **ICAP Headers** – select either **Default** or **Custom** to specify additional ICAP headers. To add custom headers, select Custom, otherwise leave as Default.

  - **OneConnect** – the F5 OneConnect profile improves performance by reusing TCP connections to ICAP servers to process multiple transactions. If the ICAP servers do not support multiple ICAP transactions per TCP connection, do not enable this option. For this lab, leave the OneConnect setting enabled.

  - **Request URI Path** – this is the RFC 3507-defined URI request path to the ICAP service. Each ICAP security vendor will differ with respect to request and response URIs, and preview length, so it is important to review the vendor's documentation. In this lab, enter /squidclamav.

  - **Response URI Path** – this is the RFC 3507-defined URI response path to the ICAP service. Each ICAP security vendor will differ with respect to request and response URIs, and preview length, so it is important to review the vendor's documentation. In this lab, enter /squidclamav.

  - **Preview Max Length(bytes)** – this defines the maximum length of the ICAP preview. Each ICAP security vendor will differ with respect to request and response URIs, and preview length, so it is important to review the vendor's documentation. A zero-length preview length implies that data will be streamed to the ICAP service, similar to an HTTP 100/Expect process, while any positive integer preview length defines the amount of data (in bytes) that are transmitted first, before streaming the remaining content. The ICAP service in this lab environment does not support a complete stream, so requires a modest amount of initial preview. In this lab, enter 524288.

  - **Service Down Action** – SSLO also natively monitors the load balanced pool of security devices, and if all pool members fail, can actively bypass this service (**Ignore**), or stop all traffic (**Reset**, **Drop**). For this lab, leave it set to Ignore.

  - **HTTP Version** – this defines whether SSLO sends HTTP/1.1 or HTTP/1.0 requests to the ICAP service.

    - **ICAP Policy** – an ICAP policy is a pre-defined LTM CPM policy that can be configured to control access to the ICAP service based on attributes of the HTTP request or response. ICAP processing is enabled by default, so an ICAP CPM policy can be used to disable the request and/or response ADAPT profiles.

    - Click Save.

- **TAP service** – a TAP service is a passive device that simply receives a copy of traffic. Select the Cisco Firepower Threat Defense TAP service from the catalog and click Add, or simply Double-click the Cisco Firepower Threat Defense TAP service, or any other TAP service in the catalog.

    - **Name** - provide a unique name to this service (example "TAP").

    - **Mac Address** – for a tap service that is not directly connected to the F5, enter the device's MAC address. For a tap service that is directly connected to the F5, the MAC address does not matter and can be arbitrarily defined. For this lab, enter 12:12:12:12:12:12.

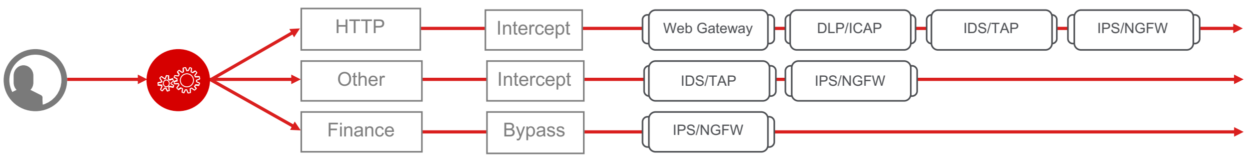
    - **VLAN** – this defines the interface connecting the F5 to the TAP service. Click Create New and provide a unique name (ex. TAP_in).
    - **Interface** – select the 1.4 interface.

    - **Enable Port Remap** – this setting allows SSLO to remap the port of HTTPS traffic flowing to this service. For this lab, leave the option disabled (unchecked).

    - Click Save.

- Click Save & Next.

- **Service Chain List** – service chains are arbitrarily-ordered lists of security devices. Based on environmental requirements, different service chains may contain different re-used sets of services, and different types of traffic can be assigned to different service chains. For example, HTTP traffic may need to go through all of the security services, while non-HTTP traffic goes through a subset, and traffic destined to a financial service URL can bypass decryption and still flow through a smaller set of security services.



  - Click Add to create a new service chain containing all of the security services.
    - **Name** – provide a unique name to this service (ex. "my_service_chain").
    - **Services** – select any number of desired service and move them into the **Selected Service Chain Order** column, optionally also ordering them as required. In this lab, select all of the services.
    - Click Save.
  - Click Add to create a new service chain for just the L2 (ex. FireEye) and TAP services.
    - **Name** – provide a unique name to this service (ex. "my_sub_service_chain").
    - **Services** – select the inline layer 2 (ex. FireEye) and TAP services.
    - Click Save.
  - Click Save & Next.

- **Security Policy** – security policies are the set of rules that govern how traffic is processed in SSLO. The "actions" a rule can take include,
    - Whether or not to allow the traffic (allow/block)
    - Whether or not to decrypt the traffic (intercept/bypass)
    - Which service chain (if any) to pass the traffic through

  The SSLO Guided Configuration presents an intuitive rule-based, drag-and-drop user interface for the definition of security policies.

Rules — Add

Name	Conditions	Action	SSL Forward Proxy Action	Service Chain
Pinners_Rule	SSL Check and SNI Category is **Pinners**	Allow	Bypass	-
All Traffic	All	Allow	Intercept	-

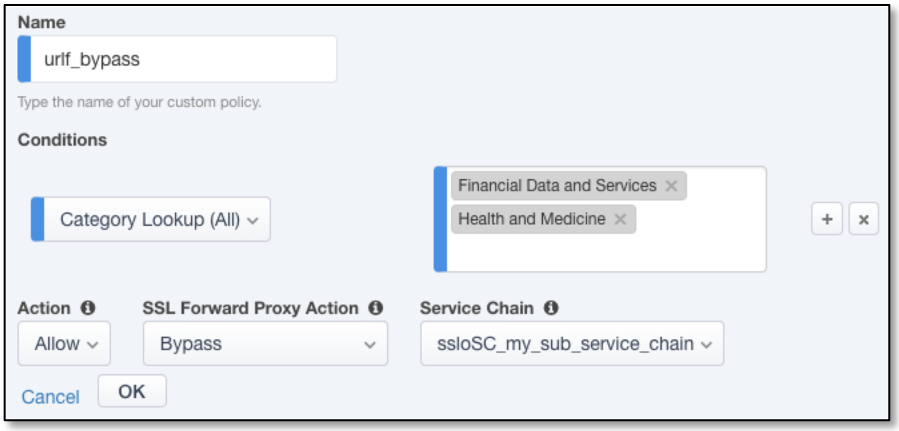
In the background, SSLO maintains these security policies as visual per-request policies. If traffic processing is required that exceeds the capabilities of the rule-based user interface, the underlying per-request policy can be managed directly.

Note that once the per-request policy is manipulated, the rules-based interface can no longer be used.

For the lab, create an additional rule to bypass SSL for "Financial Data and Services" and "Health and Medicine" URL categories.

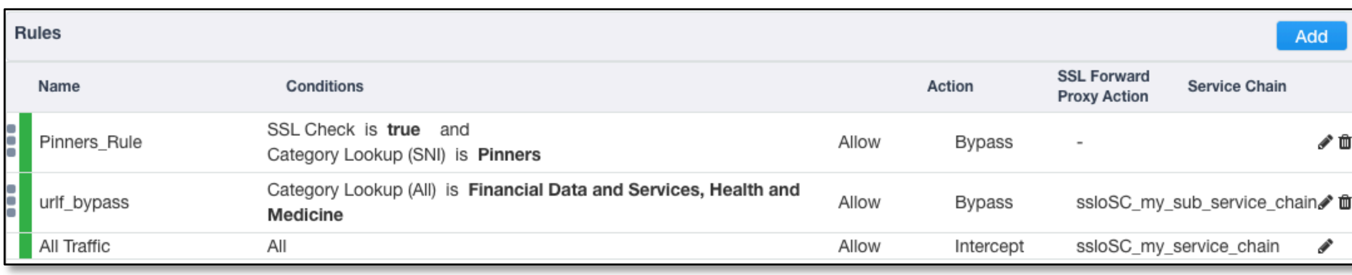
- Click Add to create a new rule.
    - **Name** – provide a unique name for the rule (ex. "urlf_bypass").
    - **Conditions**
        - **Category Lookup (All)** – add Financial Data and Services and Health and Medicine.

          The Category Lookup (All) condition provides categorization for TLS SNI, HTTP Connect and HTTP Host information.
    - **Action** – select Allow.
    - **SSL Forward Proxy Action** – select Bypass.
    - **Service Chain** – select the L2/TAP service chain.
    - Click OK.



Notice in the list of rules that the **All Traffic** rule intercepts but does not send traffic to a service chain. For the lab, edit this rule to send all intercepted traffic to a service chain.

- Click the pencil icon to edit this rule.
- Service Chain – select the service chain containing all of the services.
- Click OK.



Rules — Add

Name	Conditions	Action	SSL Forward Proxy Action	Service Chain
Pinners_Rule	SSL Check is **true** and Category Lookup (SNI) is **Pinners**	Allow	Bypass	-
urlf_bypass	Category Lookup (All) is **Financial Data and Services, Health and Medicine**	Allow	Bypass	ssloSC_my_sub_service_chain
All Traffic	All	Allow	Intercept	ssloSC_my_service_chain

- **Server Certificate Status Check** – new in SSLO 6.0, this option inserts additional security policy logic to validate the remote server certificate and return a blocking page to the user if the certificate is untrusted or expired. One or both of the Certificate Response options on the SSL Configuration page (Expire Certificate Response and Untrusted Certificate Response) must be set to 'ignore'. SSLO will "mask" the server certificate's attributes in order to present a blocking page with a valid forged certificate. For this lab, either option (enabled or disabled) is acceptable.

Click Save & Next.

- **Interception Rule** – interception rules are based on the selected topology and define the "listeners", analogous to LTM virtual servers, that accept and process different types of traffic (ex. TCP, UDP, other). The resulting LTM virtual servers will bind the SSL settings, VLANs, IPs, and security policies created in the topology workflow.
  - **Ingress Network (VLANs)** – this defines the VLANs through which traffic will enter. For a transparent forward proxy topology, this would be a client-side VLAN. Select client-net.
  - **Access Profile** – new in SSLO 6.0, the Access Profile selection is exposed for both explicit and transparent forward proxy topology deployments. In transparent forward proxy mode, this allows selection of an access policy to support captive portal authentication (covered later in this guide). For this lab, leave this setting as default.
  - **L7 Interception Rules** – FTP and email protocol traffic are all "server-speaks-first" protocols, and therefore SSLO must process these separately from typical client-speaks-first protocols like HTTP. This selection enables processing of each of these protocols, which create separate port-based listeners for each. As required, selectively enable the additional protocols that need to be decrypted and inspected through SSLO.
  - Click Save & Next.

- **Egress Setting** – traffic egress settings are now defined per-topology and manage both the gateway route and outbound SNAT settings.
  - **Manage SNAT Settings** – enables per-topology instance SNAT settings. For this lab, select Auto Map.
  - **Gateways** – enables per-topology instance gateway routing. Options are to use the system default route, to use an existing gateway pool, or to create a new gateway. For this lab, select Create New.
  - **IPv4 Outbound Gateways** – when creating a new gateway, this section provides the ratio and gateway address settings.
  - **Ratio** – multiple gateway IP addresses are load balanced in an LTM pool, and the ratio setting allows SSLO to proportion traffic to the gateway members, as required. A ratio on 1 for all members evenly distributes the load across them. For this lab, select 1.
  - **Address** – this is the next hop gateway IP address. For this lab, enter 10.30.0.1.
  - Click Save & Next.

- **Log Settings** – new in SSLO 6.0, log settings are defined per-topology. In environments where multiple topologies are deployed, this can help to streamline troubleshooting by reducing debug logging to the affected topology. Multiple discreet logging options are available:

    - **Per-Request Policy** – provides log settings for security policy processing. In Debug mode, this log facility produces an enormous amount of traffic, so it is recommended to only set Debug mode for troubleshooting. Otherwise the most appropriate setting is Error to only log error conditions.

    - **FTP** – specifically logs error conditions for the built-in FTP listener when FTP is selected among the additional protocols in the Interception Rule configuration. The most appropriate setting is Error to only log error conditions.

    - **IMAP** – specifically logs error conditions for the built-in IMAP listener when IMAP is selected among the additional protocols in the Interception Rule configuration. The most appropriate setting is Error to only log error conditions.

    - **POP3** – specifically logs error conditions for the built-in POP3 listener when POP3 is selected among the additional protocols in the Interception Rule configuration. The most appropriate setting is Error to only log error conditions.

    - **SMTP** – specifically logs error conditions for the built-in SMTP listener when SMTP is selected among the additional protocols in the Interception Rule configuration. The most appropriate setting is Error to only log error conditions.

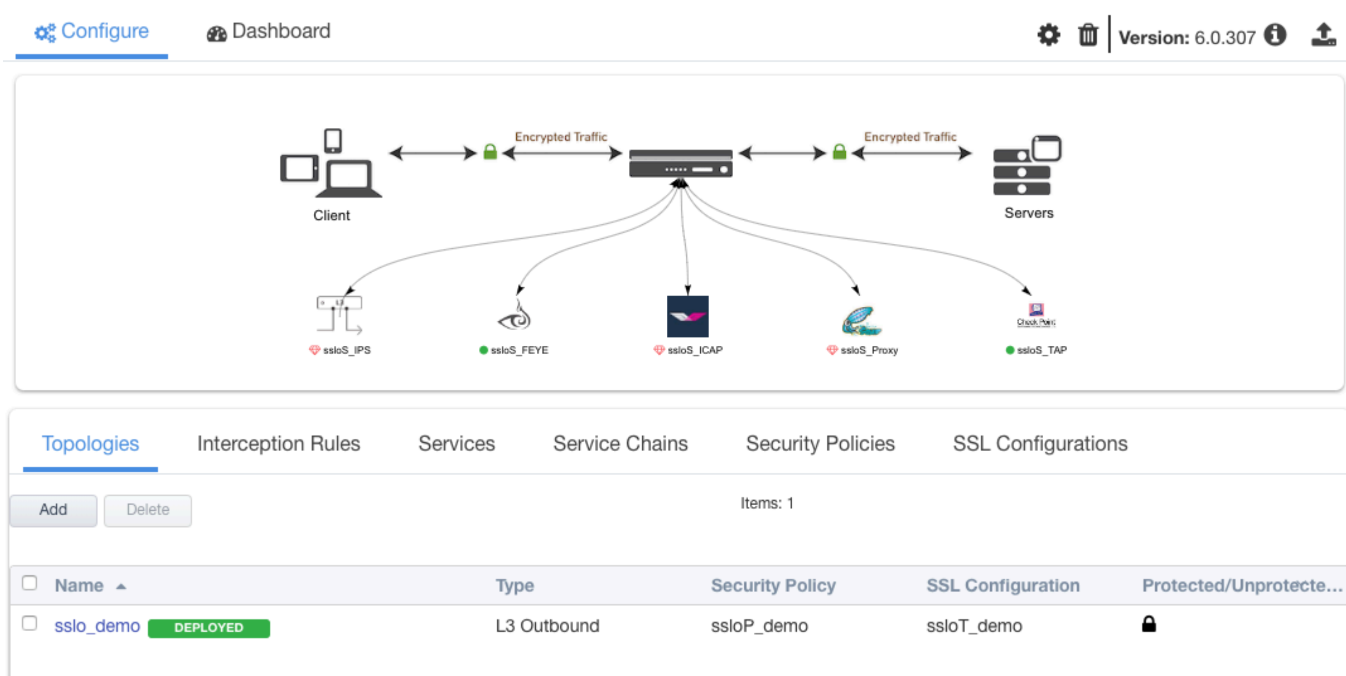
    - **SSL Orchestrator Generic** – provides log settings for generic SSLO processing. If Per-Request Policy logging is set to Error, and SSL Orchestrator Generic is set to Information, only the SSLO packet summary will be logged. Otherwise the most appropriate setting is Error to only log error conditions.

Click Save & Next.

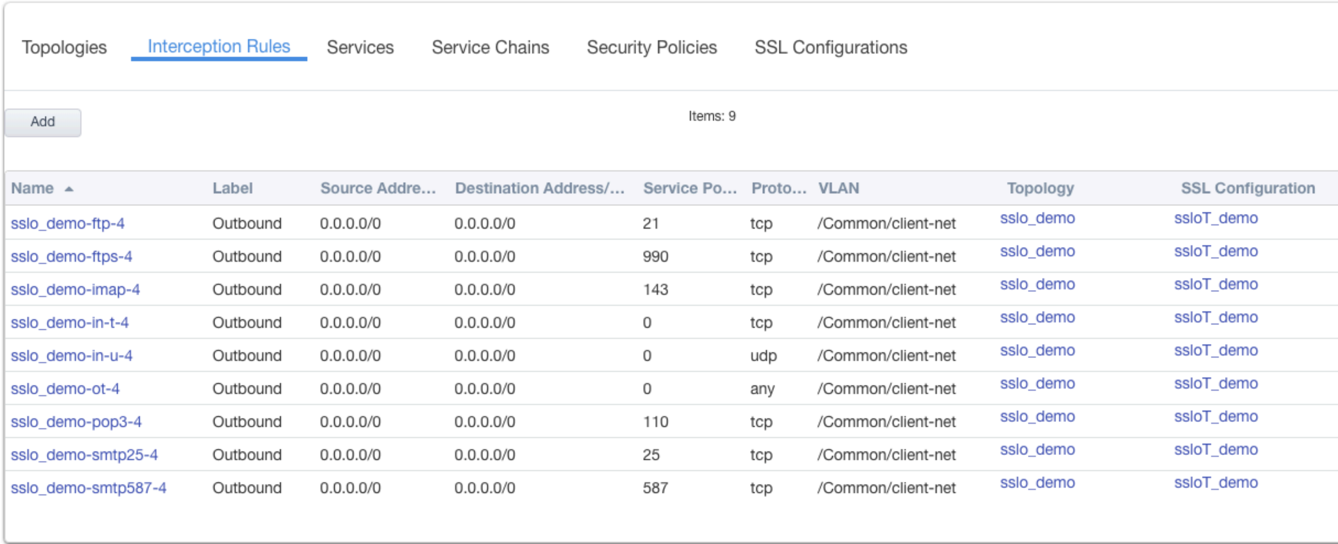
- **Summary** – the summary page presents an expandable list of all of the workflow-configured objects. To expand the details for any given setting, click the corresponding arrow icon on the far right. To edit any given setting, click the corresponding pencil icon. Clicking the pencil icon will send the workflow back to the selected settings page.
  - When satisfied with the defined settings, click Deploy.

Upon successfully deploying the configuration, SSL Orchestrator will now display a **Configure** view. The Configure view is comprised of two main sections:

- SSLO Configuration Map – a visual representation of the SSLO configuration and attached services.
- SSLO Objects – a tabbed interface showing the respective objects created through the SSLO topology workflow(s).



The **Interception Rules** tab shows the listeners that were created per the selected topology.



Name	Label	Source Addre...	Destination Address/...	Service Po...	Proto...	VLAN	Topology	SSL Configuration
sslo_demo-ftp-4	Outbound	0.0.0.0/0	0.0.0.0/0	21	tcp	/Common/client-net	sslo_demo	ssloT_demo
sslo_demo-ftps-4	Outbound	0.0.0.0/0	0.0.0.0/0	990	tcp	/Common/client-net	sslo_demo	ssloT_demo
sslo_demo-imap-4	Outbound	0.0.0.0/0	0.0.0.0/0	143	tcp	/Common/client-net	sslo_demo	ssloT_demo
sslo_demo-in-t-4	Outbound	0.0.0.0/0	0.0.0.0/0	0	tcp	/Common/client-net	sslo_demo	ssloT_demo
sslo_demo-in-u-4	Outbound	0.0.0.0/0	0.0.0.0/0	0	udp	/Common/client-net	sslo_demo	ssloT_demo
sslo_demo-ot-4	Outbound	0.0.0.0/0	0.0.0.0/0	0	any	/Common/client-net	sslo_demo	ssloT_demo
sslo_demo-pop3-4	Outbound	0.0.0.0/0	0.0.0.0/0	110	tcp	/Common/client-net	sslo_demo	ssloT_demo
sslo_demo-smtp25-4	Outbound	0.0.0.0/0	0.0.0.0/0	25	tcp	/Common/client-net	sslo_demo	ssloT_demo
sslo_demo-smtp587-4	Outbound	0.0.0.0/0	0.0.0.0/0	587	tcp	/Common/client-net	sslo_demo	ssloT_demo

In the above,

- The **-in-t-4** listener defines normal TCP IPv4 traffic.
- The **-in-u-4** listener defines normal UDP IPv4 traffic.
- The **-ot-4** listener defines normal non-TCP/non-UDP IPv4 traffic.
- The **-ftp**, **-ftps**, **-pop3**, **-smtp25** and **-smtp587** listeners create paths for each respective protocol.

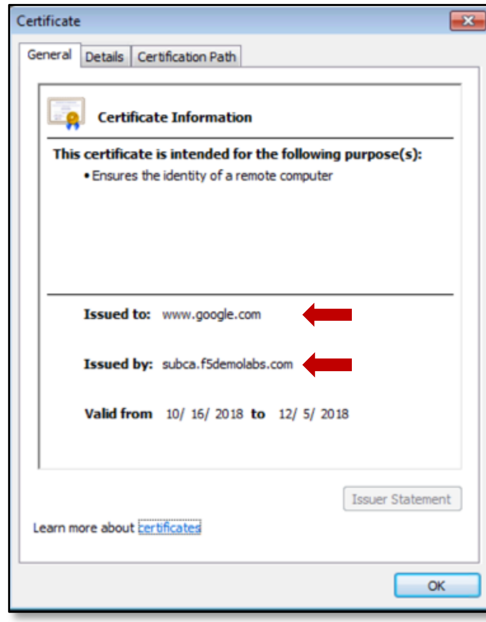
This completes the configuration of SSL Orchestrator as a transparent forward proxy. At this point an internal client should be able to browse out to external (Internet) resources, and decrypted traffic will flow across the security services.

Step 4: Test the solution

To test the deployed solution, use the following options:

- **Server certificate test**

  Open a browser on the client system and navigate to any remote HTTPS site, for example, https://www.google.com. Once the site opens in the browser, check the server certificate of the site and verify that it has been issued by the local CA configured in SSLO. This confirms that the SSL forward proxy functionality enabled by SSL Orchestrator is working correctly.



- **Decrypted traffic analysis on the F5**

  Perform a tcpdump on the F5 system to observe the decrypted clear text traffic. This confirms SSL interception by SSLO.

```
tcpdump –lnni [interface or VLAN name] -Xs0
```

  As a function of adding a new service, the UI requires a name for each (source and destination) network. SSL Orchestrator will then create separate source and destination VLANs for inline security devices, and those VLANs will be encapsulated within separate application service paths. For example, given an inline layer 2 service named "FireEye" with its "From BIGIP VLAN" named "**FireEye_in**", and its "To BIGIP VLAN" named "**FireEye_out**", its corresponding BIG-IP VLANs would be accessible via the following syntax:

  ssloN_ *+ [network name] +* ***.app/ssloN_*** *+ [network name]*

  Example:
  ssloN_FireEye_in.app/ssloN_FireEye_in
  ssloN_FireEye_in.app/ssloN_FireEye_in

  A tcpdump on the source side VLAN of this FireEye service would therefore look like this:

```
tcpdump -lnni ssloN_FireEye_in.app/ssloN_FireEye_in -Xs0
```

  The security service VLANs and their corresponding application services are all visible from the BIG-IP UI under Network -> VLANs.

- **Decrypted traffic analysis on the security services**

  Depending on the type of security service, it may easier to log into the console shell and run a similar tcpdump capture on the inbound or outbound interface, to tail its capture logs, or to log into its management UI and capture analytics. A tcpdump capture usually requires root or sudo access.

```
tcpdump -lnni [interface] -Xs0
```

LAB 2 – CREATE A GATEWAY REVERSE PROXY SSLO

SSL Orchestrator generally defines inbound traffic flows with a “gateway” architecture. That is, SSLO is designed to sit in front of a separate ADC/load balancer or routed path, and not directly in front of applications, though it is technically possible to support a “single instance” listener going to a single pool of resources. This lab will be re-using the security services created in the first lab to create a single inbound “gateway” service SSLO configuration.

This lab will consist of an abbreviated set of steps, as some of the objects created in Lab 1 (services and service chains) will be fully re-usable here. If any of these objects have not been created, please review Lab 1 for more detailed configuration instructions.

Step 1: Review the lab diagram and map out the services and endpoints

Specifically, note that in this lab there is a web server on the internal network (the client’s network in this case) that external users want to get to. An external client desktop exists on the external/outbound network, that accesses these resources through SSLO.

- The external client is attached to a *10.30.0.0/24* network and is assigned the IP *10.30.0.70*. This network is attached to the BIG-IP 1.2 interface.

- The web server is an Ubuntu 14.04 LTS server configured with Apache2 and PHP5, and listens on five addresses:
  - 10.20.0.90
  - 10.20.0.91
  - 10.20.0.92

  Each instance includes a simple Apache2 demo page that also shows which site was accessed.

- In lieu of a separate DNS server in the lab, the external client has static /etc/hosts entries that map the above addresses to the following URLs, respectively:
  - test0.f5labs.com
  - test1.f5labs.com
  - test3.f5labs.com

- A wildcard (*.f5labs.com) server certificate and private key have been installed on the SSL Orchestrator.

The external client has two options for accessing the internal websites: via wildcard (0.0.0.0/0) gateway, and direct IP listener. The lab will explore both options below.

Note: SSL Orchestrator sends all traffic through an inline layer 3 or HTTP device in the same direction – entering through the inbound interface. It is likely, therefore, that the layer 3 device may not be able to correctly route both outbound (forward proxy) and inbound (reverse proxy) traffic at the same time. Please see the appendix, “Routing considerations for layer 3 devices” for more details.

Step 2: Configure an L3 inbound SSLO deployment through Guided Configuration

In this scenario, an SSLO L3 inbound listener is configured as a gateway service. It will listen on a wildcard VIP (0.0.0.0/0), or otherwise specific subnet (vs. a dedicated single IP), and terminate inbound TLS traffic flows via wildcard or subject alternative name (SAN) certificate. Follow the L3 Inbound topology workflow to build this solution. In the SSL Orchestrator dashboard view, select the Topologies tab (bottom) and click Add.

- **Configuration review and prerequisites** – take a moment to review the topology options and workflow configuration, then click Next.
- **Topology Properties**
  - **Name**: provide some name (ex. “sslo_inbound_1”)
  - **Protocol**: TCP
  - **IP Family**: IPv4
  - **Topology**: select L3 Inbound
  - Click Save & Next
- **SSL Configuration** – an inbound topology requires different SSL settings.
  - Click Show Advanced Setting
  - **Client-side SSL**
    - **Cipher Type**: Cipher String
    - **Cipher String**: DEFAULT
    - **Certificate Key Chain** – the certificate key chain represents the certificate and private key of an endpoint server instance (the target of a remote client’s request). In a gateway-mode configuration, this would typically be a wildcard of Subject Alternative Name (SAN) certificate in the event the SSLO inbound listener was intended to service multiple sites. In this lab a wildcard certificate has been provided. Select the pencil icon to edit, then select the wildcard.f5labs.com certificate and private key and click Done.

      SSL Settings minimally require RSA-based template and CA certificates but can also support Elliptic Curve (ECDSA) certificates.
  - **Server-side SSL**
    - **Cipher Type**: Cipher String
    - **Cipher String**: DEFAULT
    - **Trusted Certificate Authority** – as an inbound solution, the server-side SSL would be pointing to internal servers. While definitely possible to perform validation against internal server certificates, it is likely less important to do so. Leave this setting as is.

- **Expire Certificate Response** – Assuming no internal certificate validation is needed, the default **drop** setting will cause the connection to fail, so leave this at Ignore.
- **Untrusted Certificate Authority** – Assuming no internal certificate validation is needed, the default **drop** setting will cause the connection to fail, so leave this at Ignore.
- **[Advanced] OCSP** – Assuming no internal certificate validation is needed, any OCSP configuration will cause the connection to fail, so leave this as is.
- **[Advanced] CRL** – Assuming no internal certificate validation is needed, any CRL configuration will cause the connection to fail, so leave this as is.

o Click Save & Next.

- **Services List** – the same services can be leveraged here, so simply click Save & Next.
- **Service Chain List** – the same service chains can be leveraged here, so simply click Save & Next.
- **Security Policy** – the security policy requirements are specific to each organization, though an inbound security policy would likely be less complex than an outbound policy.

SSL Orchestrator sends all traffic through an inline layer 3 or HTTP device in the same direction – entering through the service's "inbound" interface. It is likely, therefore, that the layer 3 device may not be able to correctly route both outbound (forward proxy) and inbound (reverse proxy) traffic at the same time. Please see the appendix, "Routing considerations for layer 3 devices" for more details.

Remove the built-in "Pinners_Rule", edit the "All Traffic" policy to add the service chain with the L2 and TAP services (only), and click Save & Next.

- **Interception Rule** – here is where a gateway-mode topology and the existing application topology generally differ. Where an explicit application topology "bolts onto" an existing application that performs its own SSL management (SSL offload), traffic management (pools) and traffic intelligence (iRules, profiles), the gateway-mode SSLO topology provides a single, generic entry point for potentially multiple applications, and would sit in front of another ADC or routing device. This is mostly useful when an SSL visibility device must sit closer to the outer edge of an environment, and/or when the SSL visibility product "owner" does not otherwise own the applications or ADC(s).

  It is possible to configure an L3 Inbound topology configuration with a single target IP address and port and destination pool (targeted mode). However, an L3 Inbound topology must re-encrypt the inbound traffic. Therefore, there are two options for this lab (choose one):

  - **Gateway mode** – interception rule listening on a wildcard IP, port 443, with a wildcard or SAN certificate. Clients route through SSLO.
    - Hide Advanced Setting
    - **Source Address**: 0.0.0.0/0
    - **Destination Address/Mask**: 0.0.0.0/0
    - **Port**: 443

        - **Access Profile**: new in SSLO 6.0, the Access Profile selection is exposed for inbound topologies to allow for insertion of per-session access and authentication processing. For this lab, leave this setting as default.
        - **VLANs**: outbound (this is the server-side VLAN)
        - **[Protocol Settings] L7 Profile Type** – this setting enables or disables HTTP processing.
        - **[Protocol Settings] L7 Profile** – if the above option is set to HTTP, this option selects a specific HTTP profile. Set both to None, or both to HTTP and /Common/http.
    - **Targeted mode** – interception rule listening on a dedicated IP, port 443, with any server certificate. Clients route to SSLO.
        - Show Advanced Setting
        - **Source Address**: 0.0.0.0/0
        - **Destination Address/Mask**: 10.30.0.200
        - **Port**: 443
        - **VLANs**: outbound (this is the server-side VLAN)
        - **[Protocol Settings] Client TCP Profile** – allows setting a custom client-side TCP profile.
        - **[Protocol Settings] Server TCP Profile** – allows setting a custom server-side TCP profile.
        - **[Protocol Settings] SSL Configuration** – allows setting a custom SSL setting.
        - **[Protocol Settings] L7 Profile Type** – this setting enables or disables HTTP processing.
        - **[Protocol Settings] L7 Profile** – if the above option is set to HTTP, this option selects a specific HTTP profile.
        - **Pool** – webserver-pool (pre-created server pool)

  Click Save & Next

- **Egress Settings** – traffic egress settings are now defined per-topology and manage both the gateway route and outbound SNAT settings.
    - **Manage SNAT Settings** – enables per-topology instance SNAT settings. For this lab, select Auto Map.
    - **Gateways** – enables per-topology instance gateway routing. Options are to use the system default route, to use an existing gateway pool, or to create a new gateway. For this lab, select Default Route.
- **Log Settings** – the Log Settings page presents a per-topology configuration for log settings. For this lab, these settings can be left as default.

- **Summary** – the summary page presents an expandable list of all of the workflow-configured objects. To expand the details for any given setting, click the corresponding arrow icon on the far right. To edit any given setting, click the corresponding pencil icon. Clicking the pencil icon will send the workflow back to the selected settings page.
    - When satisfied with the defined settings, click Deploy.
- **Testing** – for gateway-mode testing, the lab's inbound desktop client includes static Hosts entries that match the real IPs of the internal web server,
    - test0.f5labs.com = 10.20.0.90
    - test1.f5labs.com = 10.20.0.91
    - test2.f5labs.com = 10.20.0.92

  and a static persistent route that points 10.20.0.0/24 traffic to the BIG-IP outbound (external) VLAN self-IP (10.20.0.100). For targeted-mode testing, create a static Hosts entry in /etc/hosts for,
    - www.f5labs.com = 10.30.0.200

LAB 3 – CREATE AN EXPLICIT FORWARD PROXY SSLO

SSL Orchestrator creates discreet, non-overlapping interception rules (listeners) based on the selected topology. For example, the explicit forward proxy workflow minimally creates an explicit proxy listener and relying transparent proxy listener attached to the explicit proxy tunnel. If a separate transparent proxy workflow was created, the resulting listener would not conflict with or overlap the existing transparent proxy listener. Therefore, assuming a transparent forward proxy already exists from Lab 1, the following workflow will create a separate set of non-overlapping listeners to satisfy an explicit forward proxy use case.

This lab will consist of an abbreviated set of steps, as all of the objects created in Lab 1 (SSL settings, services, service chains and security policies) will be fully re-usable here. If any of these objects have not been created, please review Lab 1 for more detailed configuration instructions.

Step 1: Review the lab diagram and map out the services and endpoints

Review the same step in Lab 1 for more details. This lab uses the exact same environment, so SSL settings, services, service chains and security policy will be re-used.

Step 2: Configure an explicit proxy SSLO deployment through Guided Configuration

- **Configuration review and prerequisites** – take a moment to review the topology options and workflow configuration, then click Next.
- **Topology Properties**
    - **Name**: provide some name (ex. "sslo_explicit")
    - **Protocol**: TCP
    - **IP Family**: IPv4
    - **Topology**: select L3 Explicit Proxy
    - Click Save & Next
- **SSL Configurations** – the existing outbound SSL settings from Lab 1 can be re-used here.
    - **SSL Profile**: Use Existing, select existing outbound SSL settings.
    - Click Save & Next

  Whenever repurposing a topology setting, a warning will appear, "There are other configuration items that are referencing this item. Editing this item will affect the referencing ones mentioned below". Click OK to acknowledge.

- **Services List** – there are no new services to create.
    - Click Save & Next

- **Service Chain List** – there are no new service chains to create.
    - Click Save & Next
- **Security Policy** – the existing outbound Security Policy from Lab 1 can be re-used here.
    - **Type**: Use Existing, select existing outbound SSL settings.
    - **Proxy Connect**: this option is only available for the outbound explicit proxy topology and defines an upstream proxy chain. With this setting enabled, SSLO can egress to an upstream (external) explicit proxy gateway. An example of this might be a cloud gateway solution. Select a pool that points to the upstream explicit proxy, and optionally any (HTTP Basic) credentials needed to access this proxy. For this lab, leave this setting disabled.
    - Click Save & Next
- **Interception Rule** – an explicit proxy requires a unique IP address and port listener.
    - **IPv4 Address**: 10.20.0.150
    - **Port**: 3128
    - **Access Profile**: if enabling explicit proxy authentication, select an existing SWG-Explicit access profile here.
    - **VLANs**: client-net
    - Click Save & Next
- **Egress Setting** – traffic egress settings are now defined per-topology and manage both the gateway route and outbound SNAT settings.
    - **Manage SNAT Settings** – enables per-topology instance SNAT settings. For this lab, select Auto Map.
    - **Gateways** – enables per-topology instance gateway routing. Options are to use the system default route, to use an existing gateway pool, or to create a new gateway. For this lab, select Use Existing Gateway Pool, then select the "-ex-pool-4" gateway pool.
    - Click Save & Next
- **Log Settings** – new in SSLO 6.0, log settings are defined per-topology. In environments where multiple topologies are deployed, this can help to streamline troubleshooting by reducing debug logging to the affected topology.
- **Summary** – the summary page presents an expandable list of all of the workflow-configured objects. To expand the details for any given setting, click the corresponding arrow icon on the far right. To edit any given setting, click the corresponding pencil icon. Clicking the pencil icon will send the workflow back to the selected settings page.
    - When satisfied with the defined settings, click Deploy.

Step 3: Add DNS and Logging settings

Minimally an explicit proxy requires DNS settings. To enable this for the L3 Explicit topology, in the SSLO UI click System Settings icon (gear) on the top right of the Configure view.

- **DNS Query Resolution** – select Local Forwarding Nameserver.
- **Local Forwarding Nameserver(s)** – enter 10.30.0.1.
- **Gateway Configuration** - If using a remote DNS forwarder, that is, anything not on a local subnet to the F5 (ex. 8.8.8.8), a route must also be configured to allow SSLO to reach this remote DNS. If a system gateway route has already been defined, select Default Route here. Otherwise, select Create New and enter the local gateway route. In this lab that's 10.30.0.1.
- Click Deploy to commit the changes.

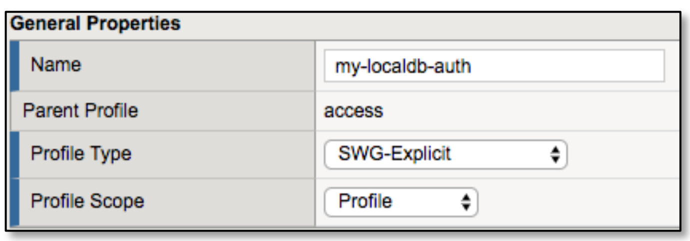
Testing – configure the browser to use 10.20.0.150:3128 for explicit proxy access. An explicit proxy request test can also be done using command-line cURL:

```
curl -vk --proxy 10.20.0.150:3128 https://www.example.com
```

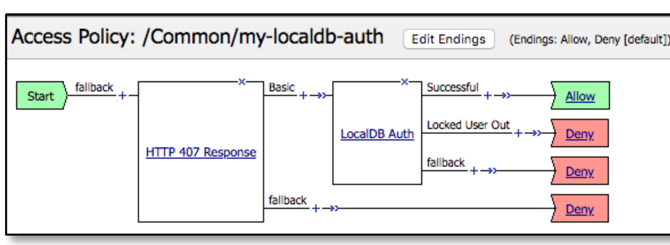
Step 4: [Optional] Add explicit proxy authentication

Enabling explicit proxy authentication in SSLO requires two steps,

- **Create an SWG-Explicit access policy** – explicit proxy authentication is defined as an access policy of type SWG-Explicit.



This policy will typically contain an HTTP 407 Response challenge, and then some form of authentication, which could HTTP Basic, NTLM or Kerberos.



- **Create or edit an Explicit Proxy SSLO topology and attach the SWG-Explicit access policy** – to attach the SWG-Explicit access policy to SSLO, create or edit an Explicit proxy SSLO topology. On the Interception Rules page, select this policy under the **Access Profile** option.

LAB 4 – CREATE AN SSLO FOR EXISTING APPLICATIONS

SSL Orchestrator defines an existing application as a typical reverse proxy LTM virtual server, performing its own SSL handling and traffic management. The Existing Application SSLO topology therefore only needs to create the components that this virtual server can consume, specifically the services, service chains, and security policy. The Existing Application SSLO workflow skips SSL management and interception rules, and ultimately produces an SSLO-type per-request policy that can be attached to an existing LTM virtual server.

This lab will consist of an abbreviated set of steps, as all of the relevant objects created in Lab 1 (services, service chains and security policies) will be fully re-usable here. If any of these objects have not been created, please review Lab 1 for more detailed configuration instructions.

Step 1: Review the lab diagram and map out the services and endpoints

Review the same step in Lab 1 for more details. This lab uses the exact same environment, so SSL settings, services, service chains and security policy will be re-used.

Step 2: Create an LTM application

For the lab, create a simple LTM application,

- **Create a pool** – use one (or multiple) of the internal webserver IPs and select port 80.
    - 10.20.0.90:80
    - 10.20.0.91:80
    - 10.20.0.92:80
- **Create a client SSL profile** – use the wildcard.f5labs.com certificate and private key.
- **Create an LTM virtual server** – use the following basic settings,
    - **Destination Address/Mask**: 10.30.0.205
    - **Service Port**: 443
    - **HTTP Profile**: http
    - **SSL Profile (Client)**: wildcard.f5labs.com SSL profile
    - **VLANs and Tunnels**: outbound VLAN
    - **Source Address Translation**: Auto Map
    - **Pool**: previously-created pool
- **Test access to the LTM virtual server** – the webserver should be accessible via HTTPS request to the LTM virtual server.

- Optionally create a Hosts entry on the client by editing /etc/hosts (as root) to point 10.30.0.205 to www1.f5labs.com, and test access to https://www1.f5labs.com. The certificate is a wildcard, so any *.f5labs.com hostname would also work.

Step 3: Configure an Existing Application deployment through Guided Configuration

- **Configuration review and prerequisites** – take a moment to review the topology options and workflow configuration, then click Next.

- **Topology Properties**
  - **Name**: provide some name (ex. "existing_app_1")
  - **IP Family**: IPv4
  - **Topology**: select Existing Application
  - Click Save & Next

- **Services List** – there are no new services to create.
  - Click Save & Next

- **Services Chain List** – there are no new service chains to create.
  - Click Save & Next

- **Security Policy** – the security policy requirements are specific to each organization, though an inbound security policy would likely be less complex than an outbound policy.

  SSL Orchestrator sends all traffic through an inline layer 3 or HTTP device in the same direction – entering through the service's "inbound" interface. It is likely, therefore, that the layer 3 device may not be able to correctly route both outbound (forward proxy) and inbound (reverse proxy) traffic at the same time. Please see the appendix, "Routing considerations for layer 3 devices" for more details.

  Remove the built-in "Pinners_Rule", edit the "All Traffic" policy to add the service chain with the L2 and TAP services (only), and click Save & Next.

- **Summary** – the summary page presents an expandable list of all of the workflow-configured objects. To expand the details for any given setting, click the corresponding arrow icon on the far right. To edit any given setting, click the corresponding pencil icon. Clicking the pencil icon will send the workflow back to the selected settings page.
  - When satisfied with the defined settings, click Deploy.

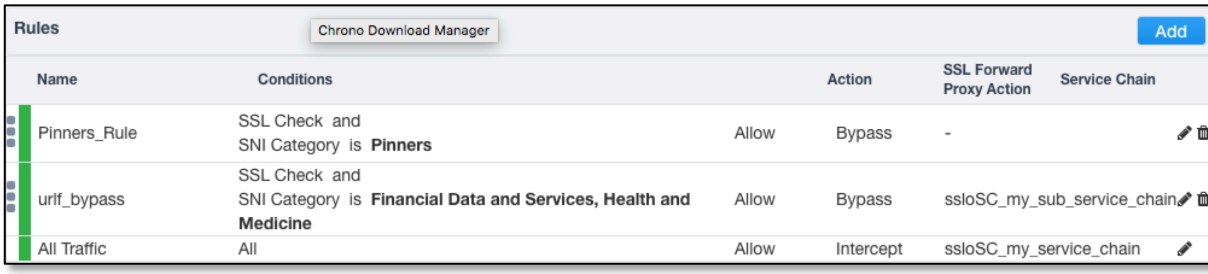
Step 4: Attach the SSLO objects to an existing LTM application

The Existing Application topology workflow produces a single SSLO per-request policy. To attach this to the LTM virtual server, edit the virtual server properties,

- **Access Policy (Access Profile**): attach the single "ssloDefault_accessProfile".
- **Access Policy (Per-Request Policy)**: attach the existing application per-request policy.

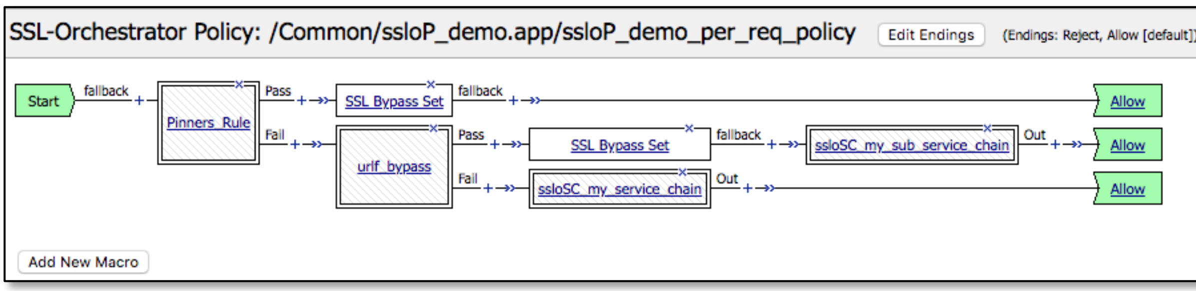
Lab 5 – Manage the SSLO security policy

SSL Orchestrator provides a rich, interactive, rules-based security policy through the Guided Configuration.


Rules   Chrono Download Manager   Add

Name	Conditions	Action	SSL Forward Proxy Action	Service Chain
Pinners_Rule	SSL Check and SNI Category is **Pinners**	Allow	Bypass	-
urlf_bypass	SSL Check and SNI Category is **Financial Data and Services, Health and Medicine**	Allow	Bypass	ssloSC_my_sub_service_chain
All Traffic	All	Allow	Intercept	ssloSC_my_service_chain

The security policy itself is a front-end to an access per-request engine that converts the rules into visual elements in this policy. Also note that the order of rules affects the order of events in the visual policy. Rules are read top-to-bottom and converted into corresponding visual agents nesting from left to right.



While security policy rules work well for most traffic processing scenarios, it may be necessary to go beyond their capabilities and manipulate the visual per-request policy directly.

Keep in mind, however, that the rules engine converts rules to visual elements in one direction only. It cannot convert visual elements back to rules, therefore once the visual per-request policy has been manipulated, the Guided Configuration security policies user interface will no longer be available.

This lab will explore some of the different options for manipulating SSLO security policies.

Step 1: Review and edit the existing security policy rules

In the SSLO dashboard view, navigate to the Security Policies tab and click on a security policy (Name). The Guided Configuration will present the rules engine previously seen as part of the topology workflow. New rules can be added, and existing rules edited. Notice also that the "All Traffic" rule is anchored to the security policy and cannot be moved or removed. This is the default action rule for the policy, similar to a default deny rule in a firewall policy. By default, it Intercepts (decrypts) traffic, but does not send traffic to any service chain. This can be edited to Intercept, bypass or block (reject), and to send traffic to a service chain.

Additional rules can use **AND** (Match All) or **OR** (Match Any) logic to create complex decisions. Review the **Conditions** options to see the possibilities.

Step 2: Review and edit the visual per-request policy

To view the underlying visual security policy, in the SSLO dashboard view, navigate to the Security Policies tab and click on a security policy (Per Request Policies). This will open a new tab with a view of the visual per-request policy. By default, the security policy is locked and prevents any changes to the visual per-request policy. To edit the visual policy, first unlock the policy in the SSLO dashboard, Security Policies tab.

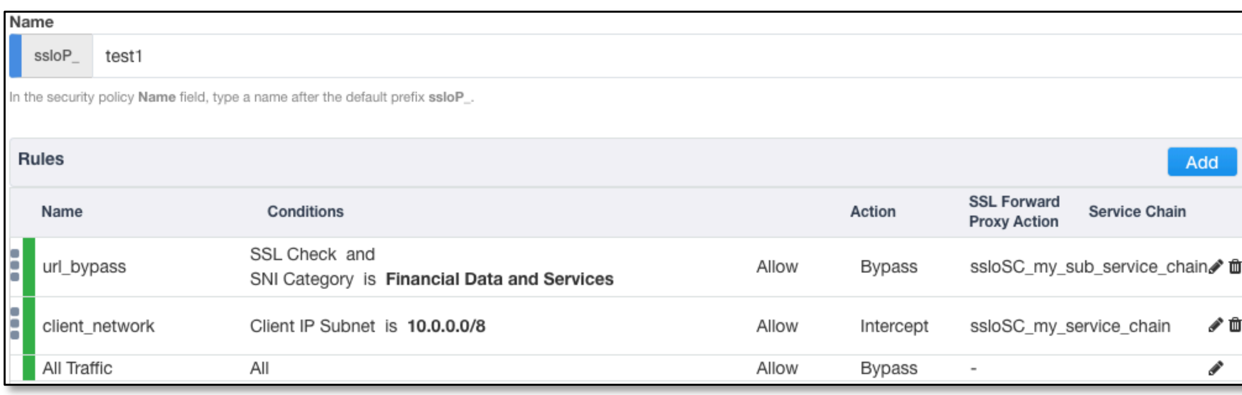
Keep in mind, however, that the rules engine converts rules to visual elements in one direction only. It cannot convert visual elements back to rules, therefore once the visual per-request policy has been manipulated, the Guided Configuration security policies user interface will no longer be available.

Step 3: Practice creating Security Policies

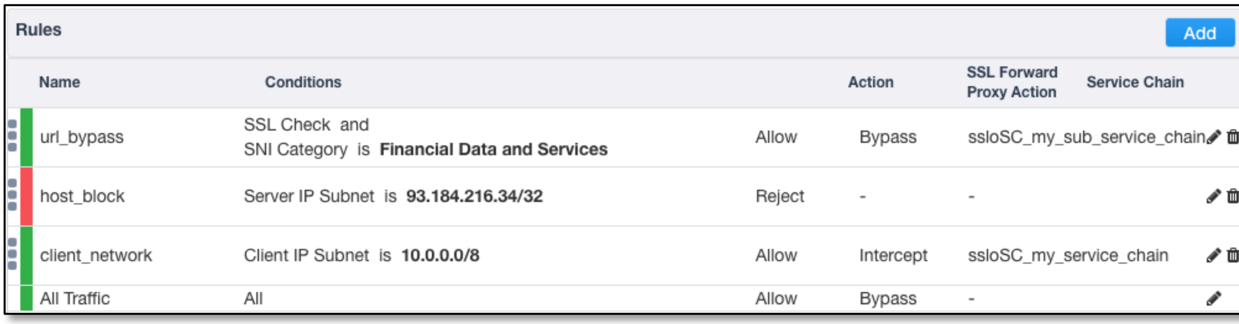
The following are a few examples of security policy use cases,

- Create a new security policy that matches source addresses in the outbound desktop client's subnet, intercepts SSL, and sends to a service chain. All other traffic is bypassed with no service chain.

- Add a rule to the above security policy that matches a specific URL category, bypasses SSL and sends to a service chain. Move this rule to the top of the list.



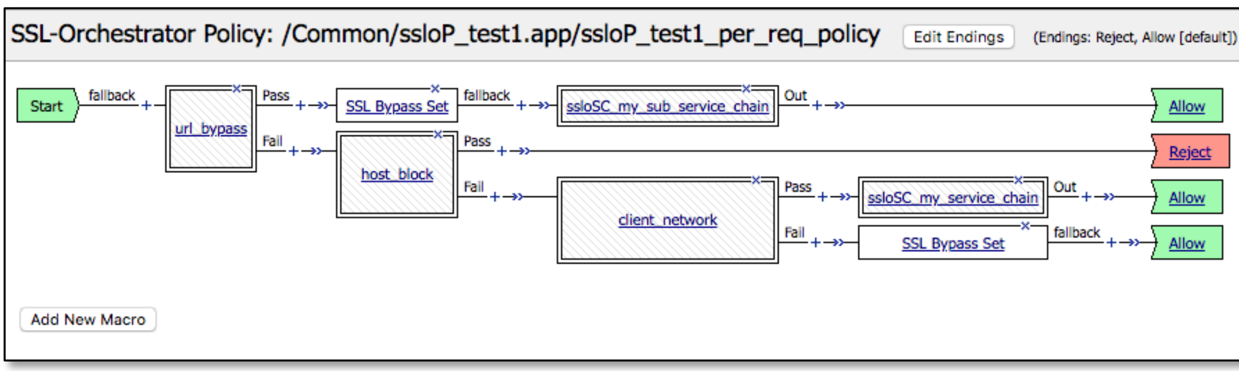
- Add a new rule to the above security policy that matches a specific destination IP and blocks this traffic. Move this rule below the URL category rule, but above the client network rule.



Rules

Name	Conditions	Action	SSL Forward Proxy Action	Service Chain
url_bypass	SSL Check and SNI Category is **Financial Data and Services**	Allow	Bypass	ssloSC_my_sub_service_chain
host_block	Server IP Subnet is **93.184.216.34/32**	Reject	-	-
client_network	Client IP Subnet is **10.0.0.0/8**	Allow	Intercept	ssloSC_my_service_chain
All Traffic	All	Allow	Bypass	-

- Click Deploy, then navigate to the **Security Policies** tab in the SSL Orchestrator UI. For the newly-created security policy, click the link under the **Per Request Policies** header. This will open a new tab to the visual per-request policy.



Notice that the visual policy elements are nested in accordance with the ordered set of rules,

- If the URL category is “Financial Data and Services” (urlf_bypass), bypass SSL and send to a service chain.
- Otherwise, if the destination IP is 93.184.216.34/32 (host_block), reject the traffic.
- Otherwise, if the client IP matches 10.0.0.0/8 (client_network), send to a service chain (SSL interception implied).
- Otherwise, bypass SSL and do not send to a service chain.

Note that the **L7 Protocol Lookup** and **URL Match** options must assume that incoming traffic is either unencrypted or decrypted, therefore any rules that use these, and any rules after these cannot select to intercept or bypass the SSL.

Apply the new rule to an existing outbound topology and test that a) financial sites are bypassed, b) https://www.example.com is blocked, c) and all other client traffic flows through the defined service chain. View the APM log to follow the policy logic:

```
tail -f /var/log/apm |grep -E “Following|Executed”
```

LAB 6 – CREATE OUTBOUND CHANNELS FOR SERVICES

An inline security device may need to access external resources. For example, an inline HTTP explicit proxy service would minimally need access to DNS services, while any security device may need to "phone home" for software and license updates, and to maintain malware signatures. Inline layer 3 devices, specifically, default route back to SSLO, so this is the path they would normally take to reach those external services. However, service-originating traffic is not "tagged" by SSLO, so cannot natively pass through the SSLO inspection zone. Therefore, to allow an internal service to reach external resources, separate service channels can be created that define listeners for specific source, destination, port and protocol combinations. Service channel requires an abbreviated L3 Outbound topology workflow.

Service-originating traffic cannot pass through the SSLO inspection zone, so the L3 Outbound service channel configuration must not define SSL and security policy settings.

Step 1: Review the service's remote access requirements

For this lab, the inline proxy service simply needs external DNS access to 8.8.8.8 UDP.

Step 2: Create an L3 Outbound service channel through Guided Configuration

- **Configuration review and prerequisites** – take a moment to review the topology options and workflow configuration, then click Next.
- **Topology Properties**
    - **Name**: provide some name (ex. "proxy_sc_dns")
    - **Protocol**: UDP
    - **IP Family**: IPv4
    - **Topology**: select L3 Outbound
    - Click Save & Next
- **Services List** – there are no new services to create.
    - Click Save & Next
- **Services Chain List** – there are no new service chains to create.
    - Click Save & Next
- **Security Policy** – service channel traffic cannot pass through the inspection services, so the security policy must be empty, with the "All Traffic" rule set to Allow, bypass SSL, and with no assigned service chain.
    - Click Save & Next

- **Interception Rule**
  - Select Custom outbound rule type and click Show Advanced Setting (top right).
  - **Source Address** – this will be the source address of the inline proxy server. The proxy server's default route is through its outbound interface, so the source address in this case will be 198.19.96.136/32.
  - **Destination Address/Mask** – the destination address is the specific target service, in this case Google DNS at 8.8.8.8/32.
  - **Port** – this will be port 53 for DNS.
  - **VLANs** – this will be the security service's outbound-side VLAN, so in this case the Proxy_out VLAN.
  - **Protocol Settings (L7 Profile Type)** – select None.
  - **Protocol Settings (L7 Profile)** – select None.
  - Click Save & Next
- **Log Settings** – new in SSLO 6.0, log settings are defined per-topology. In environments where multiple topologies are deployed, this can help to streamline troubleshooting by reducing debug logging to the affected topology.
- **Summary** – the summary page presents an expandable list of all of the workflow-configured objects. To expand the details for any given setting, click the corresponding arrow icon on the far right. To edit any given setting, click the corresponding pencil icon. Clicking the pencil icon will send the workflow back to the selected settings page.
  - When satisfied with the defined settings, click Deploy.
- **Test** – to verify the service channel is working, SSH to the proxy service and attempt to perform a DNS query to 8.8.8.8,

  dig @8.8.8.8 www.example.com

  Assuming this works, the proxy service can be configured to use this DNS service. Additional service channels can be created to provide direct access to other applications.

> A service channel works by creating a more specific listener on the destination side of the security service, based on some combination of source, destination, destination port and protocol (TCP/UDP). This can have adverse and unintentional effects if a service channel is defined too loosely. For example, if a service channel is simply defined with a destination IP (ex. 93.184.216.34), port (443), and protocol (TCP), outbound user traffic legitimately trying to get to https://www.example.com will be incorrectly subverted through the service channel.

LAB 7 – CONFIGURE CAPTIVE PORTAL AUTHENTICATION

In a traditional transparent forward proxy, the client/user is unaware of the proxy's existence. Client traffic is simply routed through the proxy. To authenticate users accessing the Internet through a transparent proxy, there are generally two options:

- **Direct** – where the proxy inserts integrated authentication challenged (i.e. NTLM/Kerberos/Basic) directly in the path of outbound traffic. This implies that users would get challenged for local authentication when going to remote Internet sites, which is typically disabled by default in most browsers, and would need to be enabled. While many proxies support this authentication mode, it is not terribly practical.

- **Captive portal** – where the proxy redirects "new" user sessions to a separate authentication site. The site provides the necessary authentication challenge, then redirects the user back through the proxy. A session is then tracked by virtue of some unique client attribute. Captive portals are very often deployed in hotels, airports, airplanes and other public places to authenticate users for outbound Internet access. Captive portal authentication also has a distinct advantage over explicit proxy authentication in that it supports more than just integrated authentication (i.e. NTLM/Kerberos/Basic). A captive portal can, for example, support login page, client certificate, and federated authentication.

> Note: it's also worth noting that any transparent proxy authentication mechanism requires cleartext access to the user traffic. The user's first request to the Internet must be over HTTP if not decrypting, so that the proxy can insert the direct challenge, or HTTP redirect to a captive portal. SSL Orchestrator generally solves this problem as a function of automatically decrypting outbound flows.

Transparent proxy captive portal authentication essentially flows like this,

- A new client opens a browser and attempts to connect to a remote Internet site (ex. www.google.com).

- The transparent proxy detects no session for this client, so inserts an HTTP redirect to its captive portal authentication service. As this is a separate site, the redirect must convey some information about the client, specifically the URL of the original request. This is usually provided in the query string of the redirect URL.

- The client accesses the captive portal, does some form of authentication, and is then redirected back to the origin URL. The origin URL is the one conveyed form the initial redirect in the query string.

- The client makes a second request to the origin URL through the transparent proxy and is permitted. Subsequent requests are tracked by whatever mechanism the proxy uses to identity the user.

As of SSLO 6.0, transparent proxy captive portal authentication is supported with the addition of APM (Access Policy Manager). The configuration requires two separate per-session access profiles – one attached to the SSLO transparent proxy configuration, and one attached to a separate virtual service configured to support the captive portal "login" process.

The following describes a minimal configuration using an APM Local DB user account and login page. As stated previously, this can also support integrated NTLM/Kerberos/Basic authentication, login pages, client certificates and federation, and can rely on Active Directory, LDAP and other identity management services.

- Optionally create the Local DB instance and any Local DB user accounts. This lab will use Local DB to authenticate users, but other identity management services may also be defined. Please see relevant APM documentation for the specific configuration steps needed for other authentication methods.

- Create an SWG-Transparent access profile. This profile will be attached to the separate captive portal "login" virtual server.

    - **Profile Type**: select SWG-Transparent.

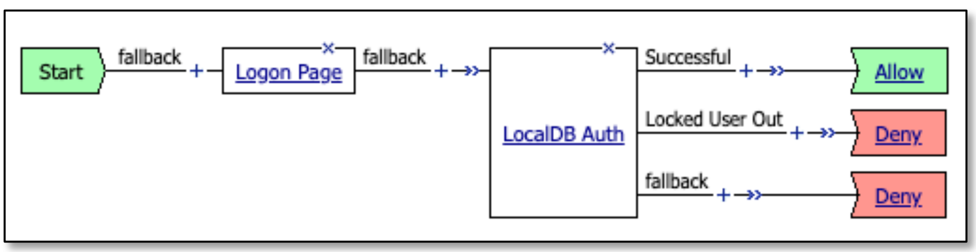
    - **Profile Scope**: SSLO introduces a new profile scope (named) for captive portal authentication that must match between it and the SWG-Transparent access profile. Select Named.

    - **Named Scope**: Enter a unique name here to represent the "authentication domain" shared between the two access profiles. For this lab, use something like "sslo".

    - **Captive Portal**: leave this as disabled. It is only enabled in the SSL Orchestrator access profile.

    - **Language**: select the desired language.

    Once completed, access the profile's visual policy to create the desired authentication strategy. This lab demonstrates a simple Local DB authentication via logon page.



- Create a new SSL Orchestrator access profile. Captive portal authentication requires a separate access profile configuration not created directly within the SSLO workflow.

    - **Profile Type**: select SSL Orchestrator.

    - **Profile Scope**: select Named to match the SWG-Transparent access profile.

    - **Named Scope**: enter the same named scope used in the SWG-Transparent profile (ex. "sslo").

    - **Captive Portal**: set this to enabled.

- **Primary Authentication URI**: this is the URL that the SSLO transparent proxy will redirect new users to, represented by and resolving to the separate virtual server instance and SWG-Transparent access profile. This would be a full URL, example: https://login.f5labs.com.

- **Language**: select the desired language.

Note: an SSL Orchestrator access profile does not have an editable visual policy.

- Create a client SSL profile. This will be needed by the captive portal login virtual server to handle incoming HTTPS communications.

- Create a virtual server. This virtual server will define the captive portal login instance that handles user authentication. Transparent proxy traffic will be redirected to this virtual server, so also ensure that the Captive Portal URL specified in the SSL Orchestrator access profile resolves to this VIP's IP address.

  - **Type**: select Standard

  - **Destination Address/Mask, and Service Port**: enter an IP address and port accessible to the client. This is the IP address that the specified captive portal URL should DNS resolve to.

  - **HTTP Profile (Client)**: the default http profile is adequate here.

  - **SSL Profile (Client)**: select the previously-created client SSL profile.

  - **VLANs and Tunnels**: select the client-facing VLAN here.

  - **Access Profile**: select the SWG-Transparent access profile here.

- Attach the new SSL Orchestrator access profile to the SSLO transparent proxy topology. In the SSLO UI, click on the relevant transparent forward proxy topology, or create a new one as described in Lab 1. On the Interception Rule page, under **Access Profile**, select the new SSL Orchestrator access profile. Complete the topology workflow and (re)deploy.

Note: when selecting a new access profile, a banner warning will be displayed above stating, "*If Access Profile is not topology specific the user cannot change the Log Settings in a topology deployment flow*". As log settings are now topology-specific, SSLO applies the selected options on the Log Settings page to the built-in SSLO access profile only. When a different access profile is selected, the Log Settings options are disabled for editing.

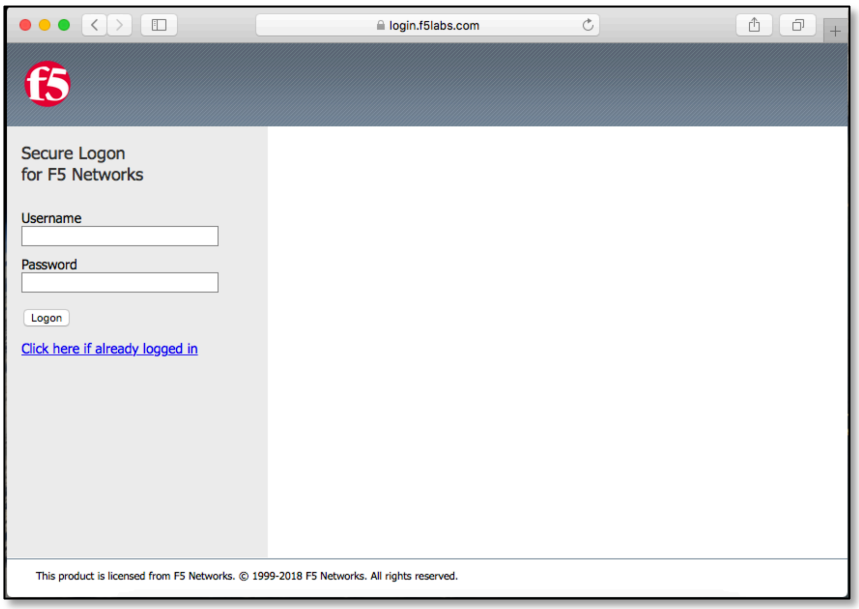
To re-acquire logging for the SSLO topology, create a new logging profile under Access – Overview – Event Logs – Settings

- **General**: enable both options (as required).

- **Access System Logs**: select the "/Common/sys-sslo-publisher" and select desired logging settings for each object.

- **URL Request Logs**: select the "/Common/sys-sslo-publisher" and minimally enable "Blocked" and "Confirmed" events (as required).
- **Access Profiles**: select the new SSL Orchestrator access profile. The SWG-Transparent access profile can also be selected (as required).

- Test the captive portal. On attempting to access an Internet site, a new user should be redirected to the login page defined in the SWG-Transparent access profile. Once authenticated, the user will be redirected back to the proxy and gain access to the origin URL content.



Lab 8 – Delete an SSLO configuration

One of the benefits of the new SSLO architecture is that configurations can be edited, deployed and re-deployed without affecting existing traffic flows. For this capability, the SSLO packaging is now broken into separate independent components. When deleting a defined topology, most of the attached components are also deleted. However, some objects, particularly those that can be consumed by multiple topologies, are not automatically deleted. This lab explores the different methods for deleting SSL Orchestrator objects.

Step 1: Deleting a topology

Deleting a topology will also delete any relying Interception Rules. The deletion process performs a complex set of REST-based tasks, therefore only one topology can be deleted at a time. In the SSLO UI, select a topology and click the Delete button. Confirm that both the topology and respective interception rules are removed.

Step 2: Deleting other objects

While deleting a topology also removes its respective interception rules, it does not remove the other objects - services, service chains, security policies and SSL settings. These can all be removed individually, however must be deleted in a hierarchical order. Once the topology and interception rules have been deleted,

- SSL Settings can be deleted any time
- Delete any unused Security Policies
- Delete any unused Service Chains
- Delete any unused Services

Step 3: Deleting everything

To completely remove the SSLO configuration and start from scratch,

- In the SSLO UI, click Delete Configurations and then click OK. This process will take some time as SSLO walks through all of the objects and dependencies to remove all configurations.
- Under the iApps menu, Application Services, Applications LX – un-deploy any remaining SSL orchestrator objects. If using any other Guided Configuration engine (ex. Access GC), ensure that only SSLO objects are deleted here.
- Under the iApps menu, Templates, Templates LX – delete all of the SSL Orchestrator templates.
- Under the iApps menu, Package management LX – delete the SSL Orchestrator package.

The next time the SSL Orchestrator configuration menu is accessed, SSLO will automatically restore the on-box package.

Optional: Deleting everything…the hard way

In the unlikely event that the above steps do not work, and some SSLO objects remain and cannot be deleted, one of the following steps can be used,

- If the topology and interception rules are gone but other objects remain and will not uninstall in the SSL Orchestrator UI, in the BIG-IP UI navigate to iApps -> Application Services -> Applications LX. The remaining objects will all be here in states of deployed (green), undeployed (gray), and error (red). Delete any objects in an error state and toggle the other objects from deployed to undeployed and back until they enter an error state and can also be deleted.

- If the above fails, the following script can be used to automate destruction of SSLO objects.

> Note: this is an option of last resort if the SSLO configuration is beyond saving.

  - Copy the script to the BIG-IP (ex. sslo-nuclear-delete.sh)
  - Chmod the script to give it execute privileges: chmod +x sslo-nuclear-delete.sh
  - Execute the script: ./sslo-nuclear-delete.sh
  - It will typically be necessary to execute the script several times to get through dependencies. It is completely done when the script returns quickly with no additional output. Validate that all SSLO objects are gone from the BIG-IP UI under the Local Traffic and Network sections.
  - Under the iApps menu, Application Services, Applications LX – un-deploy any remaining SSL orchestrator objects. If using any other Guided Configuration engine (ex. Access GC), ensure that only SSLO objects are deleted here.
  - Under the iApps menu, Templates, Templates LX – delete all of the SSL Orchestrator templates.
  - Under the iApps menu, Package management LX – delete the SSL Orchestrator package.

sslo-nuclear-delete.sh:

```
#!/bin/bash

## v6 (20190408)

user_pass='admin:admin'

########################################
echo "** Deleting iApp templates and installed package"
blocks=$(tmsh list mgmt shared iapp blocks |grep "mgmt shared iapp blocks" |awk -F" " '{print $5}')
for b in $blocks
do
   tmsh delete mgmt shared iapp blocks $b > /dev/null 2>&1
done
package=$(tmsh list mgmt shared iapp installed-packages |grep "mgmt shared iapp installed-packages" |awk -F" " '{print
$5}')
```

```
for p in $package
do
   tmsh delete mgmt shared iapp installed-packages $p > /dev/null 2>&1
done


########################################
echo "** Deleting application services"
for svc in `curl -sk -X GET "https://localhost/mgmt/tm/sys/application/service" -u ${user_pass} | jq -r '.items[].fullPath'
|sed 's/\/Common\///g' |grep ^sslo`; do
   tmsh modify sys application service ${svc} strict-updates disabled
   tmsh delete sys application service ${svc}
done


########################################
echo "** Unbinding SSLO objects"
for block in `curl -sk -X GET
'https://localhost/mgmt/shared/iapp/blocks?$select=id,state,name&$filter=state%20eq%20%27*%27%20and%20state%20ne%20%27TEMPL
ATE%27' -u ${user_pass} | jq -r '.items[] | [.name, .id] |join(":")' |grep -E '^sslo|f5-ssl-orchestrator' | awk -F":"
'{print $2}'`; do
   curl -sk -X PATCH "https://localhost/mgmt/shared/iapp/blocks/${block}" -d '{state:"UNBINDING"}' -u ${user_pass} >
/dev/null 2>&1
   sleep 15
   curl -sk -X DELETE "https://localhost/mgmt/shared/iapp/blocks/${block}" -u ${user_pass} > /dev/null 2>&1
done

sslo_ibjects=''
sslo_objects=`tmsh list |grep -v "^\s" |grep sslo |sed -e 's/{//g;s/}//g' |grep -v "apm profile access
/Common/ssloDefault_accessProfile" |grep -v "apm log-setting /Common/default-sslo-log-setting" |grep -v "net dns-resolver
/Common/ssloGS_global.app/ssloGS-net-resolver" |grep -v "sys application service /Common/ssloGS_global.app/ssloGS_global"
|grep -v "sys provision sslo"`


########################################
echo "** Deleting SSLO objects"
tmsh delete apm profile access /Common/ssloDefault_accessProfile > /dev/null 2>&1
tmsh delete net dns-resolver /Common/ssloGS_global.app/ssloGS-net-resolver > /dev/null 2>&1
tmsh delete sys application service /Common/ssloGS_global.app/ssloGS_global > /dev/null 2>&1
tmsh delete apm policy access-policy /Common/ssloDefault_accessPolicy > /dev/null 2>&1

while read -r line
do
    if [ ! -z "$sslo_objects" ]
    then
       eval "tmsh delete $line" > /dev/null 2>&1
    fi
```

```
done <<< "$sslo_objects"


########################################
echo "** Final config save"
tmsh save sys config > /dev/null 2>&1
sleep 5
#bigstart restart restnoded
sleep 15

echo "** Complete - Run this script at least twice and until no errors are output."
```

Note: in this lab, the sslo-nuclear-delete.sh script already exists under the /config/dev directory.

- If the above fails, manually clear the REST database from the command line,
  - Break any HA configuration
  - Issue the 'clear-rest-storage [options]' command, where the options are "-l" (lowercase L) to delete the restjavad log files as well as the stored state, and "-d" to reset the system configuration to default. This command will remove all SSL Orchestrator objects from the restnoded database. After issuing this command, follow with 'bigstart restart restnoded' and 'bigstart restart restjavad', clear the browser cache, log out and back in.
  - Issue the 'tmsh delete sys application service recursive' command to also delete any remaining SSL Orchestrator application service objects.
  - Once all SSLO objects have been removed, also uninstall the SSLO RPM package under the iApps menu, Package management LX – delete the SSL Orchestrator package.
  - Rebuild HA and redeploy SSLO by navigating to the SSL Orchestrator configuration UI. On first visit it will automatically restore the on-box package.

TROUBLESHOOT SSLO

While the SSL Orchestrator product has certainly evolved, as with anything in the computing world, problems are usually inevitable and poorly timed. In the event that an SSL Orchestrator configuration has failed, or that it has succeeded but not behaving as expected, the following troubleshooting tools should be useful.

Step 1: Test the configuration

It is important to first define “normal” behavior. If the SSL Orchestrator deployment process was successful, it will be possible to access remote Internet sites from the client workstation without issue, and HTTPS sites appear to have a locally-trusted, re-issued server certificate. This would be considered normal behavior. If any of these do not happen, use the tools below to troubleshoot.

Step 2: Troubleshoot

Below is a reasonably-ordered list of troubleshooting steps.

- If the SSL Orchestrator deployment process fails, review the ensuing error message. It would be impossible to list here all of the possible error messages and their meanings, but often enough the messages will reveal the issue.
- Re-review the lab steps for any missing or misconfigured settings.
- Enable debug logging in the SSL Orchestrator configuration. Tail the APM log from a BIG-IP command line or from the logs page in the management UI. Debug logging will very often reveal important issues. Specifically, it will indicate traffic classification matches, mismatches or deployment issues.

```
tail –f /var/log/apm
tail -f /var/log/restnoded/restnoded.log
tail -f /vr/log/restjavad.0.log
```

- If the SSL Orchestrator deployment process succeeds, but traffic isn’t flowing through the environment made evident by lack of access to remote sites from the client:
    - Ensure that the client is properly configured to either default route to the ingress VLAN and self-IP of the BIG-IP for transparent proxy access or has the correct browser proxy settings defined for explicit proxy access.
    - Ensure that traffic is flowing to the BIG-IP from the client with a tcpdump capture at the ingress interface.
    - Review the LTM configuration created by the SSL Orchestrator. Specifically, look at the pools and respective monitors for any failures.
    - Isolate service chain services. If at least one service chain has been created, and debug logging indicates that traffic is matching this chain, remove all but one service from that chain and test. Add one service back at a time until traffic flow stops. If a single added service breaks traffic flow, this service will typically be the culprit.

- If a broken service is identified, insert probes to verify inbound and outbound traffic flow. Inline services will have a source (S) VLAN and destination (D) VLAN, and ICAP and receive only services will each have a single source VLAN. Insert a tcpdump capture at each VLAN in order to determine if traffic is getting to the device, and if traffic is leaving the device through its outbound interface.

- If no service chains are defined, it may be necessary to remove all of the defined services and re-create them one-by-one to validate flow through the built-in All chain. If a broken service is identified, insert tcpdump probes as described above.

- If traffic is flowing through all of the security devices, insert a tcpdump probe at the egress point to verify traffic is leaving the BIG-IP to the gateway router.

- If traffic is flowing to the gateway router, perform a more extensive packet analysis to determine if SSL if failing between the BIG-IP egress point and the remote server.

```
tcpdump –i 0.0:nnn –nn –Xs0 –vv –w <file.pcap> <any additional filters>
```

Then either export this capture to WireShark are send to ssldump:

```
ssldump -nr <file.pcap> -H -S crypto > text-file.txt
```

- If the WireShark or ssldump analysis verifies an SSL issue:

  - Plug the site's address into the SSLLabs.com server test site at:
    https://www.ssllabs.com/ssltest/
    This report will indicate any specific SSL requirements that this site has.

  - Verify that the SSL Orchestrator server SSL profiles (two of them) have the correct cipher string to match the requirements of this site. To do that, perform the following command at the BIG-IP command line:

```
tmm --clientciphers 'CIPHER STRING AS DISPLAYED IN SERVER SSL PROFILES'
```

  - Further SSL/TLS issues are beyond the depth of this lab guide. Seek assistance.

- If all else fails, seek assistance.

APPENDIX – COMMON TESTING COMMANDS

The following are some simple, but powerful commands that are useful in developing and troubleshooting SSL visibility projects.

Packet capture

Second only to debug logging, packet captures are crucial to troubleshooting (and simply validating) network and service-related issues. Each security service is connected to separate "ingress" and "egress" VLANs, traffic going into the service from the F5, and traffic leaving the service back to the F5, respectively. To verify that traffic is entering, or leaving a security device, insert a tcpdump "tap" on the appropriate VLAN.

```
tcpdump –lnni [VLAN]:nnn -Xs0
```

Note that the service VLANs reside with application service containers, so must be referenced accordingly. The easiest way to derive this path is from the BIG-IP UI. Navigate to the Network – VLANs menu. In the "Partition / Path" column for the desired VLAN, copy the path beyond the "Common/" string. For example, if the path is "*Common/ssloN_IPS_in.app*", copy "*ssloN_IPS_in.app*". The full path will be this value, plus the same string again without the "*.app*" extension. The VLAN path will therefore look like this:

`ssloN_IPS_in.app/ssloN_IPS_in`

From the BIG-IP command line, insert the tcpdump tap on the ingress side of this IPS service like this:

```
tcpdump -lnni ssloN_IPS_in.app/ssloN_IPS_in
```

Pass traffic through SSLO to verify that data is flowing to the inline service. Switch the VLAN value to the egress VLAN to also verify data is flowing out of the inline service. To view decrypted traffic, add "-Xs0" (zero) to the tcpdump command.

```
tcpdump -lnni ssloN_IPS_in.app/ssloN_IPS_in -Xs0
```

And to filter out ICMP traffic and other unneeded flows, add filters to the end of the capture.

```
tcpdump -lnni ssloN_IPS_in.app/ssloN_IPS_in not icmp
```

Control the SSLFWD certificate cache

The behavior of the SSL Forward Proxy changes after a certificate is cached, which will make it difficult to troubleshoot some issues. The following allows you to both list and delete the certificates in the cache.

```
tmsh show ltm clientssl-proxy cached-certs clientssl-profile [CLIENTSSL PROFILE] virtual [INGRESS TCP VIP]
tmsh delete ltm clientssl-proxy cached-certs clientssl-profile [CLIENTSSL PROFILE] virtual [INGRESS TCP VIP]
```

Isolate SSLO traffic

Any given website will be full of images, scripts, style sheets, and very often references to document objects on other sites (like a CDN). This can make troubleshooting very complex. The following cURL commands allow you to isolate traffic to a single request and response.

```
curl -vk https://www.bing.com

curl -vk --proxy 10.30.0.150:3128 https://www.bing.com

curl -vk --proxy 10.30.0.150:3128 --location https://www.bing.com
```

Optionally, between each cURL test, delete the certificate cache and start logging:

```
tmsh delete ltm clientssl-proxy cached-certs clientssl-profile [CLIENTSSL PROFILE] virtual
[INGRESS TCP VIP] && tail -f /var/log/apm
```

Debugging

There is simply nothing better than debug logging for troubleshooting SSL intercept issues. The SSL Orchestrator in debug mode pumps out an enormous set of logs, describing every step along a connection's path. Remember to never leave debug logging enabled.

```
tail -f /var/log/apm
```

SSL inspection

```
ssldump -AdNd -i [VLAN] port 443 <and additional filters>

tcpdump -i 0.0:nnn -nn -Xs0 -vv -w <file.pcap> <and additional filters>

ssldump -nr <file.pcap> -H -S crypto > text-file.txt
```

TLS is rarely the issue, but a sight or configuration error may render some sites inaccessible.

Control the URL Filtering database

To show the current status of the database:

```
tmsh list sys url-db download-result
```

To initiate (force) the URL DB to update:

```
tmsh modify sys url-db download-schedule all status true download-now true
```

To verify that the URL DB is actively updating:

```
tcpdump  -lnni 0.0 port 80 and host 204.15.67.80
```

External testing

Plug the site's address into SSLLabs.com server test site at **https://www.ssllabs.com/ssltest/** to see if the site has any unusual SSL/TLS requirements.

Appendix – Testing TLS 1.3

Formally defined in RFC 8446, TLS 1.3 is a significant enhancement to modern "secure" Internet communications.

SSLO 6.0 now supports reverse proxy (SSLO inbound) handling. To configure inbound TLS 1.3 support, perform the following steps.

- Create a new Cipher Rule to represent the more condensed set of ciphers supported in TLS 1.3. In the BIG-IP UI, under Local Traffic – Ciphers – Rules, click Create.
    - **Cipher Suites**: enter the following string to enable the three TLS 1.3 ciphers currently supported in BIG-IP 15.0:

      ```
      TLS13-AES128-GCM-SHA256:TLS13-AES256-GCM-SHA384:TLS13-CHACHA20-POLY1305-SHA256
      ```

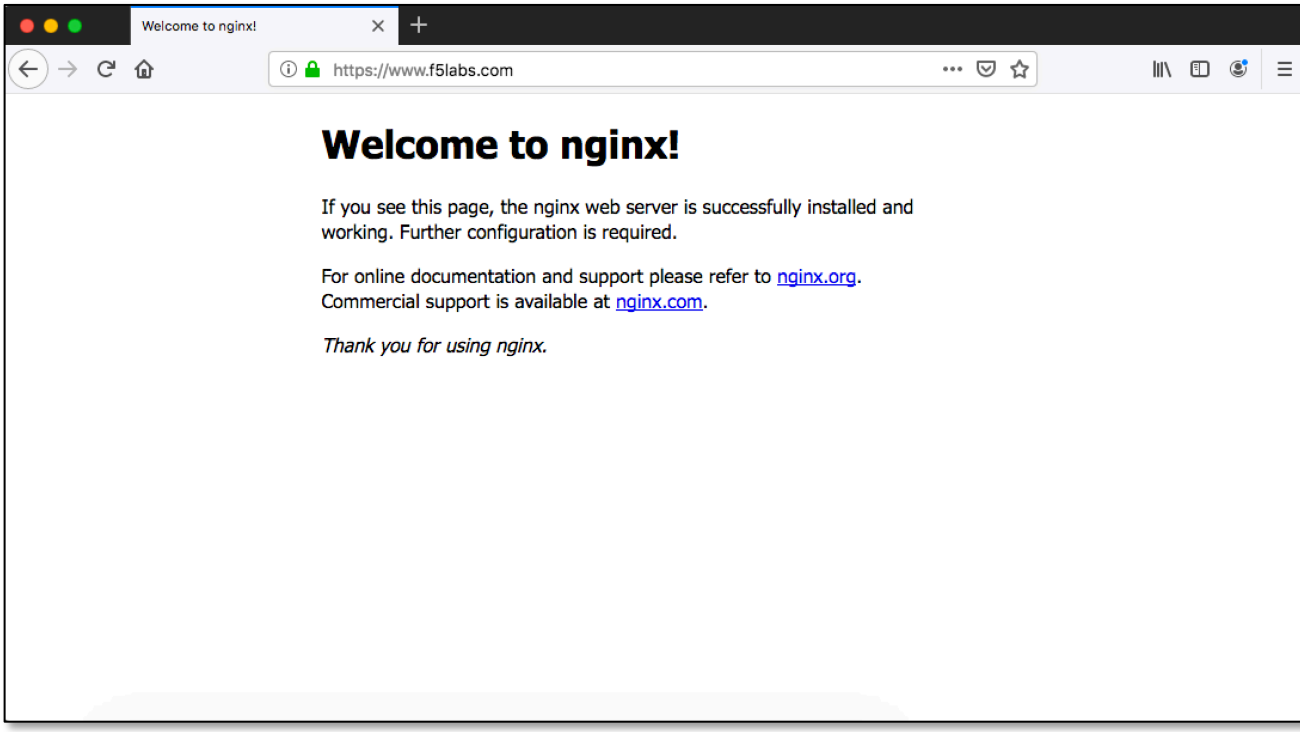
    - **DH Groups**: enter the keyword DEFAULT.
    - **Signature Algorithms**: enter the keyword DEFAULT.

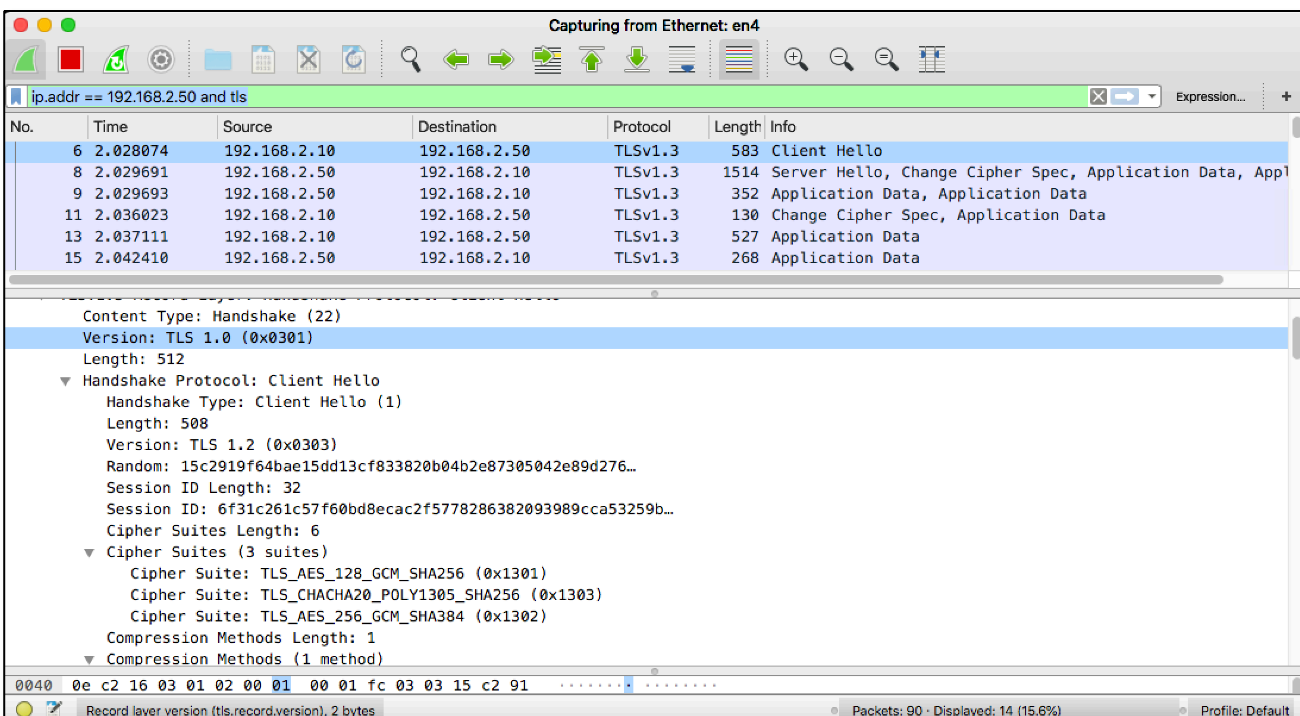
  Note: It is also acceptable to simply use the built-in "f5-default" cipher group, as that contains the two TLS13-AES-GCM ciphers.

- Create a new Cipher Group to contain the Cipher Rule. The SSLO SSL configuration will reference this Cipher Group. In the "Allow the following" column, add the previously-created Cipher Rule.
- Create a new SSLO Inbound topology or edit an existing one. On the SSL Configuration page, in the top right corner click the "Show Advanced Setting" link.
    - **Client-side SSL (Processing Options)**: TLS 1.3 is disabled by default, by function of the disabled "TLSv1.3" option. To enable TLS 1.3, move this item from the Disabled Options column to the Enabled Options column.
    - **Client-side SSL (Cipher Type)**: TLS 1.3 requires a Cipher Group. Select this option then specify the previously-created Cipher Group.
    - Optionally enable TLS 1.3 in the same manner on the server-side, if server-side resources support and require TLS 1.3.
- (Re)Deploy.

To test TLS 1.3 through the inbound SSLO, enable TLS 1.3 support in a browser and access the internal websites through SSLO. See https://geekflare.com/enable-tls-1-3-in-browsers/ for tips on enabling TLS 1.3 support in the various browsers.

For example, to force Firefox to use TLS 1.3 (only), open the browser and navigate to about:config. Search for 'security.tls.version.min' and 'security.tls.version.max'. To force TLS 1.3, set them both to a value of 4. The below screenshots show a successful TLS 1.3 HTTPS request through SSLO, and a client-side Wireshark capture of that transaction.





Note: while technically not supported in SSLO version 6.0, forward proxy TLS 1.3 is available in BIG-IP 15.0, therefore with minor modifications it's possible to configure an SSLO outbound topology to support end-to-end TLS 1.3.

- Create a normal SSLO outbound topology and deploy.

- In the SSLO UI, under the SSL Configurations tab, click the lock icon to the right of the respective SSL configuration to unlock strictness on this object.

- With strictness on the SSL configurations disabled, navigate to SSL profiles under Local Traffic – Profiles – SSL, and edit both the client and server "-vhf" SSL profiles.

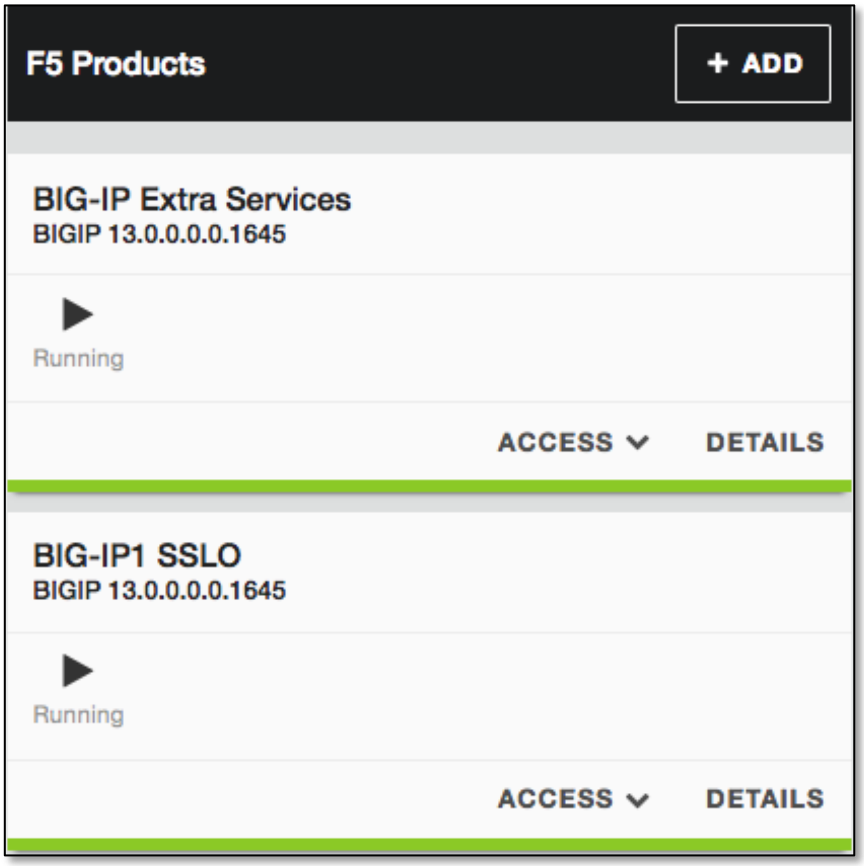
    - **Ciphers**: change this to Cipher Group and select the previously-created TLS 1.3 cipher group, or simply select the "f5-default" cipher group.

    - **Options**: move the "No TLSv1.3" option from the Enabled column to the Disabled column.

The outbound SSLO topology should now be able to support full end-to-end TLS traffic. An example test scenario would be to set Firefox to only support TLS 1.3 (as above) and navigate to https://www.cloudflare.com.

APPENDIX – THINGS TO DO WITH THE EXTRA SERVICES BIG-IP

This lab environment contains an additional BIG-IP machine named "BIG-IP Extra Services" and has no specific use in the previously-described demo environment.



However, a BIG-IP can be a useful tool in an SSL Orchestrator environment. In most cases it just needs to be re-licensed and reconfigured on required networks. Building any tools is beyond the scope of the guide, but here is a quick list of things you can do with it.

- **Build an SSLO HA pair**
  - Ensure that SSLO is <u>not</u> deployed before starting the HA configuration.
  - Configure both BIG-IPs with the same client-vlan, outbound-vlan and dlp-vlan, respective self-IPs and floating self-IPs.
  - Create a separate VLAN to carry sync traffic between the boxes. Provide self-IPs and set the 'Allow All' or 'Allow Default' Port Lockdown setting. SSLO uses a separate REST-based sync process through the channel, over port 443. This may require repurposing a security service VLAN that won't be used in demos/training.
  - Configure normal BIG-IP active/standby HA, with <u>manual incremental sync</u>.
  - Configure SSLO on the active unit and verify that the REST-based sync is correctly syncing objects to the standby unit.

- **Create a transparent proxy security service**
    - On the extra BIG-IP, configure separate inbound and outbound VLANs (or a single tagged VLAN).
    - On the extra BIG-IP, create self-IPs on these VLANs that will be specified in the SSLO service configuration (ex. 198.19.96.66/25 and 198.19.96.130/25).
    - On the extra BIG-IP, create a default system route that points to an IP in the outbound-side VLAN (ex. 198.19.96.245).
    - On the extra BIG-IP, create a standard or forward wildcard virtual server (0.0.0.0/0:0), address and port translation disabled, listening on the inbound-side VLAN. Optionally assign an HTTP profile if any HTTP iRule processing will be required.
    - On the SSLO box, define a transparent proxy HTTP service, specify a self-IP in the same inbound-side subnet (ex. 198.19.96.7/25), a VLAN (and tag if needed) that connects to the inbound-side VLAN of the service, a self-IP in the same outbound-side subnet and the same as the route specified on the extra BIG-IP (ex. 198.19.96.245), and a VLAN (and tag if needed) that connected to the outbound-side VLAN of the service. In the Security Devices section, specify the inbound-side self-IP of the extra BIG-IP (ex. 198.19.96.66).

- **Create an explicit proxy security service**
    - On the extra BIG-IP, configure separate inbound and outbound VLANs (or a single tagged VLAN).
    - On the extra BIG-IP, create self-IPs on these VLANs that will be specified in the SSLO service configuration (ex. 198.19.96.66/25 and 198.19.96.130/25).
    - On the extra BIG-IP, create a default system route that points to an IP in the outbound-side VLAN (ex. 198.19.96.245).
    - On the extra BIG-IP, create a TCP forwarding tunnel, DNS resolver, and HTTP Explicit profile. For simplicity, set the **Default Connection Handling** setting in the HTTP Explicit profile to “Allow”. This will process all HTTP and HTTPS traffic through a single explicit proxy VIP, versus requiring a separate VIP for tunneled HTTPS.
    - On the extra BIG-IP, create a VIP on the inbound-side VLAN subnet, port 3128 or 8080, with address and port translation enabled, listening on the inbound-side VLAN, and assigned the HTTP explicit profile and gateway pool (ex. 198.19.96.67:3128).
    - On the SSLO box, define an explicit proxy HTTP service, specify a self-IP in the same inbound-side subnet (ex. 198.19.96.7/25), a VLAN (and tag if needed) that connects to the inbound-side VLAN of the service, a self-IP in the same outbound-side subnet and the same as the route specified on the extra BIG-IP (ex. 198.19.96.245), and a VLAN (and tag if needed) that connected to the outbound-side VLAN of the service. In the Security Devices section, specify the VIP address of the extra BIG-IP (ex. 198.19.96.67:3128).

- **Create an upstream routed path to serve as an alternate path to the Internet** – this would test the ability to use the Proxy Select agent in the SSLO service visual policy to redirect flows through alternate gateways.
    - Repurpose the DLP VLAN on the SSLO box and create the same on the extra BIG-IP to create a separate channel between them. Provide unique self-IPs and ensure that each box can ping the other box's self-IP.
    - On the extra BIG-IP, create a pool that points to the Internet gateway.
    - On the extra BIG-IP, create a wildcard VIP (0.0.0.0/0:0), with address and port translation disabled, listening on the DLP VLAN, and assigned the gateway pool.
    - On the SSLO box, configure an SSLO topology to point to the extra box's DLP VLAN self-IP as its outbound route.
- **Create an upstream explicit proxy path** – this would also serve to test the ability to use the Proxy Select agent for alternate explicit proxy gateway paths.
    - Repurpose the DLP VLAN on the SSLO box and create the same on the extra BIG-IP to create a separate channel between them. Provide unique self-IPs and ensure that each box can ping the other box's self-IP.
    - On the extra BIG-IP, create a pool that points to the Internet gateway.
    - On the extra BIG-IP, create a TCP forwarding tunnel, DNS resolver, and HTTP Explicit profile. For simplicity, set the **Default Connection Handling** setting in the HTTP Explicit profile to "Allow". This will process all HTTP and HTTPS traffic through a single explicit proxy VIP, versus requiring a separate VIP for tunneled HTTPS.
    - On the extra BIG-IP, create a VIP on the DLP VLAN subnet, port 3128 or 8080, with address and port translation enabled, listening on the DLP VLAN, and assigned the HTTP explicit profile and gateway pool.
    - On the SSLO box, create a pool that points the new explicit proxy gateway IP and port.
    - On the SSLO box, configure an explicit forward proxy SSLO topology to point to the new explicit proxy gateway IP and port. On the topology Security Policy page, enable the **Proxy Connect** option, then select the previously-created explicit proxy pool. This will generate policy agents to "proxy chain" outbound traffic through the upstream explicit proxy gateway.

- **Create an additional web server to test inbound traffic flows**
    - On the extra BIG-IP, create an iRule that responds with a simple “Welcome” message:

```
when HTTP_REQUEST {
    HTTP::respond 200 content “Welcome\r\n” “Connection” “close”
}
```

    - On the extra BIG-IP, create a simple virtual server with generic SSL settings, HTTP profile and the above iRule.
    - For a targeted inbound website, enter an IP and port and select a VLAN accessible to the SSLO box, and create a pool on the SSLO box that points to this IP. Create an inbound SSLO topology that points this pool.
    - To use this website for rapid outbound request testing through SSLO, on the extra BIG-IP create a wildcard VIP (0.0.0.0/0:0) with generic SSL settings, HTTP profile and the above iRule. Attach a VLAN accessible to the outbound side of the SSLO box. Configure an outbound L3 SSLO topology as usual but point the gateway route at the extra box’s self-IP. On the client side, use any tool that can produce rapid requests. For example, here is a simple Bash command:

```
cnt=1; while true; do curl -sk https://1.1.1.1 --write-out "(${cnt}):
%{http_code}\n" -o /dev/null; cnt=$((cnt + 1)); done
```

      The specified URL does not matter here, as the extra BIG-IP will answer all requests. This will create an infinite While loop that executes a cURL request and writes out an incrementing (number) and the HTTP status code of the response (ex. 200).

APPENDIX – CONFIGURING SSLO FOR HIGH AVAILABILITY

SSL Orchestrator HA presents a different model for HA sync/failover than normal BIG-IP HA. Specifically, SSLO relies on a separate REST-based process to perform internal sync between the peers and does not rely on BIG-IP mcpd. It is therefore important to understand the conditions and caveats of this separate process.

- An SSL Orchestrator system must be configured for **MANUAL with INCREMENTAL SYNC**. The REST operations take care of synchronizing the SSLO configurations. This will also, at times, trigger a warning on the BIG-IP that the boxes are out of sync, though they are not. It is acceptable to ignore these warnings, though it is also possible to manually sync the boxes **AFTER** the SSLO sync process.
- HA must be configured and stable **BEFORE** deploying SSLO. Any SSLO upgrade process must first break HA before continuing. Therefore, to upgrade an SSLO system, break HA, upgrade the systems independently, re-establish HA, then re-configure/re-deploy SSLO. When upgrading the BIG-IP itself, break HA, upgrade the systems independently, and then re-establish HA. The BIG-IP ISO comes with a base version of SSLO that may not be the one needed. **BEFORE** accessing the SSLO menu, remove and replace the SSLO RPM package to prevent the base package from deploying itself.

Note: the extra BIG-IP in this lab environment is perfectly suited to demonstrate SSLO HA. Simply configure identical networking, floating self-IPs, resource provisioning, and set up as an HA peer. Use the ICAP/DLP or TAP service VLAN for the sync channel (whichever won't be needed).

To deploy SSLO in a High Availability pair, perform the following operations.

- Confirm that you have administrative access to the BIG-IP UI and to the shell (SSH).
- Perform the typical BIG-IP HA setup process and confirm that the boxes are in a good HA state.
    - Confirm HA state by reviewing logs (restnoded, restjavad, and tmm) for any errors relating to HA/sync.
    - Navigate to *https://<management-ip>/mgmt/shared/gossip* on both HA devices. Verify that the "status" value indicated "ACTIVE".
    - Navigate to https://<management-ip>/mgmt/tm/cm/device on both HA devices. Verify that the item count returned is the same on both. Verify that the "configsyncip" attribute exists and matches the HA VLAN IP on each corresponding device. And also verify that the "unicastAddress" exists, and that "configsyncip" is contained in this value. Usually the management IP should also be an antryu of "unicastAddress".
    - Navigate to https://management-ip/mgmt/shared/resolver/device-groups/tm-shared-all-big-ips/devices on both HA devices. Verify that the returned information is the same on both boxes. Specifically, validate the "address" attribute exists and matches the corresponding "configsyncip".
    - Check port lockdown settings on both HA devices and verify that the designated sync and failover VLANs use either "Allow All" or "Allow Default" in their Self-IP configurations.
    - Navigate to https://management-ip/mgmt/tm/shared/bigip-failover-state on both HA devices. Verify that the "failoverState" value is "active" for the active device, and "standby" for the standby device.

  - Check HA sync failover group settings (Device Management – Device Groups). Verify that a device group exists, that the device group type is “Sync-Failover”, that all HA devices are in the “includes” field, and that sync type is “Manual with Incremental Sync”.
  - Verify that the BIG-IP .iso and SSLO .rpm are the same on both devices.
  - Verify that NTP and DNS settings match on both HA devices.
  - Verify that overview status (Device Management – Overview Status) shows no warnings or errors.
- If upgrading the BIG-IP,
  - Perform a manual config sync and take UCS backups on both boxes.
  - Disable HA by removing both devices from the device group (from the standby box).
  - Follow normal procedures to install a new BIG-IP ISO on both boxes.
- Navigate to the iApps Package Management menu and verify that the correct .rpm package is installed or replace if not.
- Re-enable HA (if previously disabled for upgrade) by adding both devices back to the device group.
- Initiate a config sync.
- Deploy SSL Orchestrator. The SSLO peers will sync their configs via REST calls between them. This may at times present a warning in the UI that the boxes are out of sync, though they are not. Review both devices to verify like settings. It is also acceptable to perform a manual sync AFTER the SSLO sync process.
- If any errors are encountered in the steps above, restore from the UCS backup.

APPENDIX – ROUTING CONSIDERATIONS FOR LAYER 3 DEVICES

SSL Orchestrator sends all traffic through an inline layer 3 or HTTP device in the same direction – entering through the inbound interface. It is likely, therefore, that the layer 3 device may not be able to correctly route both outbound (forward proxy) and inbound (reverse proxy) traffic at the same time. Please see the appendix, "Routing considerations for layer 3 devices" for more details. For example, in a simple Linux-type environment there would be two routes needed for SSLO:

- The default gateway to send traffic back to SSLO through the service's outbound interface
- A static return route to allow client traffic to return through the service's inbound interface

Example:

Destination	*Gateway*	*Genmask*	*Flags*	*Metric*	*iFace*
default	*198.19.64.245*	*0.0.0.0*	*UG*	*0*	*eth2*
10.1.10.0	*198.19.64.7*	*255.255.255.0*	*UG*	*o*	*eth1*

In the above, configured for an outbound traffic flow, the default gateway is on the outbound side interface (eth2), with a static route for 10.1.10.0/24 (client-sourced) traffic flowing back through the inbound interface (eth1). An inbound flow, however, would require the opposite:

Destination	*Gateway*	*Genmask*	*Flags*	*Metric*	*iFace*
default	*198.19.64.7*	*0.0.0.0*	*UG*	*0*	*eth1*
10.1.10.0	*198.19.64.245*	*255.255.255.0*	*UG*	*o*	*eth2*

There are generally a few options for handling inbound and outbound traffic flows:

- Do not use the same layer 3 device for inbound and outbound flows – the simplest option, but not always possible in some environments.
- Create a policy route, if the device supports it, to create multiple gateways.

We will explore the second and second options below.

Configuring a policy route on the layer 3 device

If a service supports it, policy routing allows you to create multiple gateways on a layer 3 (routed) device. In lieu of creating separate inbound and outbound services, and service chains for a single L3 device, all traffic in this use case still flows through the inbound side interface, but the policy route will effectively steer traffic in the correct direction. Policy routing can be a complex topic in and of itself, and each security product will have its own way of configuring policy routing anyway, so it cannot be covered in total in this guide. Please refer to product-specific documentation to learn more about your policy routing options.

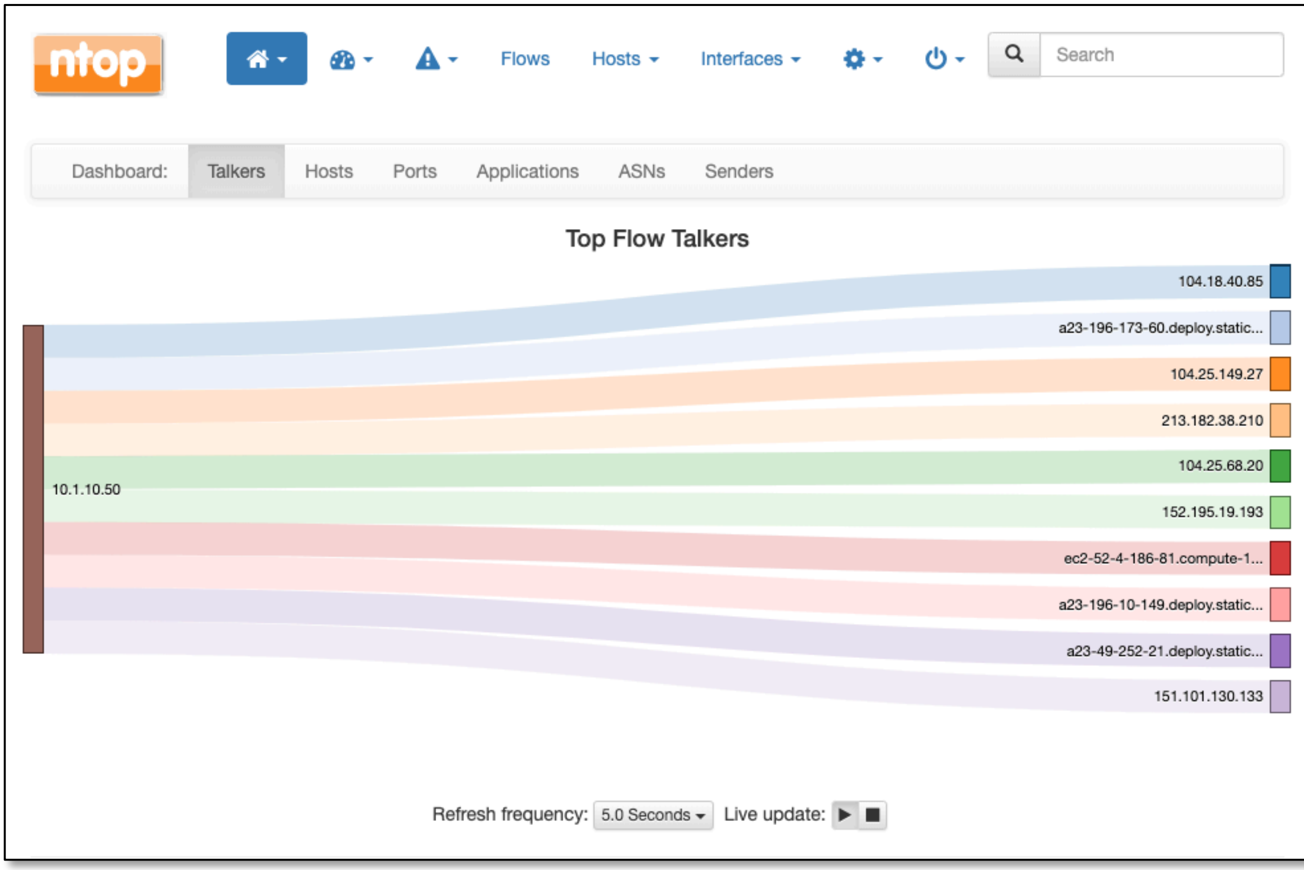
The following is an example script to enable a policy route on a generic Linux device (most of which have iproute2 installed by default). In the script, it is only necessary to modify the top eight variables, defining attributes of the inbound and outbound networks. Once complete, chmod the script to make it executable, test it, and then call it from a startup process like /etc/rc.local or /etc/init.d/rc.local. If the script is successful, you should be able to send inbound and outbound SSLO traffic flows through this device.

```
#!/bin/bash

## Inbound interface
inbound_interface=eth1.10
inbound_ip=198.19.64.65
inbound_mask=25
inbound_gw=198.19.64.7

## Outbound interface
outbound_interface=eth1.20
outbound_ip=198.19.64.130
outbound_mask=25
outbound_gw=198.19.64.245

### ---------------------------------------------- ###
### ---------------------------------------------- ###

## static table names
inbound_table=av_in
outbound_table=av_out

## function to get network from mask and IP
get_network () {
   IFS=. read -r io1 io2 io3 io4 <<< "$2"
   set -- $(( 5 - ($1 / 8) )) 255 255 255 255 $(( (255 << (8 - ($1 % 8))) & 255 )) 0 0 0
   [ $1 -gt 1 ] && shift $1 || shift
   NET_ADDR="$((${io1} & ${1-0})).$((${io2} & ${2-0})).$((${io3} & ${3-0})).$((${io4} & ${4-0}))"
   echo "$NET_ADDR"
}

## stop if iproute2 isn not installed
if ! [ -d "/etc/iproute2/" ]; then
    echo "iproute2 policy routing is not available on this system - exiting"
    exit
fi

## create the ipproute2 tables
if ! grep -q ${inbound_table} /etc/iproute2/rt_tables; then
    echo "200 ${inbound_table}" >> /etc/iproute2/rt_tables
fi
if ! grep -q ${outbound_table} /etc/iproute2/rt_tables; then
    echo "201 ${outbound_table}" >> /etc/iproute2/rt_tables
fi

## get the inbound and outbound networks from function
inbound_net=$(get_network ${inbound_mask} ${inbound_ip})
```

```
outbound_net=$(get_network ${outbound_mask} ${outbound_ip})

## create policy routes
ip rule add iif ${inbound_interface} table ${inbound_table}
ip rule add iif ${outbound_interface} table ${outbound_table}
ip addr add ${inbound_ip}/${inbound_mask} brd + dev ${inbound_interface}
ip addr add ${outbound_ip}/${outbound_mask} brd + dev ${outbound_interface}
ip route add ${inbound_net}/${inbound_mask} dev ${inbound_interface} src ${inbound_ip} table ${inbound_table}
ip route add ${inbound_net}/${inbound_mask} dev ${inbound_interface} src ${inbound_ip} table ${outbound_table}
ip route add ${outbound_net}/${outbound_mask} dev ${outbound_interface} src ${outbound_ip} table ${inbound_table}
ip route add ${outbound_net}/${outbound_mask} dev ${outbound_interface} src ${outbound_ip} table ${outbound_table}
ip route add default via ${outbound_gw} table ${inbound_table}
ip route add default via ${inbound_gw} table ${outbound_table}
```

APPENDIX – USING THE NTOPNG SERVICE FOR TRAFFIC ANALYSIS

This lab environment contains an additional traffic analysis service, running on the inline L3 service, using the community version of NTOPNG. It is provided here as an additional visual tool for displaying decrypted traffic flows.



Additional information about the NTOPNG utility can be found at:

- Primary reference: https://www.ntop.org
- Installation reference: http://packages.ntop.org/apt/

To access the UI,

1. Find the public IP address assigned to the Inline L3 service in Ravello. Click on the "Layer 3 Security" object in the Ravello UI and review its properties to reveal the assigned public address.

2. Open a new browser window and navigate to this IP, via HTTP on port 3000 (http://IP:3000). If it prompts for credentials, login is 'admin' with password 'ntopng'.

3. Configure an SSLO topology to include the Inline L3 service in a service chain.

4. Pass traffic through SSLO to view real-time analysis of traffic through the Inline L3 service.

APPENDIX – DEMO SCRIPTS

Lab 1 demo script

Configuration review and prerequisites

1. Optionally define DNS, NTP and gateway route
2. Click Next

Topology Properties

1. Name - some name
2. Protocol: Any
3. IP Family: IPv4
4. Topology: L3 Outbound
5. Click Save & Next

SSL Configuration

1. Create a New SSL Profile
2. Client-side SSL (Cipher Type): Cipher String
3. Client-side SSL (Cipher String): DEFAULT
4. Client-side SSL (Certificate Key Chain): default.crt and default.key
5. Client-side SSL (CA Certificate Key Chain): subrsa.f5labs.com
6. Server-side SSL (Cipher Type): Cipher String
7. Server-side SSL (Cipher String): DEFAULT
8. Server-side SSL (Trusted Certificate Authority): ca-bundle.crt
9. Click Save & Next

Service List

1. **Inline Layer 2 service**
   a. Name: some name (ex. FireEye)
   b. Network Configuration
      - Ratio: 1
      - From BIGIP VLAN: Create New, name (ex. FireEye_in), int 1.6
      - To BIGIP VLAN: Create New, name (ex. FireEye_out), int 1.7
      - Click Done
   c. Service Action Down: Ignore
   d. Enable Port Remap: Enable, 8080
   3. Click Save
2. **Inline layer 3 service**
   a. Name: some name (ex. IPS)
   b. IP Family: IPv4
   c. Auto Manage: Enabled
   d. To Service Configuration
      - To Service: 198.19.64.7/25
      - VLAN: Create New, name (ex. IPS_in), interface 1.3, tag 50
   e. Service Action Down: Ignore
   f. L3 Devices: 198.19.64.64
   g. From Service Configuration
      - From Service: 198.19.64.245/25
      - VLAN: Create New, name (ex. IP_out), interface 1.3, tag 60
   h. Enable Port Remap: Enabled, 8181
   i. Manage SNAT Settings: None
   j. Click Save
3. **Inline HTTP service**
   a. Name: some name (ex. Proxy)
   b. IP Family: IPv4
   c. Auto Manage: Enabled
   d. Proxy Type: Explicit
   e. To Service Configuration
      - To Service: 198.19.96.7/25
      - VLAN: Create New, name (ex. Proxy_in), interface 1.3, tag 110
   f. Service Action Down: Ignore
   g. HTTP Proxy Devices: 198.19.96.66, Port 3128
   h. From Service Configuration
      - From Service: 198.19.96.245/25
      - VLAN: Create New, name (ex. Proxy_out), interface 1.3, tag 120
   i. Manage SNAT Settings: None
   j . Authentication Offload: Disabled
   k. Click Save
4. **ICAP Service**
   a. Name: some name (ex. DLP)
   b. IP Family: IPv4
   c. ICAP Devices: 10.70.0.10, Port 1344
   d. Request URI Path: /squidclamav
   e. Response URI Path: /squidclamav
   f. Preview Max Length(bytes): 524288
   g. Service Action Down: Ignore
   h. Click Save
5. **TAP Service**
   a. Some Name (ex. TAP)
   b. Mac Address: 12:12:12:12:12:12
   c. VLAN: Create New, name (ex. TAP_in)
   d. Interface: 1.4
   e. Service Action Down: Ignore
   f. Click Save
6. Click Save & Next

Service Chain List

1. Add
   a. Name: some name (ex. my-service-chain)
   b. Services: all of the services
   c. Click Save
2. Add
   a. name: some name (ex. my-sub-service-chain)
   b. Services: L2 and TAP services
   c. Click Save
3. Click Save & Next

Security Policy

1. Add a new rule
   a. Name: some name (ex. urlf_bypass)
   b. Conditions
      - Category Lookup (All)
      - SNI Category: Financial Data and Services, Health and Medicine
   c. Action: Allow
   d. SSL Forward Proxy Action: bypass
   e. Service Chain: L2/TAP service chain
   f. Click OK
2. Modify the All rule
   a. Service Chain: all services chain
   b. Click OK
3. Click Save & Next

Interception Rule

a. Select Outbound Rule Type: Default
b. Ingress Network (VLANs): client-side
c. L7 Interception Rules: apply FTP and email protocols as required
d. Click Save & Next

Egress Setting

a. Manage SNAT Settings: Auto Map
b. Gateways: New, ratio 1, 10.30.0.1

Summary

a. Review configuration
b. Click Deploy

Lab 2 demo script

Configuration review and prerequisites

1. Optionally define DNS, NTP and gateway route
2. Click Next

Topology Properties

1. Name: some name (ex. sslo-inbound-1)
2. Protocol: TCP
3. IP Family: IPv4
4. Topology: L3 Inbound
5. Click Save & Next

SSL Configuration

1. Show Advanced Setting
2. Client-side SSL (Cipher Type): Cipher String
3. Client-side SSL (Cipher String): DEFAULT
4. Client-side SSL (Certificate Key Chain): wildcard.f5labs.crt and wildcard.f5labs.com.key
5. Server-side SSL (Cipher Type): Cipher String
6. Server-side SSL (Cipher String): DEFAULT
7. Server-side SSL (Trusted Certificate Authority): ca-bundle.crt
8. Advanced (Expire Certificate Control): Ignore
9. Advanced (Untrusted Certificate Authority): Ignore
10. Click Save & Next

Services List

1. Click Save & Next

Service Chain List

1. Click Save & Next

Security Policy

1. Remove Pinners_Rule
2. Edit All Traffic rule and add L2/TAP service chain
3. Click Save & Next

Interception Rule

1. Gateway-mode
   a. Hide Advanced Setting
   b. Source Address: 0.0.0.0/0
   c. Destination Address/Mask: 0.0.0.0/0
   d. Port: 443
   e. VLANs: outbound
2. Targeted-mode
   a. Show Advanced Setting
   b. Source Address: 0.0.0.0/0
   c. Destination Address: 10.30.0.200
   d. Port: 443
   e. VLANs: outbound
   f. Pool: webserver-pool
3. Click Save & Next

Egress Settings

1. Manage SNAT Settings: Auto Map
2. Gateways: Default Route

Summary

1. Review configuration
2. Click Deploy

Lab 3 demo script

Configuration review and prerequisites

1. Optionally define DNS, NTP and gateway route
2. Click Next

Topology Properties

1. Name: some name (ex. sslo-explicit)
2. Protocol: TCP
3. IP Family: IPv4
4. Topology: L3 Explicit Proxy
5. Click Save & Next

SSL Configuration

1. SSL Profile: Use Existing, existing outbound SSL settings
2. Click Save & Next

Services List

1. Click Save & Next

Service Chain List

1. Click Save & Next

Security Policy

1. Type: Use Existing, existing outbound security policy
2. Click Save & Next

Interception Rule

1. IPV4 Address: 10.20.0.150
2. Port: 3128
3. VLANs: client-net
4. Click Save & Next

Egress Settings

1. Manage SNAT Settings: Auto Map
2. Gateways: Existing Gateway Pool, -ex-pool-4 pool

Summary

1. Review configuration
2. Click Deploy

System Settings

1. DNS Query Resolution: Local Forwarding Nameserver
2. Local Forwarding Nameserver(s): 10.30.0.1
3. Click Deploy