Configuring Ethernet Local Management Interface at a Provider Edge

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The advent of Ethernet as a metropolitan-area network (MAN) and WAN technology imposes a new set of operations, administration, and management (OAM) requirements on Ethernet's traditional operations, which had been centered on enterprise networks only. The expansion of Ethernet technology into the domain of service providers, where networks are substantially larger and more complex than enterprise networks and the user-base is wider, makes operational management of link uptime crucial. More importantly, the timeliness in isolating and responding to a failure becomes mandatory for normal day-to-day operations, and OAM translates directly to the competitiveness of the service provider.

This module provides general information about configuring Ethernet Local Management Interface (LMI), an OAM protocol, on a provider edge (PE) device.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

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Prerequisites for Configuring Ethernet Local Management Interface at a Provider Edge

- Ethernet OAM must be operational in the network.
- For Ethernet OAM to operate, the PE side of a connection must be running Ethernet Connectivity Fault Management (CFM) and Ethernet LMI.
- All VLANs used on a PE device to connect to a customer edge (CE) device must also be created on that CE device.
- To use Non-Stop Forwarding (NSF) and In Service Software Upgrade (ISSU), Stateful Switchover (SSO) must be configured and working properly.

Restrictions for Configuring Ethernet Local Management Interface at a Provider Edge

- Ethernet LMI is not supported on routed ports, EtherChannel port channels, or ports that belong to an EtherChannel, private VLAN ports, IEEE 802.1Q tunnel ports, or Ethernet over Multiprotocol Label Switching (MPLS) ports.
- Ethernet LMI cannot be configured on VLAN interfaces.
- The High Availability (HA) features NSF/SSO--E-LMI Support and ISSU--E-LMI Support are not supported on a CE device.

Information About Configuring Ethernet Local Management Interface at a Provider Edge

Ethernet Virtual Circuit

An Ethernet virtual circuit (EVC) as defined by the Metro Ethernet Forum is a port level point-to-point or multipoint-to-multipoint Layer 2 circuit. EVC status can be used by a CE device to find an alternative path in to the service provider network or in some cases, fall back to a backup path over Ethernet or another alternative service such as Frame Relay or ATM.

Ethernet LMI

Ethernet LMI is an Ethernet OAM protocol between a CE device and a PE device. Ethernet LMI provides CE devices with the status of EVCs for large Ethernet MANs and WANs and provides information that enables CE devices to autoconfigure. Specifically, Ethernet LMI runs on the PE-CE user network interface (UNI) link and notifies a CE device of the operating state of an EVC and the time when an EVC is added or deleted. Ethernet LMI also communicates the attributes of an EVC.

Ethernet LMI interoperates with Ethernet CFM, an OAM protocol that runs within the provider network to collect OAM status. Ethernet CFM runs at the provider maintenance level (user provider edge [UPE] to UPE at the UNI). Ethernet LMI relies on the OAM Ethernet Infrastructure (EI) to interwork with CFM to learn the end-to-end status of EVCs across CFM domains.

Ethernet LMI is disabled globally by default. When Ethernet LMI is enabled globally, all interfaces are automatically enabled. Ethernet LMI can also be enabled or disabled at the interface to override the global configuration. The last Ethernet LMI command issued is the command that has precedence. No EVCs, Ethernet service instances, or UNIs are defined, and the UNI bundling service is bundling with multiplexing.

Ethernet CFM

Ethernet CFM is an end-to-end per-service-instance (per VLAN) Ethernet layer OAM protocol that includes proactive connectivity monitoring, fault verification, and fault isolation. End-to-end CFM can be from PE device to PE device or from CE device to CE device. For more information about Ethernet CFM, see " Configuring Ethernet Connectivity Fault Management in a Service Provider Network" in the *Cisco IOS Carrier Ethernet Configuration Guide* .

OAM Manager

The OAM manager is an infrastructure element that streamlines interaction between OAM protocols. The OAM manager requires two interworking OAM protocols, in this case, Ethernet CFM and Ethernet LMI. No interactions are required between Ethernet LMI and the OAM manager on the CE side. On the UPE side, the OAM manager defines an abstraction layer that relays data collected from Ethernet CFM to the Ethernet LMI device.

Ethernet LMI and OAM manager interaction is unidirectional, from the OAM manager to Ethernet LMI on the UPE side of the device. An information exchange results from an Ethernet LMI request or is triggered by the OAM manager when it receives notification from the OAM protocol that the number of UNIs has changed. A change in the number of UNIs may cause a change in EVC status.

The OAM manager calculates EVC status given the number of active UNIs and the total number of associated UNIs. You must configure CFM to notify the OAM manager of all changes to the number of active UNIs or to the remote UNI ID for a given service provider VLAN (S-VLAN) domain.

The information exchanged includes the following:

- EVC name and availability status (active, inactive, partially active, or not defined)
- Remote UNI name and status (up, disconnected, administratively down, excessive frame check sequence [FCS] failures, or not reachable)
- Remote UNI counts (the total number of expected UNIs and the number of active UNIs)

Benefits of Ethernet LMI at a Provider Edge

- Communication of end-to-end status of the EVC to the CE device
- Communication of EVC and UNI attributes to a CE device
- Competitive advantage for service providers

HA Features Supported by Ethernet LMI

In access and service provider networks using Ethernet technology, HA is a requirement, especially on Ethernet OAM components that manage EVC connectivity. End-to-end connectivity status information is critical and must be maintained on a hot standby route processor (RP) (a standby RP that has the same software image as the active RP and supports synchronization of line card, protocol, and application state information between RPs for supported features and protocols).

End-to-end connectivity status is maintained on the CE, PE, and access aggregation PE (uPE) network nodes based on information received by protocols such as Ethernet LMI, CFM, and 802.3ah. This status information is used to either stop traffic or switch to backup paths when an EVC is down.

The NSF/SSO and ISSU support enhancements are introduced and enabled automatically during configuration of the Cisco 7600 router.

Metro Ethernet clients (E-LMI, CFM, 802.3ah) maintain configuration data and dynamic data, which is learned through protocols. Every transaction involves either accessing or updating data in the various databases. If the database is synchronized across active and standby modules, the modules are transparent to clients.

The Cisco IOS infrastructure provides component Application Programming Interfaces (APIs) that are helpful in maintaining a hot standby RP. Metro Ethernet HA clients (E-LMI, HA/ISSU, CFM HA/ISSU, 802.3ah HA/ISSU) interact with these components, update the database, and trigger necessary events to other components.

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Benefits of Ethernet LMI HA

- Elimination of network downtime for Cisco IOS software image upgrades, resulting in higher availability.
- Elimination of resource scheduling challenges associated with planned outages and late night maintenance windows
- Accelerated deployment of new services and applications and faster implementation of new features, hardware, and fixes due to the elimination of network downtime during upgrades.
- Reduced operating costs due to outages while delivering higher service levels due to the elimination of network downtime during upgrades

NSF SSO Support in E-LMI

The redundancy configurations SSO and NSF are supported in Ethernet LMI and are automatically enabled. A switchover from an active to a standby RP occurs when the active RP fails, is removed from the networking device, or is manually taken down for maintenance. The primary function of Cisco NSF is to continue forwarding IP packets following an RP switchover. NSF also interoperates with the SSO feature to minimize network downtime following a switchover.

For detailed information about the SSO feature, see the 'Stateful Switchover' chapter of the *Cisco IOS High Availability Configuration Guide*. For detailed information about the NSF feature, see the 'Cisco Nonstop Forwarding' chapter of the *Cisco IOS High Availability Configuration Guide*.

ISSU Support in E-LMI

ISSU allows you to perform a Cisco IOS software upgrade or downgrade without disrupting packet flow. E-LMI performs updates of the parameters within the Ethernet LMI database to the standby RP. This checkpoint data requires ISSU capability to transform messages from one release to another. All the components that perform active RP to standby RP updates using messages require ISSU support. ISSU is automatically enabled in Ethernet LMI.

ISSU lowers the impact that planned maintenance activities have on network availability by allowing software changes while the system is in service. For detailed information about ISSU, see the Cisco OS In Service Software Upgrade Process chapter of the *Cisco IOS High Availability Configuration Guide*.

How to Configure Ethernet Local Management Interface at a Provider Edge

Configuring Ethernet LMI Interaction with CFM

For Ethernet LMI to function with CFM, you must configure EVCs, Ethernet service instances, and Ethernet LMI customer VLAN mapping. Most of the configuration occurs on the PE device on the interfaces connected to the CE. On the CE device, you need only enable Ethernet LMI on the connecting interface. Also, you must configure some OAM parameters; for example, EVC definitions on PE devices on both sides of a metro network.

CFM and OAM interworking requires an inward facing Maintenance Entity Group End Point (MEP).

Configuring the OAM Manager

Note   If you configure, change, or remove a UNI service type, EVC, Ethernet service instance, or CE-VLAN configuration, all configurations are checked to ensure that the configurations match (UNI service type with EVC or Ethernet service instance and CE-VLAN configuration). The configuration is rejected if the configurations do not match.

Perform this task to configure the OAM manager on a PE device.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ethernet cfm domain** *domain-name* **level** *level-id* [**direction outward**]
4. **service** *csi-id* **vlan** *vlan-id*
5. **exit**
6. **ethernet evc** *evc-id*
7. **oam protocol** {**cfm svlan** *svlan-id* **domain** *domain-name* | **ldp**}
8. **uni count** *value* [**multipoint**]
9. **exit**
10. Repeat Steps 3 through 9 to define other CFM domains that you want OAM manager to monitor.
11. **interface** *type number*
12. **service instance** *id* **ethernet** [*evc-id*]
13. **ethernet lmi ce-vlan map** {*vlan-id* [**untagged**] | **any** | **default** | **untagged**}
14. **exit**
15. **ethernet uni** [**bundle** [**all-to-one**] | **id** *uni-id* | **multiplex**]
16. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**ethernet cfm domain** *domain-name* **level** *level-id* [**direction outward**] **Example:** Router(config)# ethernet cfm domain cstmr1 level 3	Defines a CFM domain, sets the domain level and places the command-line interface (CLI) in Ethernet CFM configuration mode.

	Command or Action	Purpose
Step 4	**service** *csi-id* **vlan** *vlan-id* **Example:** Router(config-ether-cfm)# service csi2 vlan 10	Defines a universally unique customer service instance (CSI) and VLAN ID within the maintenance domain.
Step 5	**exit** **Example:** Router(config-ether-cfm)# exit	Returns the CLI to global configuration mode.
Step 6	**ethernet evc** *evc-id* **Example:** Router(config)# ethernet evc 50	Defines an EVC and enters EVC configuration mode.
Step 7	**oam protocol** {**cfm svlan** *svlan-id* **domain** *domain-name* | **ldp**} **Example:** Router(config-evc)# oam protocol cfm svlan 10 domain cstmr1	Configures the EVC OAM protocol as CFM and identifies the S-VLAN-ID for the CFM domain maintenance level as configured in Steps 3 and 4. **Note** If the CFM domain does not exist, this command is rejected, and an error message is displayed.
Step 8	**uni count** *value* [**multipoint**] **Example:** Router(config-evc)# uni count 3	(Optional) Sets the UNI count for the EVC. • If this command is not issued, the service defaults to a point-to-point service. If a value of 2 is entered, point-to-multipoint service becomes an option. If a value of 3 or greater is entered, the service is point-to-multipoint. **Note** If you enter a number greater than the number of endpoints, the UNI status is partially active even if all endpoints are up. If you enter a UNI count less than the number of endpoints, status might be active, even if all endpoints are not up.
Step 9	**exit** **Example:** Router(config-evc)# exit	Returns the CLI to global configuration mode.
Step 10	Repeat Steps 3 through 9 to define other CFM domains that you want OAM manager to monitor.	

Command or Action	Purpose
Step 11 **interface** *type number* **Example:** Router(config)# interface ethernet 1/3	Specifies a physical interface connected to the CE device and enters interface configuration mode.
Step 12 **service instance** *id* **ethernet** [*evc-id*] **Example:** Router(config-if)# service instance 400 ethernet 50	Configures an Ethernet service instance on the interface and enters Ethernet service configuration mode. • The Ethernet service instance identifier is a per-interface service identifier and does not map to a VLAN.
Step 13 **ethernet lmi ce-vlan map** {*vlan-id* [**untagged**] | **any** | **default** | **untagged**} **Example:** Router(config-if-srv)# ethernet lmi ce-vlan map 30	Configures an Ethernet LMI customer VLAN-to-EVC map for a particular UNI.
Step 14 **exit** **Example:** Router(config-if-srv)# exit	Returns the CLI to interface configuration mode.
Step 15 **ethernet uni** [**bundle** [**all-to-one**] | **id** *uni-id*| **multiplex**] **Example:** Router(config-if)# ethernet uni bundle	Sets UNI bundling attributes.
Step 16 **end** **Example:** Router(config-if)# end	Returns the CLI to privileged EXEC mode.

Enabling Ethernet LMI

The order in which the global and interface configuration commands are issued determines the configuration. The last command that is issued has precedence.

Perform this task to enable Ethernet LMI on a device or on an interface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ethernet lmi interface**
5. **ethernet lmi** {**n393** *value* | **t392** *value*}
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** Router(config)# interface ethernet 1/3	Defines an interface to configure as an Ethernet LMI interface and enters interface configuration mode.
Step 4	**ethernet lmi interface** **Example:** Router(config-if)# ethernet lmi interface	Configures Ethernet LMI on the interface. When Ethernet LMI is enabled globally, it is enabled on all interfaces unless you disable it on specific interfaces. If Ethernet LMI is disabled globally, you can use this command to enable it on specified interfaces.
Step 5	**ethernet lmi** {**n393** *value*	**t392** *value*} **Example:** Router(config-if)# ethernet lmi n393 10	Configures Ethernet LMI parameters for the UNI.

Command or Action	Purpose
Step 6 **end** **Example:** `Router(config-if)# end`	Returns the CLI to privileged EXEC mode.

Displaying Ethernet LMI and OAM Manager Information

Perform this task to display Ethernet LMI or OAM manager information. All the steps are optional and can be performed in any order.

SUMMARY STEPS

1. **enable**
2. **show ethernet lmi** {{**evc** [**detail** *evc-id* [**interface** *type number*] | **map interface** *type number*]} | {**parameters** | **statistics**} **interface** *type number* | **uni map** [**interface** *type number*]}}
3. **show ethernet service evc** [**detail** | **id** *evc-id* [**detail**] | **interface** *type number*[**detail**]]
4. **show ethernet service instance** [**detail** | **id** *id* | **interface** *type number* | **policy-map** | **stats**]
5. **show ethernet service interface** [*type number*] [**detail**]

DETAILED STEPS

Command or Action	Purpose
Step 1 **enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2 **show ethernet lmi** {{**evc** [**detail** *evc-id* [**interface** *type number*]	**map interface** *type number*]}	{**parameters**	**statistics**} **interface** *type number*	**uni map** [**interface** *type number*]}} **Example:** `Router# show ethernet lmi evc`	Displays information that was sent to the CE.
Step 3 **show ethernet service evc** [**detail**	**id** *evc-id* [**detail**]	**interface** *type number*[**detail**]] **Example:** `Router# show ethernet service evc`	Displays information about all EVCs or about a specified EVC.

	Command or Action	Purpose
Step 4	**show ethernet service instance** [**detail** | **id** *id* | **interface** *type number* | **policy-map** | **stats**] **Example:** Router# show ethernet service instance detail	Displays information about customer service instances. • This example shows detailed information about all service instances (see the following section).
Step 5	**show ethernet service interface** [*type number*] [**detail**] **Example:** Router# show ethernet service interface ethernet 1/3 detail	Displays interface-only information about Ethernet customer service instances for all interfaces or for a specified interface. • This example shows detailed information about service instances for interface Ethernet 1/3 (see the following section).

Examples

The following example shows sample output from the **show ethernet lmi**command using the **evc** keyword:

```
Router# show ethernet lmi evc
St   EVC Id                                                        Port
---  ------------------------------------------------------------- --------------
A    EVC_MP2MP_101                                                 Gi0/1
A    EVC_P2P_110                                                   Gi0/1
```

The following example shows sample output from the **show ethernet service evc** command:

```
Router# show ethernet service evc
Identifier                      Type   Act-UNI-cnt Status
50                              MP-MP   0          NotDefined
```

The following example shows sample output from the **show ethernet service interface** command using the **detail** keyword:

```
Router# show ethernet service interface ethernet 1/3 detail
Interface: Ethernet1/3
ID: uni2
CE-VLANS: 30
EVC Map Type: Bundling
Associated EVCs:
    EVC-ID                          CE-VLAN
    50                              30
Associated Service Instances:
    Service-Instance-ID CE-VLAN
    400                 30
```

The following example shows sample output from the **show ethernet service instance**command using the **detail** keyword:

```
Router# show ethernet service instance detail

Service Instance ID: 400
Associated Interface: Ethernet1/3
Associated EVC: 50
CE-Vlans: 30
State: AdminDown
EFP Statistics:
    Pkts In   Bytes In   Pkts Out  Bytes Out
       0         0          0         0
```

Configuration Examples for Ethernet Local Management Interface at a Provider Edge

Example Ethernet OAM Manager on a PE Device Configuration

This example shows a sample configuration of OAM manager, CFM, and Ethernet LMI on a PE device:

```
Router# configure terminal
Router(config)# ethernet cfm domain Top level 7
Router(config)# ethernet cfm domain Provider level 4
Router(config-ether-cfm)# service customer_1 vlan 101
Router(config-ether-cfm)# mep crosscheck mpid 404 vlan 101
Router(config-ether-cfm)# exit
Router(config)# ethernet cfm domain Operator_level 2
Router(config-ether-cfm)# service operator_1 vlan 101
Router(config-ether-cfm)# exit
Router(config)# ethernet cfm enable
Router(config)# ethernet evc test1
Router(config-evc)# oam protocol cfm svlan 101 domain Provider
Router(config-evc)# exit
Router(config)# ethernet evc 101
Router(config-evc)# uni count 3
Router(config-evc)# oam protocol cfm svlan 101 domain Operator
Router(config-evc)# exit
Router(config)# ethernet lmi global
Router(config)# interface gigabitethernet 1/0/2
Router(config-if)# service instance 101 ethernet test1
Router(config-if-srv)# ethernet lmi ce-vlan map 101
Router(config-if-srv)# exit
Router(config-if)# exit
Router(config)# ethernet cfm cc enable level 2-4 vlan 101

Router(config)# exit
```

Example Ethernet OAM Manager on a CE Device Configuration

This example shows how to configure Ethernet LMI globally on a CE device:

```
Router# configure terminal
Router(config)# ethernet lmi global
Router(config)# exit
```

Additional References

Related Documents

Related Topic	Document Title
Ethernet CFM	"Configuring Ethernet Connectivity Fault Management in a Service Provider Network" in the *Cisco IOS Carrier Ethernet Configuration Guide*
Ethernet LMI	"Enabling Ethernet Local Management Interface" in the *Cisco IOS Carrier Ethernet Configuration Guide*
Remote Port Shutdown feature	"Configuring Remote Port Shutdown" in the *Cisco IOS Carrier Ethernet Configuration Guide*
IEEE 802.3ah	*IEEE 802.3ah Ethernet in the First Mile*
Cisco IOS HA configuration information	*Cisco IOS High Availability Configuration Guide*
Ethernet LMI commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	*Cisco IOS Carrier Ethernet Command Reference*
Cisco IOS commands: master list of commands with complete command syntax, command mode, command history, defaults, usage guidelines, and examples	Cisco IOS Master Command List, All Releases

Standards

Standard	Title
IEEE P802.1ag/D5.2	*Draft Standard for Local and Metropolitan Area Networks*
ITU-T	*ITU-T Y.1731 OAM Mechanisms for Ethernet-Based Networks*
IETF VPLS OAM	*L2VPN OAM Requirements and Framework*
Metro Ethernet Forum 16 Technical Specification	*Technical Specification MEF 16- Ethernet Local Management Interface*
ITU-T Q.3/13	*Liaison statement on Ethernet OAM (Y.17ethoam)*

MIBs

MIB	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	--

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Configuring Ethernet Local Management Interface at a Provider Edge

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1   *Feature Information for Configuring Ethernet Local Management Interface at a Provider Edge*

Feature Name	Releases	Feature Information
Ethernet Local Management Interface at a Provider Edge	12.2(33)SRB 12.2(33)SXI	Ethernet LMI is an Ethernet OAM protocol between a CE device and a PE device. Ethernet LMI provides CE devices with the status of EVCs for large Ethernet MANs and WANs and provides information that enables CE devices to autoconfigure. Specifically, Ethernet LMI runs on the PE-CE UNI link and notifies a CE device of the operating state of an EVC and when an EVC is added or deleted. Ethernet LMI also communicates the attributes of an EVC. In Cisco IOS Release 12.2(33)SRB, this feature was introduced on the Cisco 7600 series router. The following commands were introduced or modified: **debug ethernet lmi**, **debug ethernet service, ethernet evc**, **ethernet lmi ce-vlan map**, **ethernet uni**, **oam protocol**, **service instance ethernet**, **show ethernet service evc**, **show ethernet service instance**, **show ethernet service interface, uni count**.
ISSU Support in E-LMI	12.2(33)SRD 15.0(1)S	ISSU allows you to perform a Cisco IOS software upgrade or downgrade without disrupting packet flow. ISSU lowers the impact that planned maintenance activities have on network availability by allowing software changes while the system is in service. In Cisco IOS Release 12.2(33)SRD, this feature was introduced on the Cisco 7600 series router. The following commands were introduced or modified: **debug ethernet lmi**.

Feature Name	Releases	Feature Information
NSF/SSO Support in E-LMI	12.2(33)SRD 15.0(1)S	The redundancy configurations SSO and NSF are supported in Ethernet LMI and are automatically enabled. A switchover from an active to a standby RP occurs when the active RP fails, is removed from the networking device, or is manually taken down for maintenance. The primary function of Cisco NSF is to continue forwarding IP packets following an RP switchover. NSF also interoperates with the SSO feature to minimize network downtime following a switchover. In Cisco IOS Release 12.2(33)SRD, this feature was introduced on the Cisco 7600 series router. The following commands were introduced or modified: **debug ethernet lmi**.