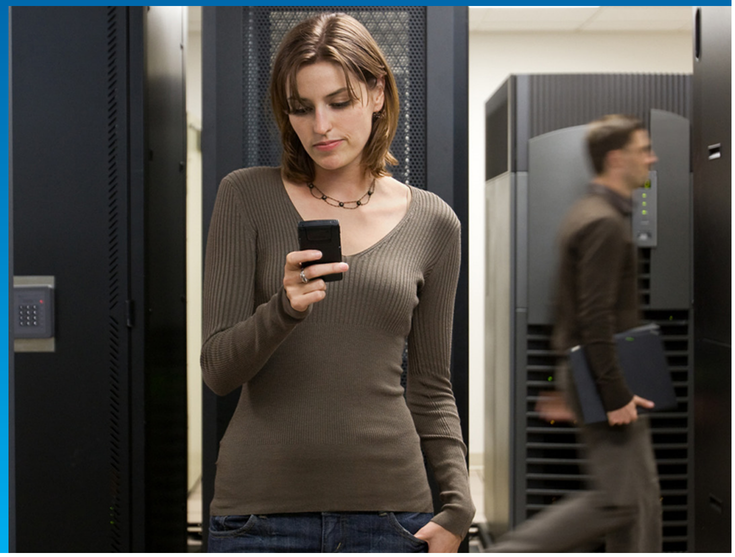
## Abstract

Government mandates, e-business and Internet growth requirements, and impending IPv4 address exhaustion concerns are prompting many enterprises to begin implementing an IPv6 transition strategy. Techniques available to support IPv6 transition strategies fall into three categories: native IPv6 (or dual-stack), IPv6 tunneling, and IPv6 translation. These techniques can, by themselves, have limitations, be difficult to deploy, or add constraints to the network. The Locator/ID Separation Protocol (LISP) implements a new, address-family-agnostic routing architecture that is designed for a much broader purpose than IPv6 transition. Incorporating LISP into an IPv6 transition strategy has demonstrated quick deployment times, low deployment and operational costs, little or no need for additional equipment or modifications, and high user satisfaction. This document describes two common IPv6 transition use cases and shows how LISP can be incorporated to achieve success.

# IPv6 Transition and Coexistence Using LISP

## LISP Support for IPv6 Transition and Coexistence Strategies

The need to transition to IPv6 is becoming a necessity due to the impending running out of IPv4 address space. Because IPv6 is not interoperable with IPv4, achieving a smooth transition requires careful planning and a well-organized strategy. Whether deploying IPv6 in a production environment, for example, to establish a web presence, or simply for experimenting to gain hands-on experience with the IPv6 protocol, incorporating the Locator/ID Separation Protocol (LISP) in the strategy can help achieve the desired goals.

LISP is a new, address-family-agnostic routing architecture that implements a new semantic for addressing that creates two namespaces: Endpoint Identifiers (EIDs), which are the current addresses assigned to end-hosts today, and Routing Locators (RLOCs), which are the addresses assigned to devices (primarily routers) that make up the global routing system. Splitting EID and RLOC functions yields many benefits such as improved routing scalability, improved multihoming efficiency, and IP mobility. However, because it also enables the capability to use the same or different address families for the EIDs and the RLOCs, incorporating LISP within any IPv6 transition or coexistence strategy is very natural.

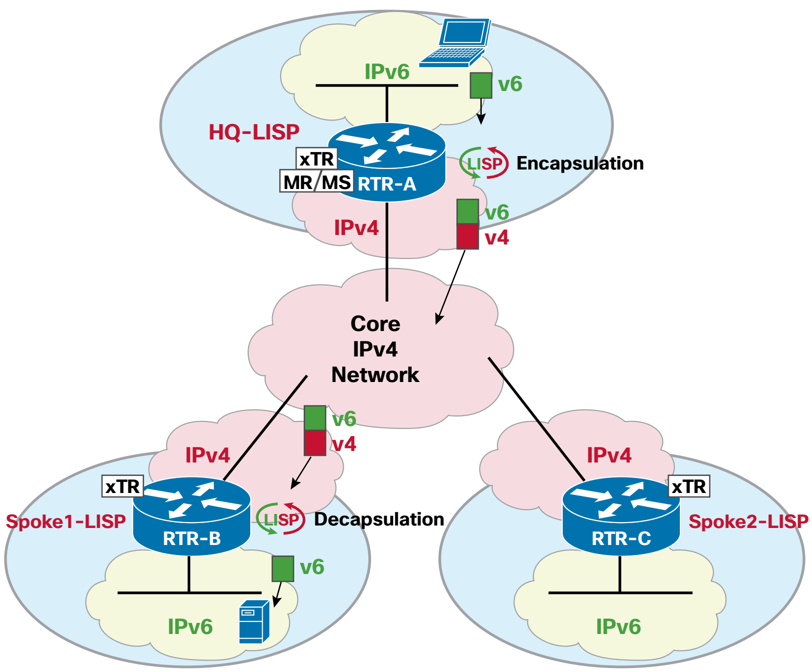
Incorporating LISP into an IPv6 transition or coexistence strategy can both speed and simplify the initial rollout of IPv6 by taking advantage of the LISP mechanisms to encapsulate IPv6 host packets within IPv4 headers (or IPv4 host packets within IPv6 headers). For example, it is quite simple to build IPv6 islands and connect them using the existing IPv4 core network and Internet access. In addition, when LISP internetworking infrastructure is included, IPv6 Internet users (non-LISP) can easily connect to a LISP-enabled IPv6 site, again using existing IPv4 Internet connectivity at the enterprise site. These approaches can often be implemented using existing hardware and with little to no impact on existing network operations, minimizing both capital expenses (CapEx) and operational expenses (OpEx). In addition, the broader features of LISP (inherent multihoming, ingress traffic engineering, and mobility) can be significant benefits for long-term deployments.

To illustrate how LISP can be effective in an IPv6 transition strategy, two common use cases are highlighted here: IPv6 islands connected over an IPv4 core, and deployment of an IPv6 web presence.

## Scenario 1: Connecting IPv6 Islands over an IPv4 Core

One way to gain basic IPv6 experience while limiting CapEx and OpEx and minimizing changes to the existing infrastructures is to create IPv6 islands within the corporate network and connect them using LISP over the existing IPv4 core. This implementation can be accomplished rapidly and easily with LISP without changing to the underlying network. This cost-effective solution is illustrated in Figure 1. In this example, IPv6 islands are added at each site by configuring the site routers as dual stack to provide the connectivity between the existing IPv4 topology and the new IPv6 prefixes. These routers also perform the required LISP functions, which are all run completely internally to the enterprise.

**Figure 1. IPv6 Islands Connected over an IPv4 Core and the Associated Packet Flow.**



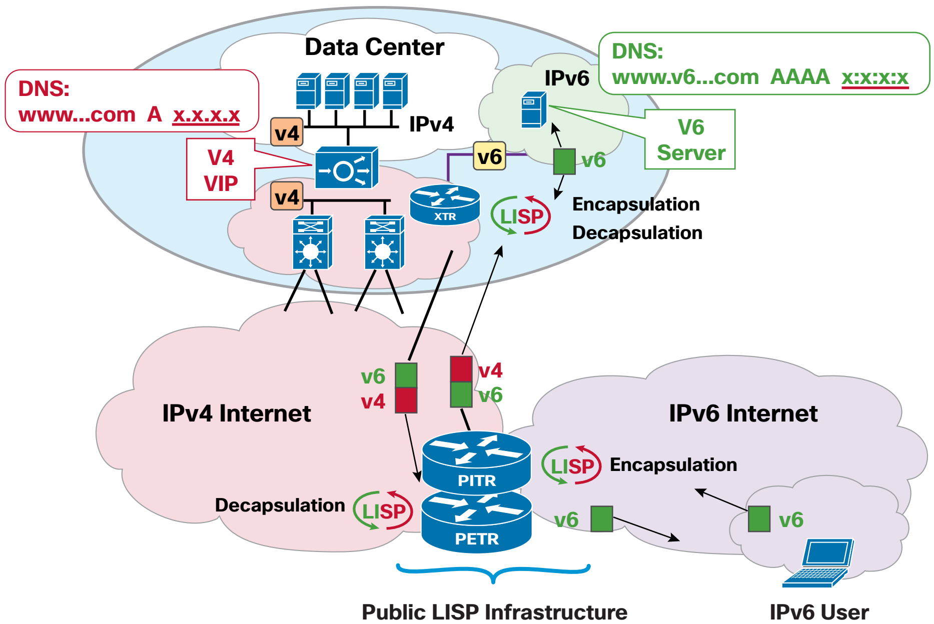

As illustrated in Figure 1, the headquarters (HQ-LISP) LISP router (RTR-A) performs both LISP mapping services (MR/MS) and LISP encapsulation services (xTR). The LISP routers (RTR-B and RTR-C) at the LISP spoke sites (Spoke1-LISP and Spoke2-LISP) perform LISP encapsulation services only. Here, IPv6 packets sourced from the HQ-LISP site and destined for the Spoke1-LISP site are LISP-encapsulated by RTR-A within IPv4 and decapsulated by RTR-B to connect these IPv6 islands.

To accomplish this solution, only a small number of configuration changes are needed: the addition of IPv6 subnets and a few lines of LISP configuration. These changes can be accomplished in just a few minutes and are all that is required to fully connect the IPv6 islands. Note that there is no hard tunnel configuration or state. Destination site locations are obtained by querying the LISP Mapping System and encapsulations are built dynamically. This LISP solution can be extended by incorporating any of the comprehensive set of Cisco IOS® Software features (access control lists [ACLs], Network Address Translation [NAT], quality of service [QoS], Cisco IOS NetFlow, encryption, and so on), if desired, to further extend this solution.

## Scenario 2: Deployment of an IPv6 Internet Web Presence

Another compelling use case is that of establishing an IPv6 Internet web presence quickly and without disrupting existing IPv4 services. Using LISP and the public LISP mapping services, enterprises can establish an IPv6 web presence using existing IPv4 WAN connectivity, and with few modifications to the current data center infrastructure. This cost-effective solution is illustrated in Figure 2. In this example, LISP is used to connect non-LISP IPv6 Internet users to corporate web services. Again, this solution can be achieved with few configuration changes and can typically be implemented within a few hours.

**Figure 2. IPv6 Web Presence Using Existing IPv4 Internet Access**




As shown in Figure 2, IPv6 is deployed on only one internal subnet, as well as on a web server. (Alternatively, server load-balancer IPv6/IPv4 translation or web-proxy IPv6/IPv4 translation methods can be used.) In this case, public LISP mapping services and interworking services are required, as represented in Figure 2 by the Proxy Ingress/Egress Tunnel Routers (PITR/PETR), also available today. These public LISP services provide non-LISP to LISP interworking as well as IPv6/IPv4 interconnections. Using LISP to carry IPv6 user traffic over the IPv4 Internet eliminates the entire IPv6 Internet connection process, allowing quick time to market for meeting the business goal of establishing an IPv6 web presence. While this can be a temporary solution, using LISP also provides other benefits (such as ingress traffic engineering and mobility) that could be useful in making this a long-term solution as well.

## Conclusions

Whether deploying IPv6 in a production environment, for example to establish a web presence, or simply experimenting to gain hands-on experience with the IPv6 protocol, incorporating LISP in the strategy can help achieve the desired goals. This capability has been proven by real success stories (such as those detailed in references [1], [2], and [3]) in practical production implementations to be ideal for many IPv6 transition strategies. Incorporating LISP into an IPv6 transition strategy has demonstrated quick deployment time, low deployment and operational cost, little or no need for additional equipment or modifications, and high user satisfaction. In addition, the broader features of LISP (inherent multihoming, ingress traffic engineering, and mobility) can be significant benefits for long-term deployments.

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Printed in USA

C11-665752-00 5/11