

# **The Path to Six/One**

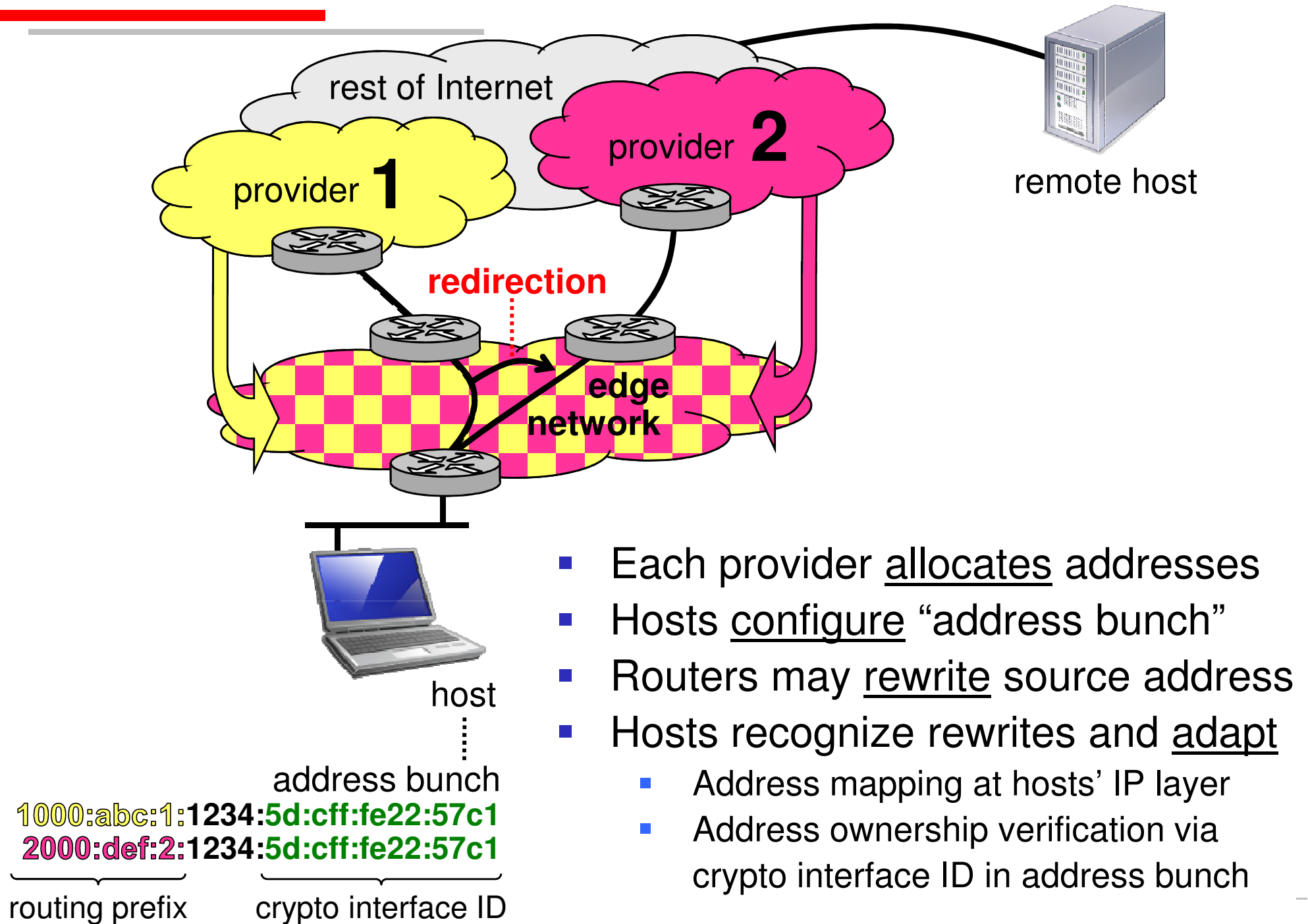
## **Incentives, Backward-Compatibility and Deployment Flexibility**

**Christian Vogt**

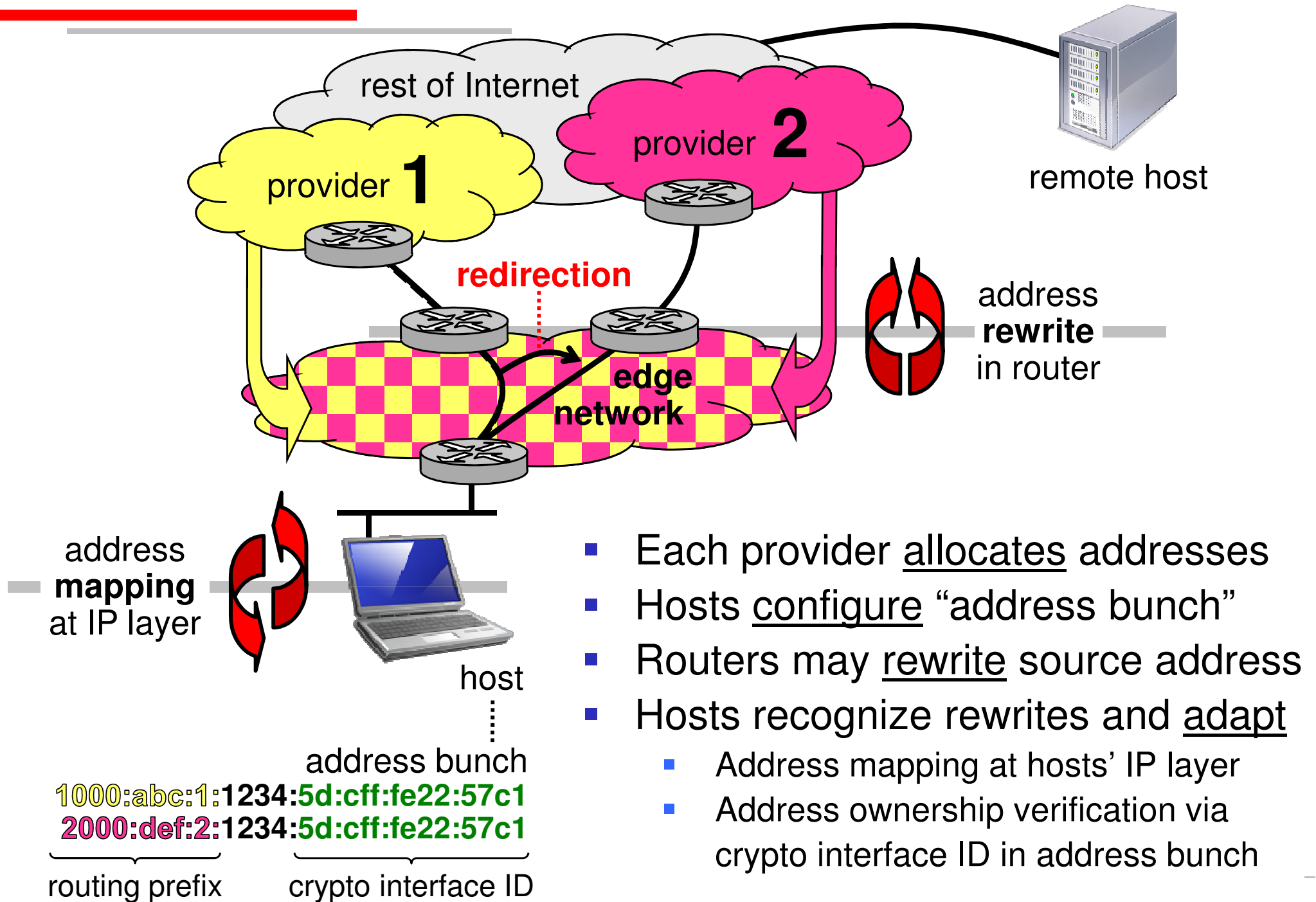
**IRTF Routing research group meeting, Vancouver  
December 3, 2007**



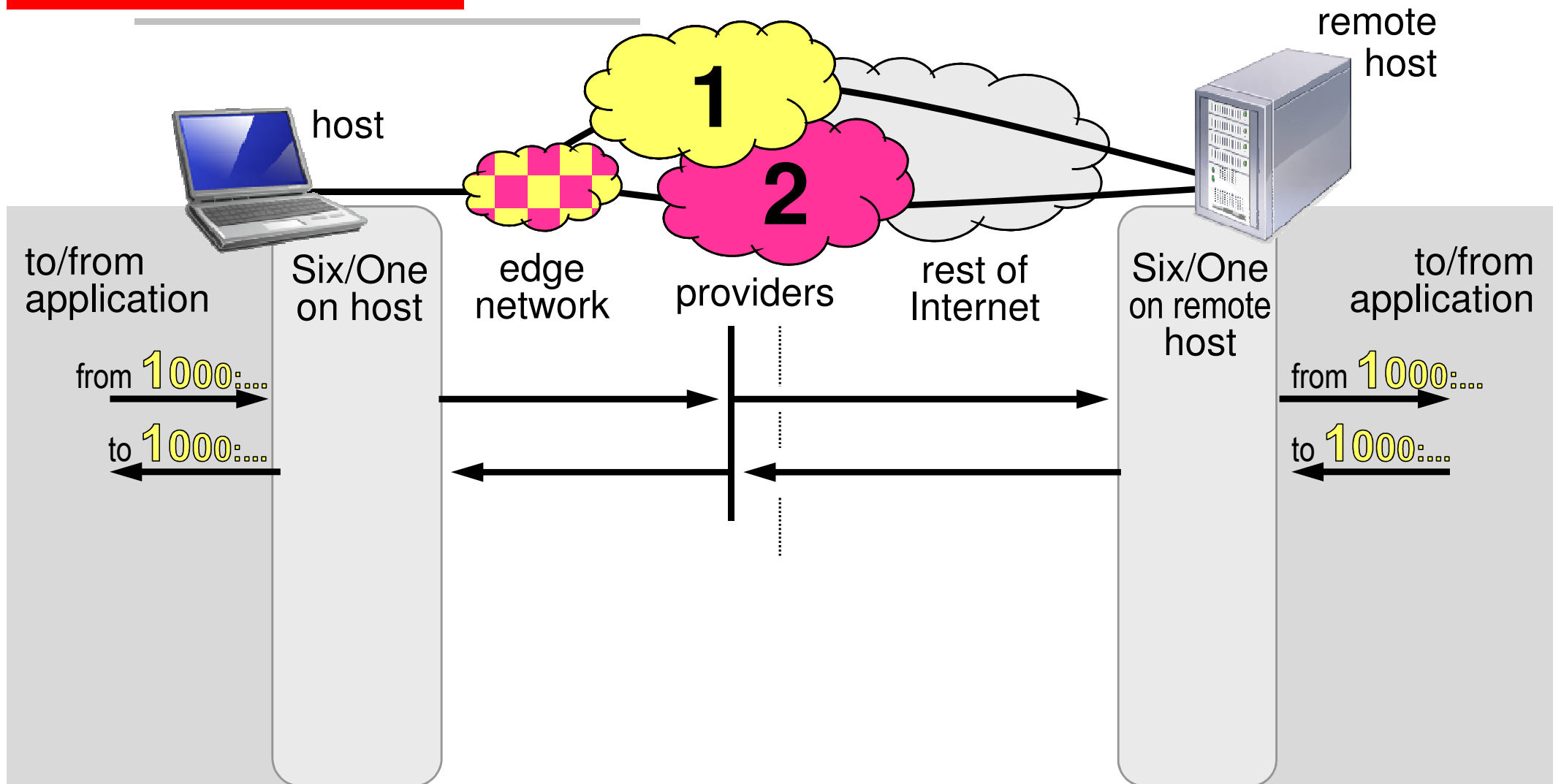
# Recap of Six/One



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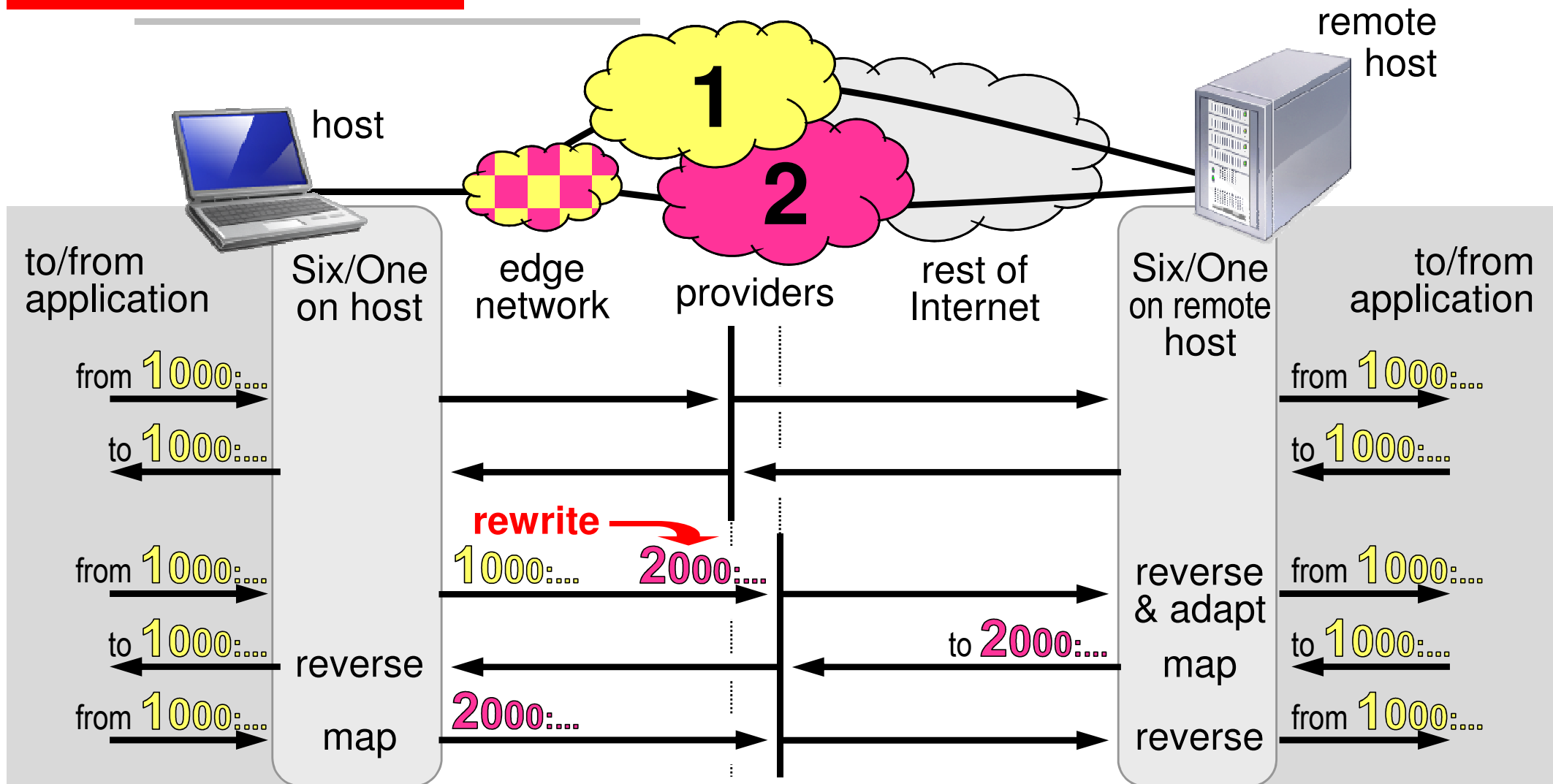
# Six/One: Mapping and Rewriting in Detail



## Case 1: no rewriting

- Host selects source address
- It thereby suggests provider
- Routers accept host selection

# Six/One: Mapping and Rewriting in Detail



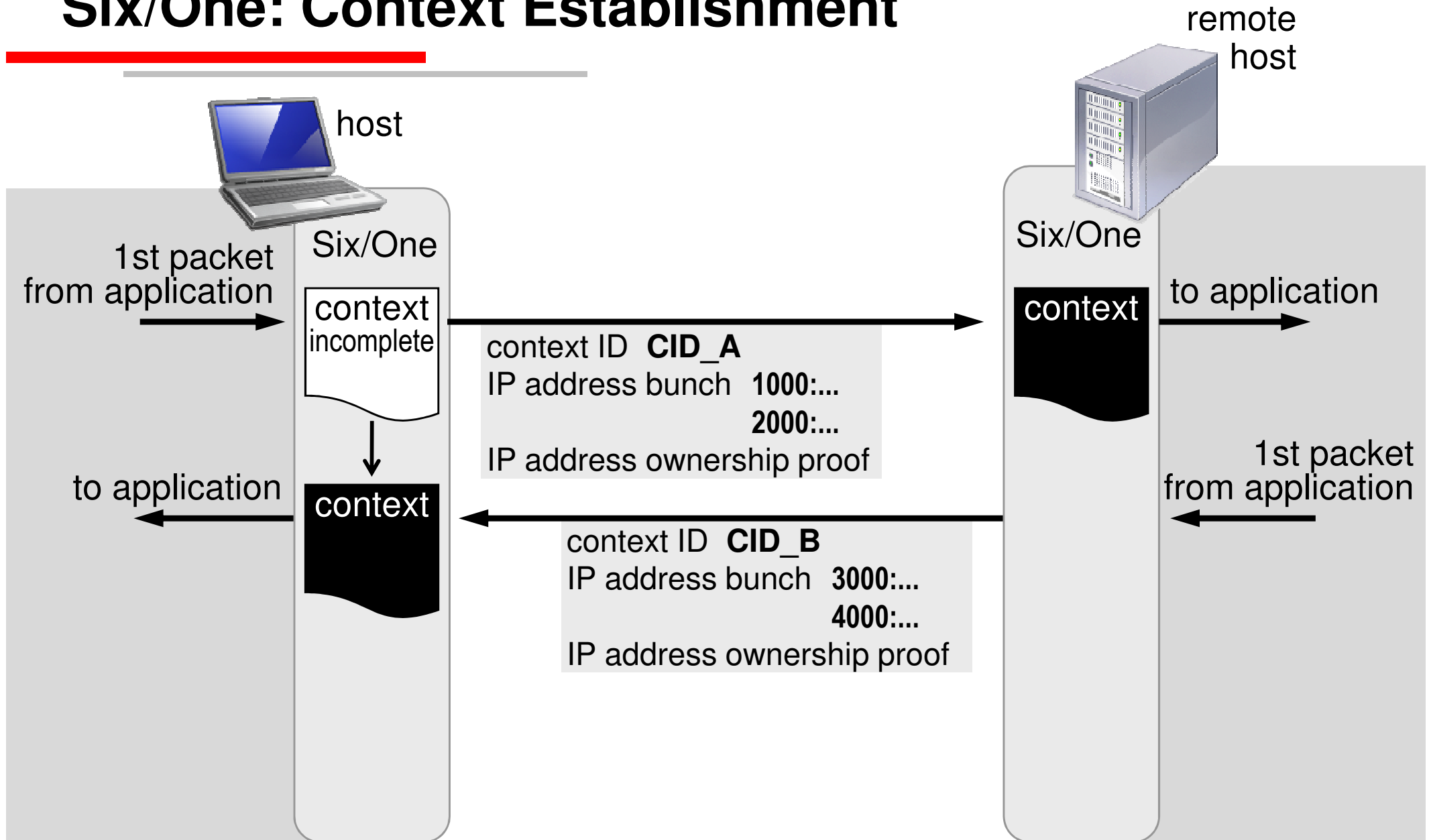
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## Case 2: rewriting in edge network

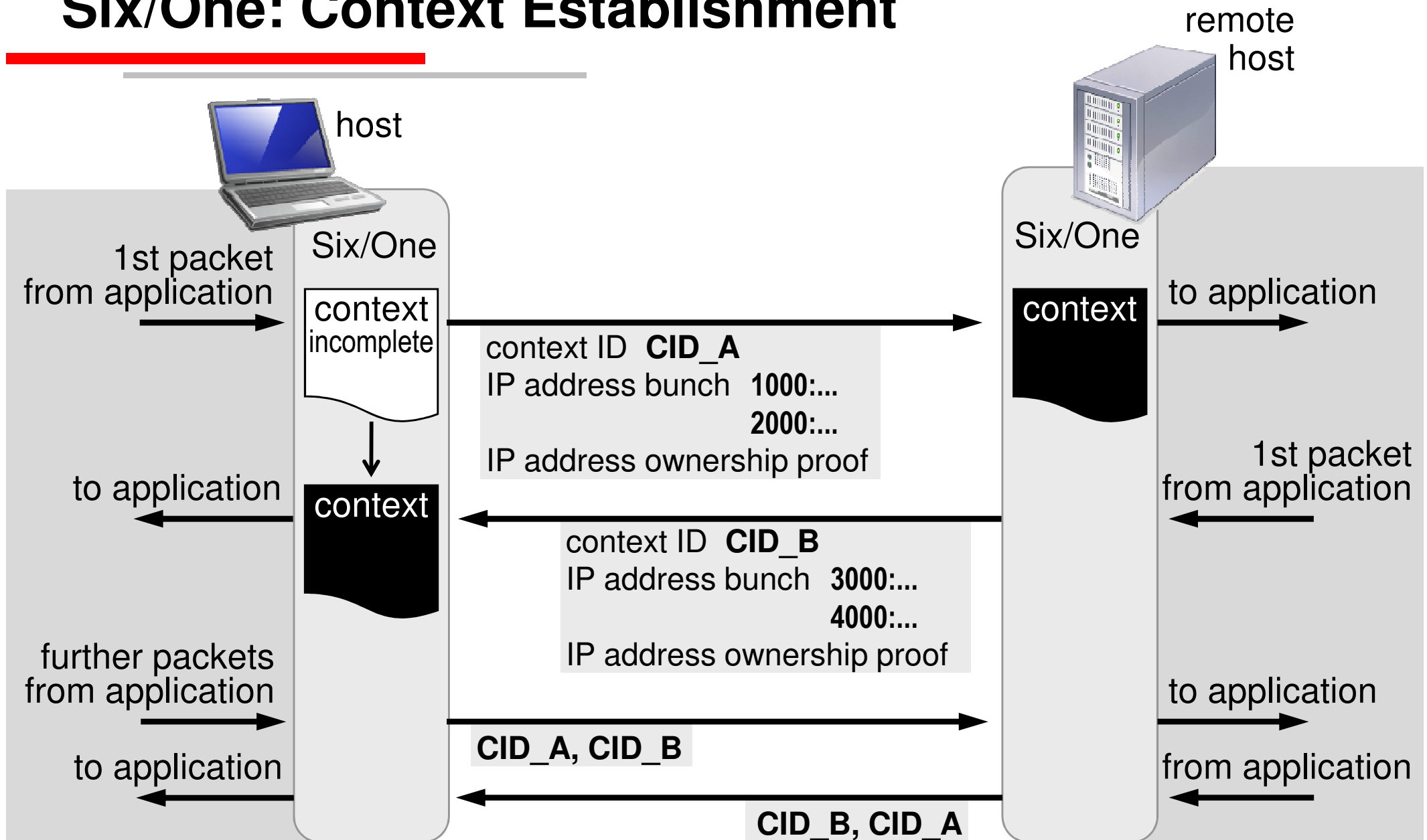
- Router rewrites source address
- Hosts learn new address and adapt
- No address change in application

# Six/One: Context Establishment



- Context establishment when hosts initiate first communication session
- Context IDs for subsequent look-up

# Six/One: Context Establishment



- Context establishment when hosts initiate first communication session
- Context IDs for subsequent look-up
- Routers do not rewrite IP address prefixes before context established

# Transition Path

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## Incentives for providers

- Smaller global routing table
- Less frequent table updates

## Incentives for edge networks

- Packet flow redirection ability if Six/One support on remote side
- Reduced renumbering costs

## Advantages for hosts

- Influence on path selection
  - during session establishment
  - upon failure
- Light-weight IPv6 crypto
  - Security without infrastructure
  - No costly public-key math
- Cross-layer optimization

## Deployment flexibility

- Rewrite functionality can be located in arbitrary routers

## Backward-compatibility

- En- and disable Six/One based on support on remote side



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## Deployment flexibility

- Rewrite functionality can be located in arbitrary routers
- **Deployment without host upgrades?**

## Backward-compatibility

- En- and disable Six/One based on support on remote side
- **Packet flow redirection even if remote side is legacy-v6/v4?**
- **Support Six/One hosts connected via v4 Internet?**

# New Transition Tools

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## 1. Proxies

- Run Six/One on behalf of host
- Six/One deployment without host upgrades

## 2. Translators

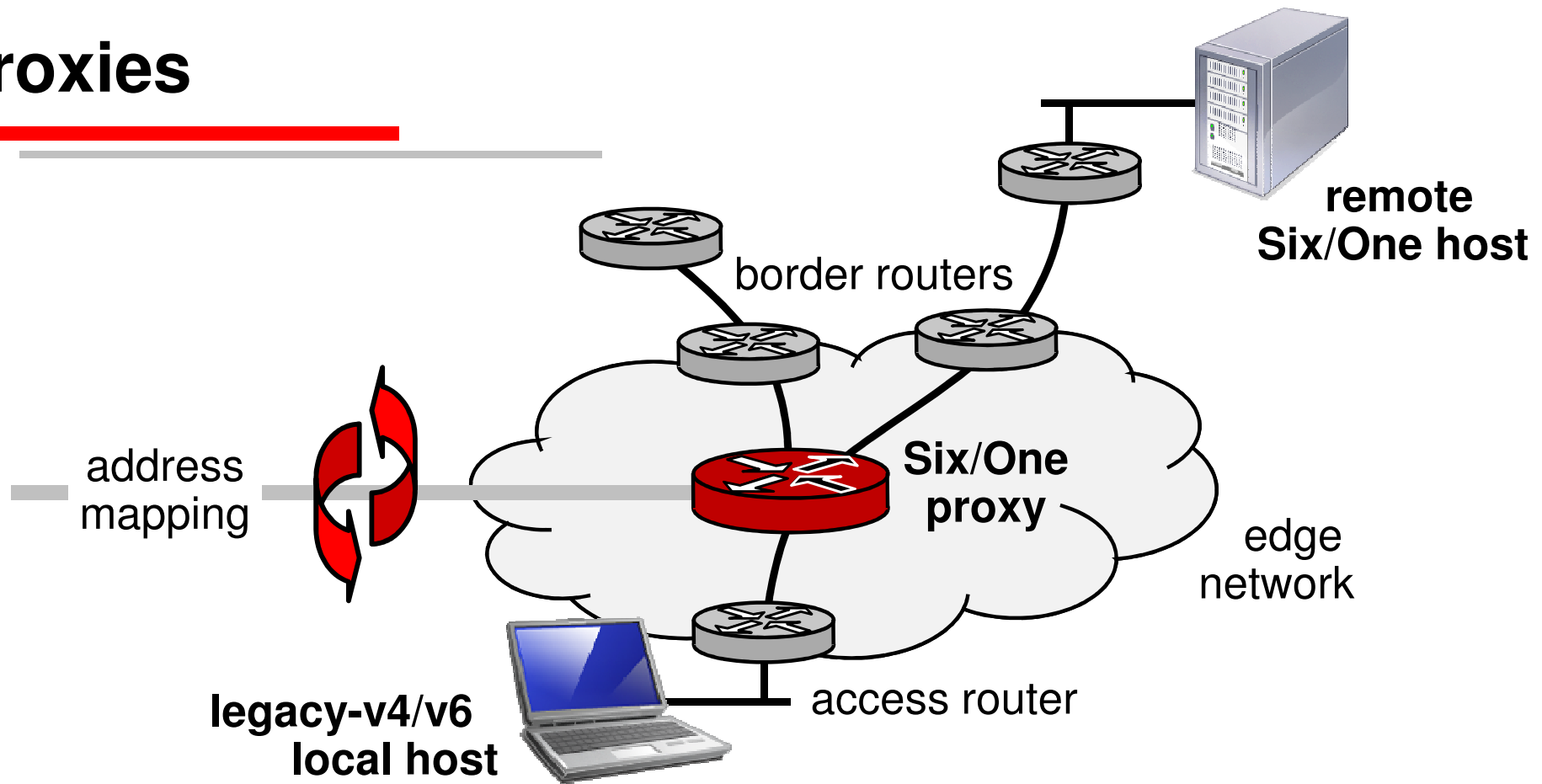
- Replace addresses in packets without reversal
- Benefits also without Six/One support on remote side

## 3. v4 Gateways

- Tunnel packets between Six/One-enabled hosts via v4 Internet

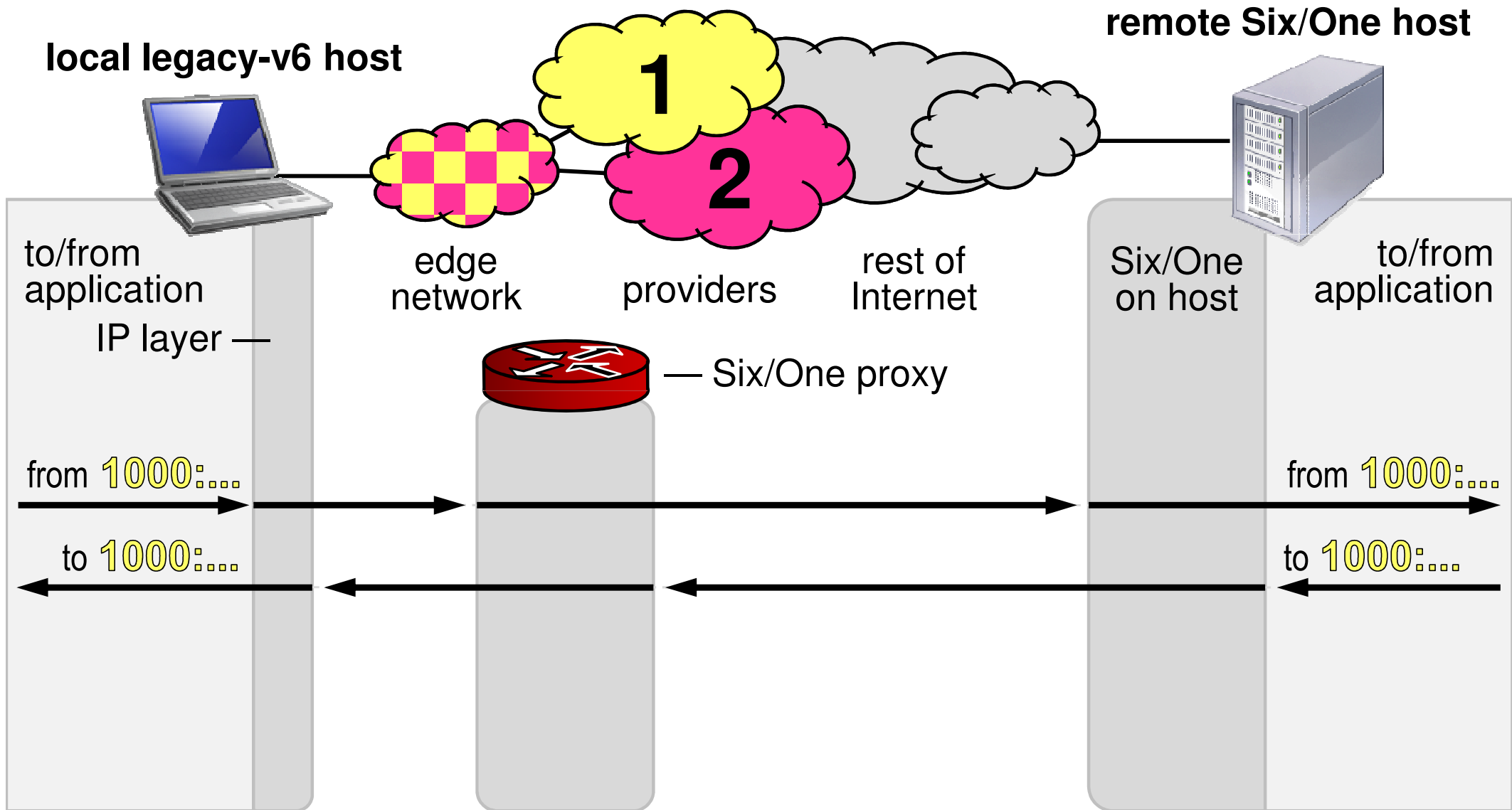
**Transition tools composable, depending on need**

# Proxies



- Proxy in network runs Six/One on behalf of local legacy host
  - Perform address mapping
  - Recognize address rewrites, adapt
- Alternative deployment
  - Don't wait for host upgrades
  - For hosts with limited capabilities
- Designed for interoperability
  - Transparent to local legacy hosts
  - Works with local Six/One hosts
  - Interoperable with remote Six/One hosts and proxies
- Free placement of proxies
  - Packet flow redirection between proxies requires synchronization

# Proxy Operation in Detail

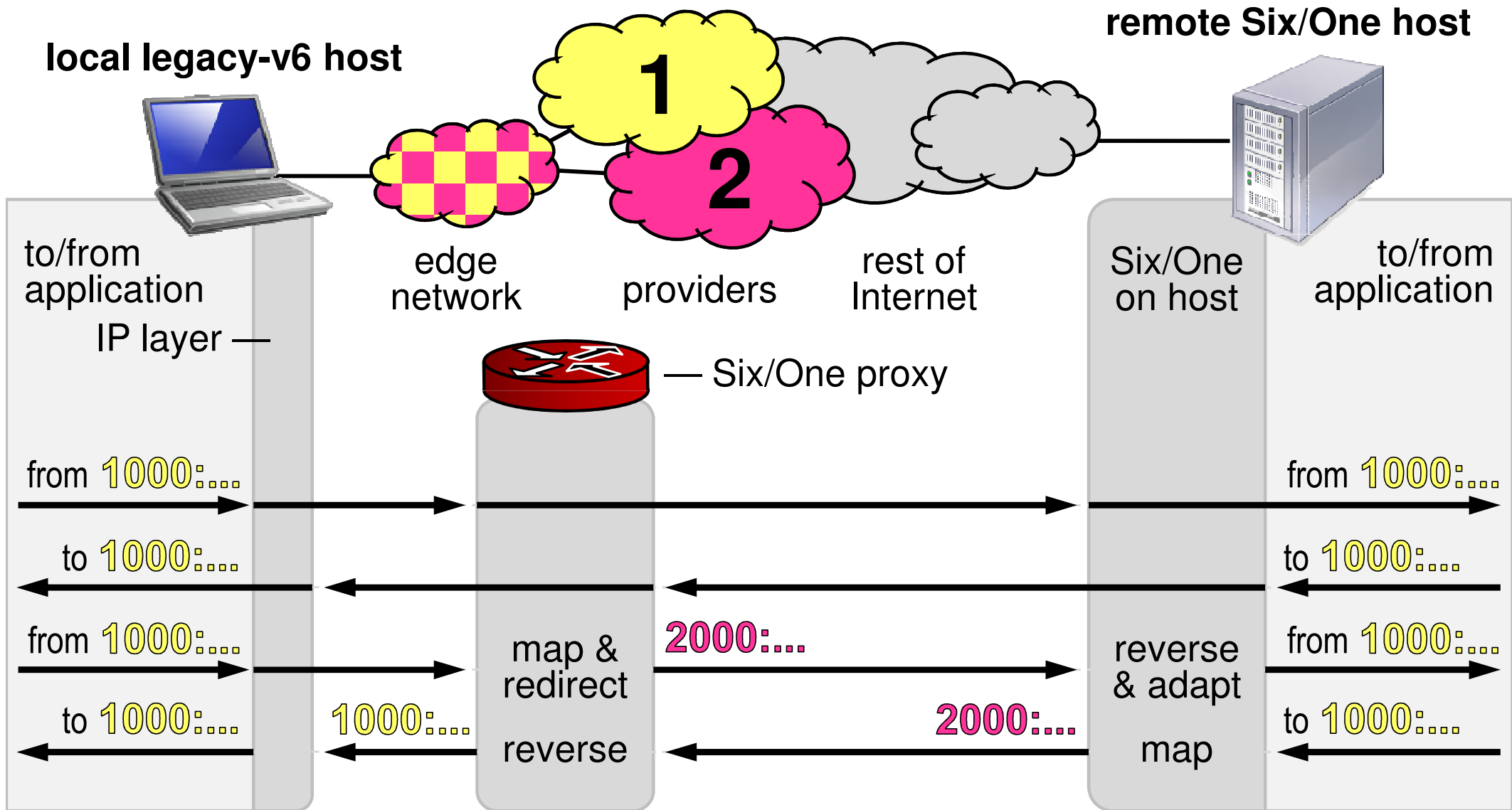


address bunch of local host

1000:abc:1:1234:5d:cff:fe22:57c1

2000:def:2:1234:5d:cff:fe22:57c1

# Proxy Operation in Detail



address bunch of local host

**1000:abc:1:1234:5d:cff:fe22:57c1**

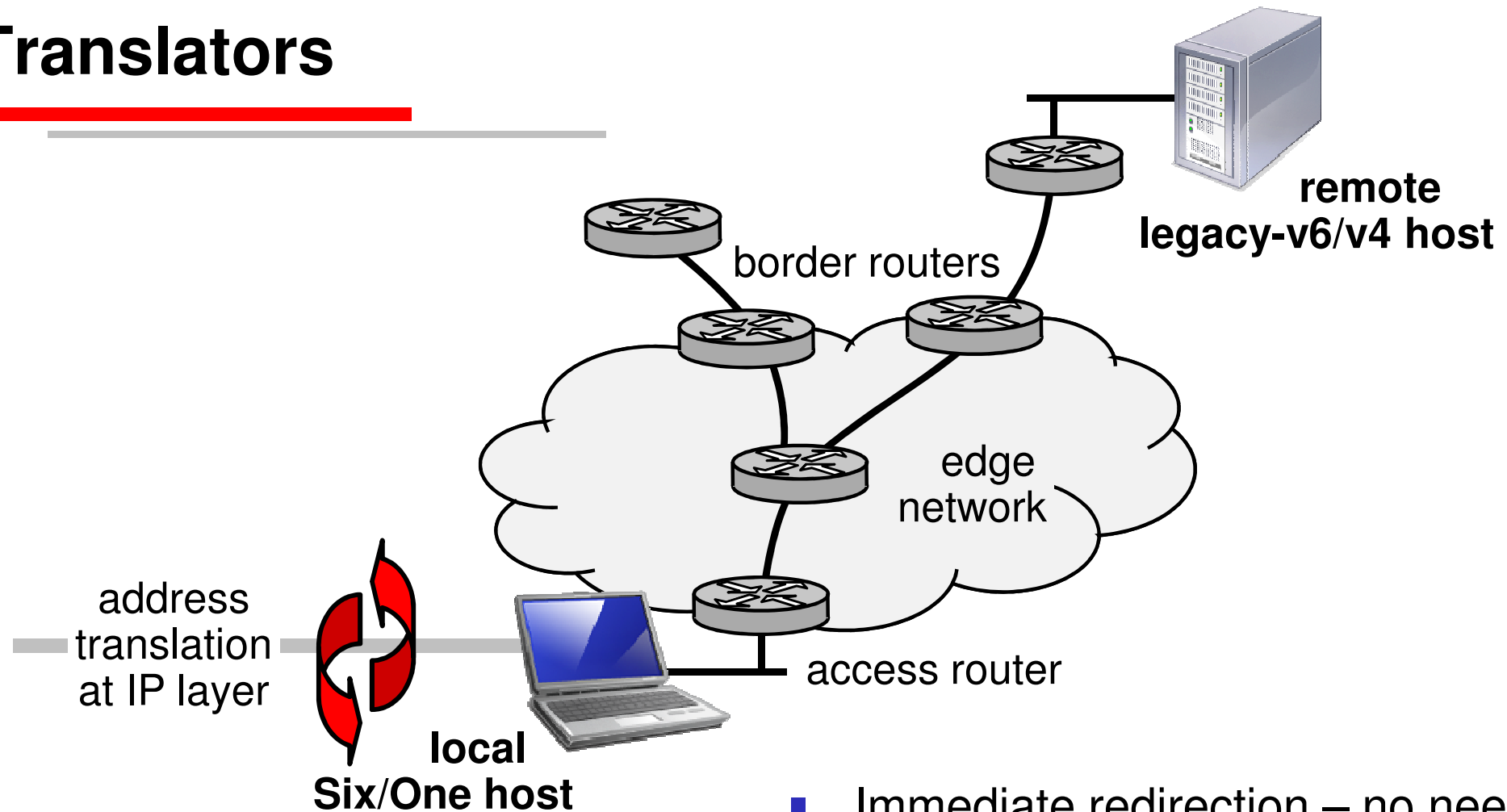
**2000:def:2:1234:5d:cff:fe22:57c1**

# Address Bunch Configuration with Proxies

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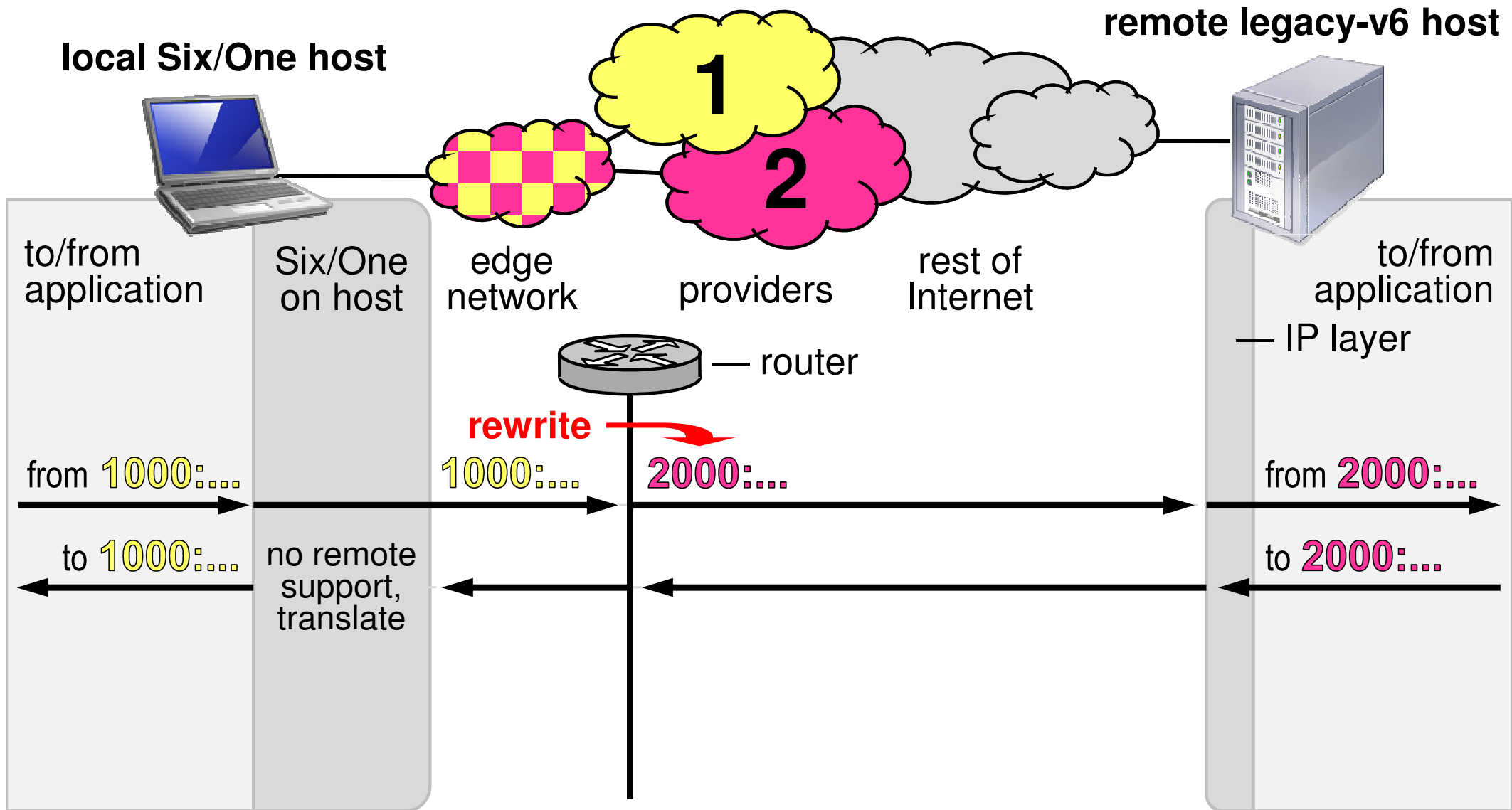
- DHCP server generates address bunch
  - Crypto parameters made by DHCP server
  - Proxy retrieves crypto parameters from DHCP server
- Flexible support for Six/One-upgraded hosts
  - Disable by mandating standard DHCP
  - Permit by allowing Six/One hosts to autonomously configure address bunches in Router Advertisements
  - Permit by communicating crypto parameters to hosts, e.g., via new DHCP option

# Translators



- Enable packet flow redirection without remote Six/One support
- Like a NAT: Replace addresses in packets without reversal
- Translator on host or on proxy
- Immediate redirection – no need to check remote support first
- No address ownership verification necessary
- Facilitates backward-compatibility for remote legacy-v4 hosts

# Translator Operation in Detail



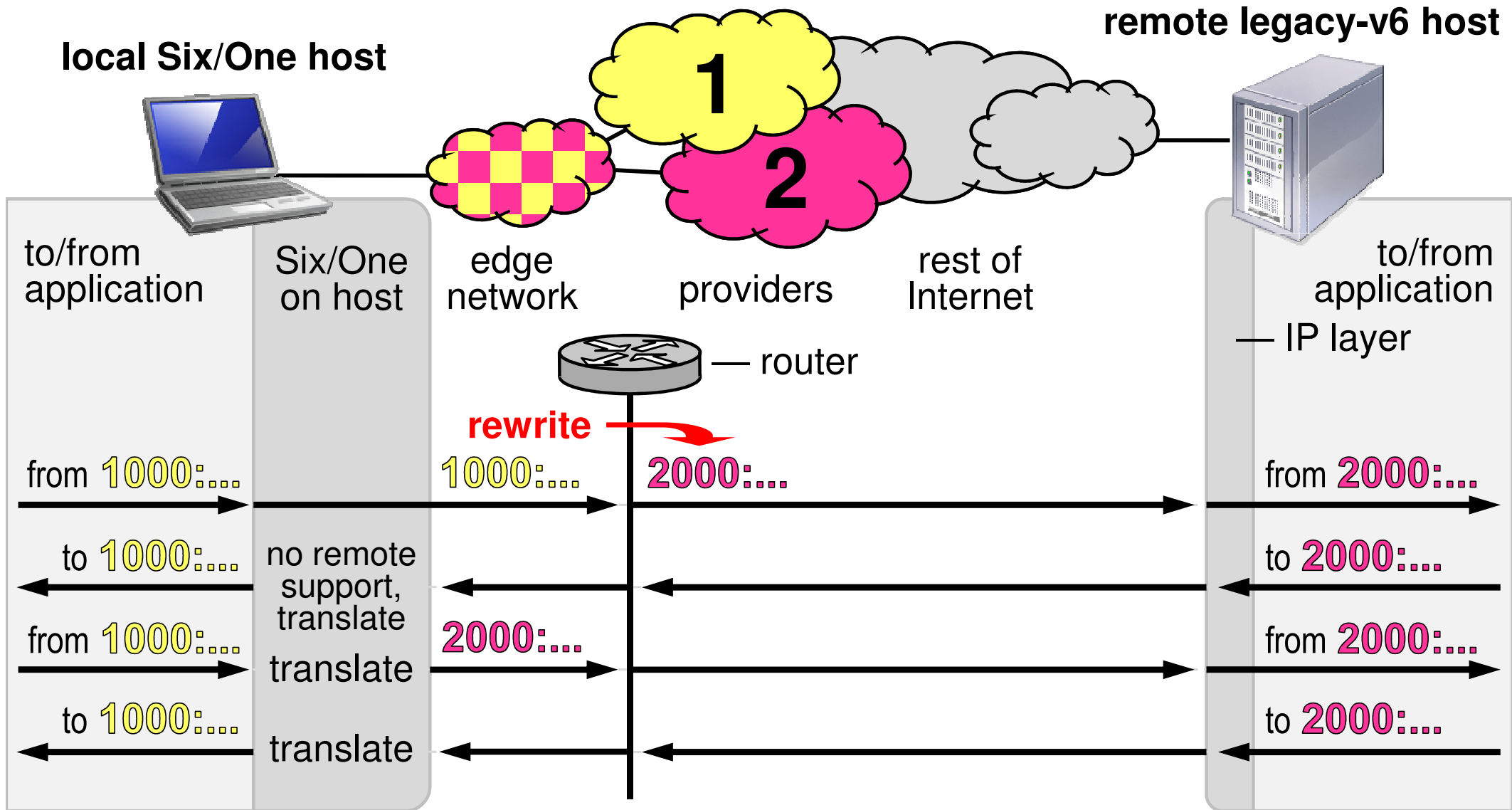
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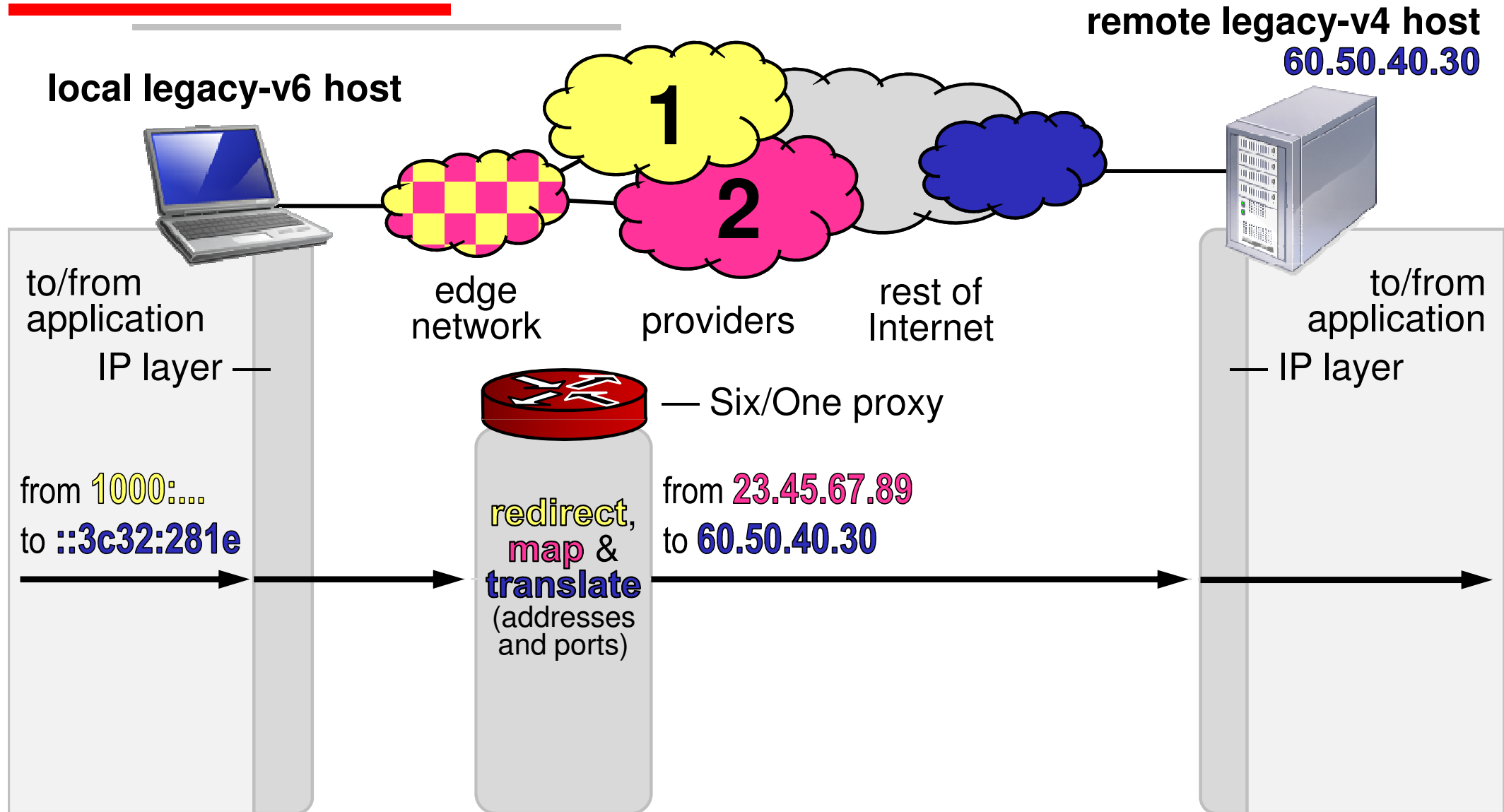


address bunch of local host

1000:abc:1:1234:5d:cff:fe22:57c1

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# Combined Proxy and Translator for v4 Support

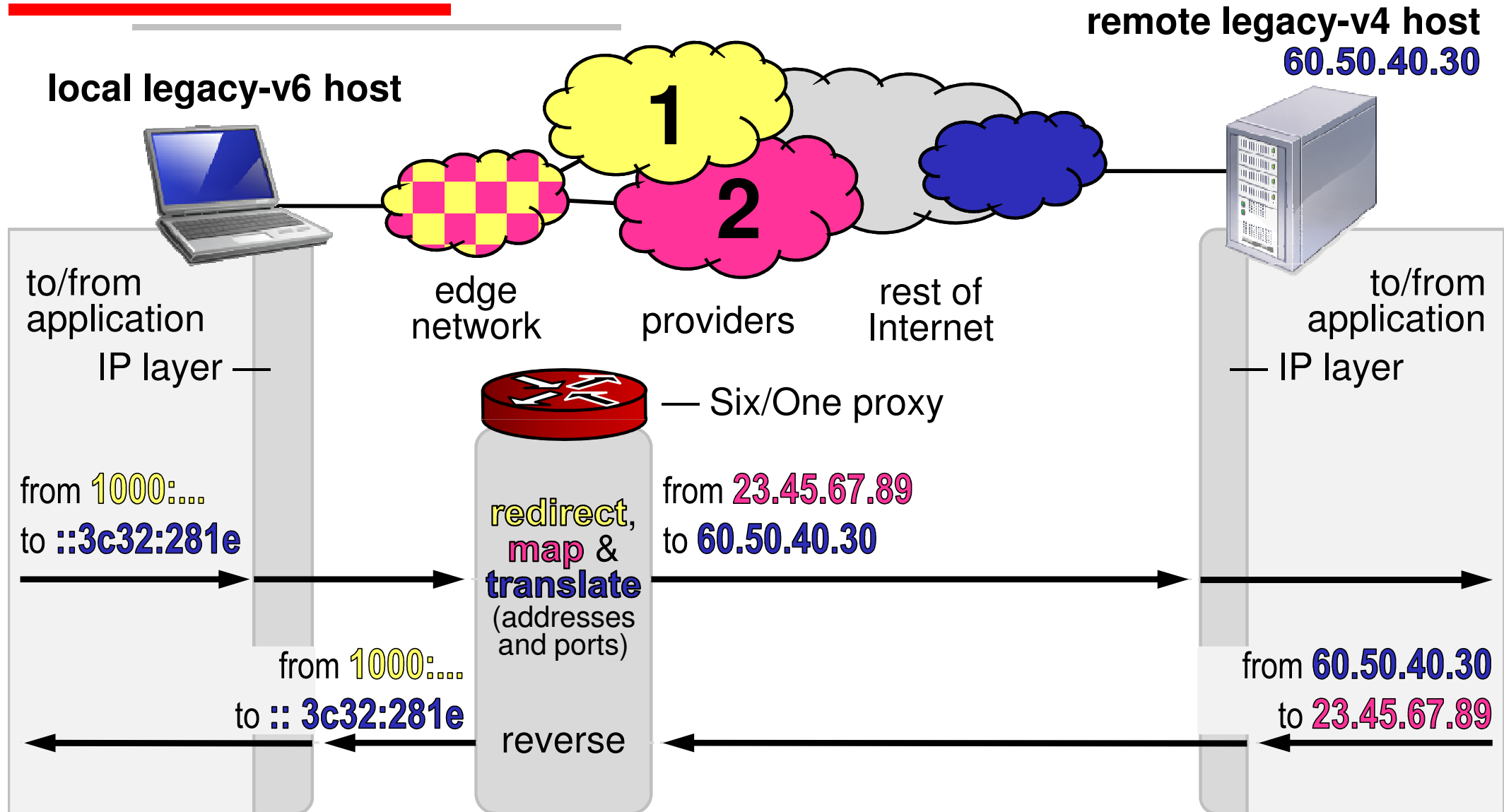


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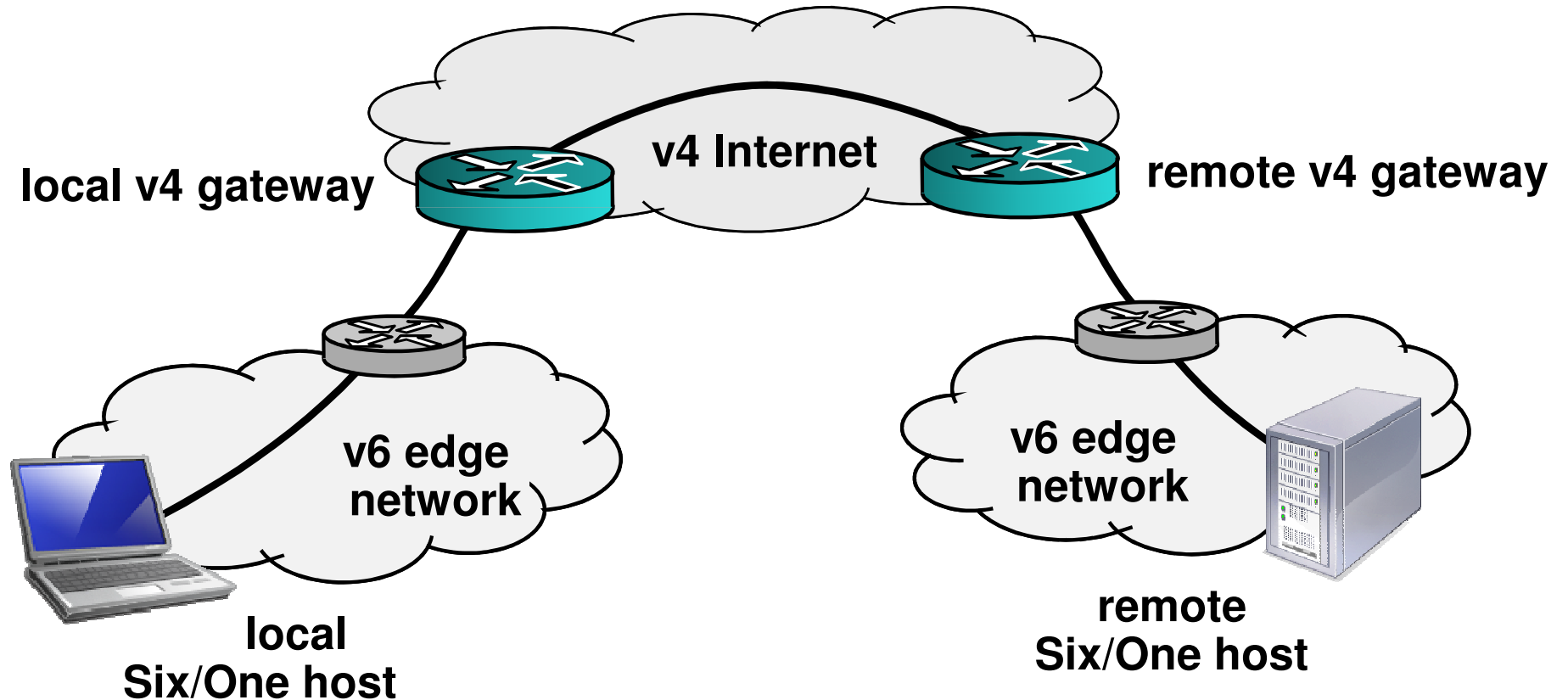
# Combined Proxy and Translator for v4 Support



address bunch of local host  
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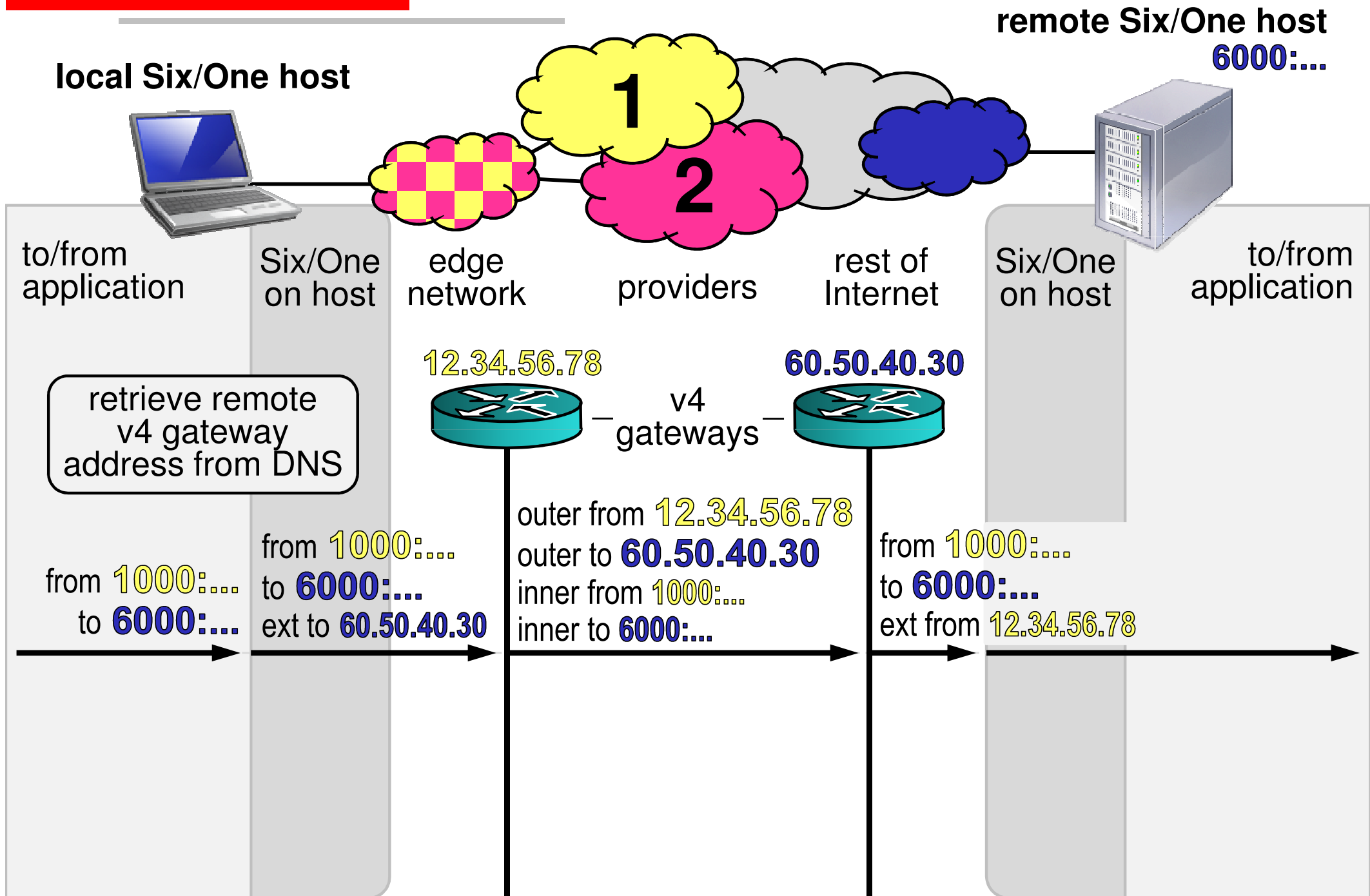
Translation may again also happen  
on host directly (without proxy)

# v4 Gateways

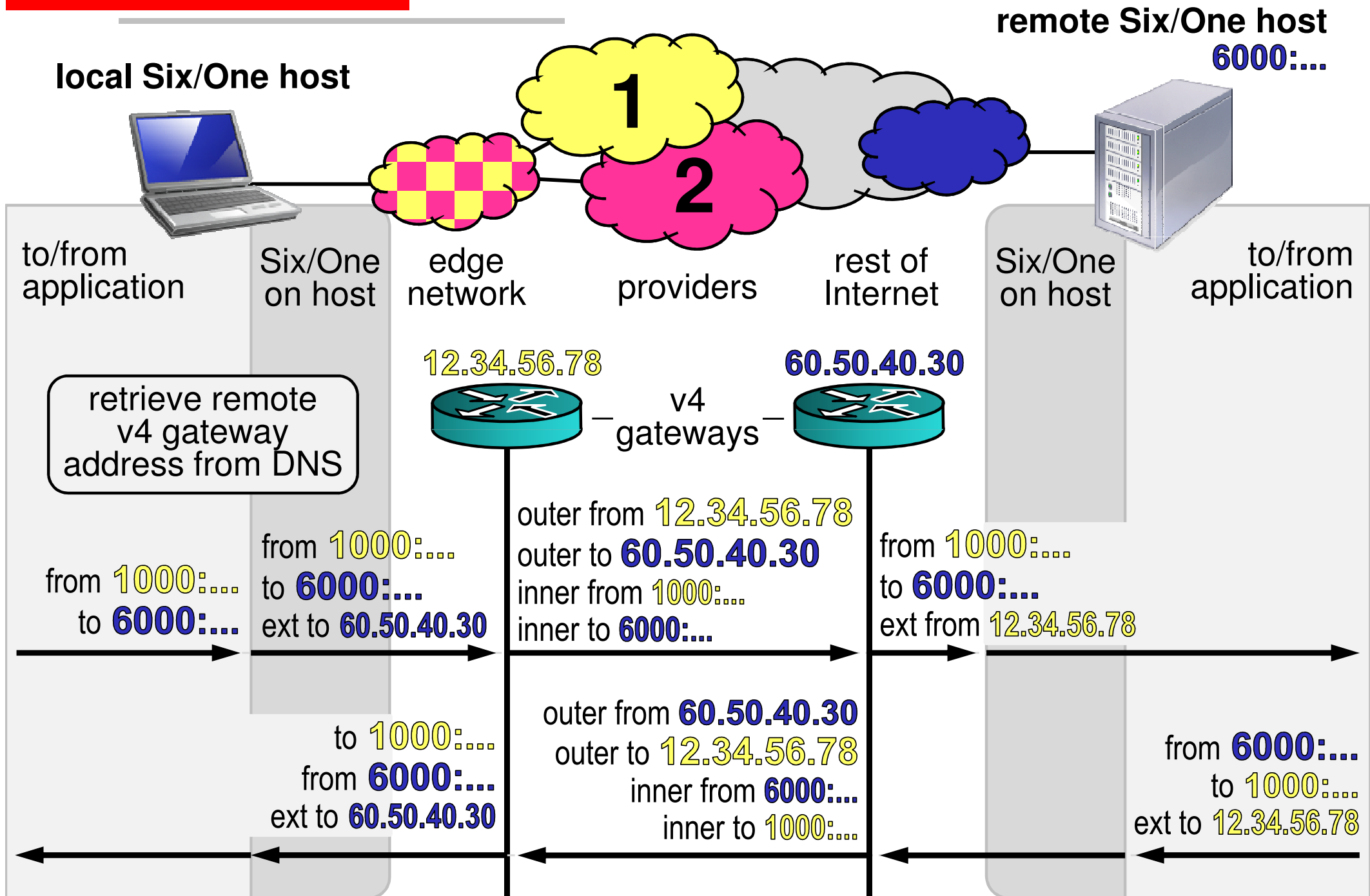


- Connect Six/One hosts via v4 Internet
- Automated tunneling: Packet extensions with gateway addresses
- Redirection: Gateway addresses are bound to address bunches
  - Local gateways in Router Advertisement
  - Remote gateway in DNS

# v4 Gateway Operation in Detail



# v4 Gateway Operation in Detail



# Conclusions

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- Improve existing transition path to Six/One
  - Higher deployment flexibility
  - Benefits also with legacy hosts
  - Backward-compatibility with v4
- Flexible, arbitrary composition, depending on need
  - Local legacy-v6/v4 hosts via proxies
  - Remote legacy-v6/v4 host via translators
  - Legacy-v4 Internet via v4 gateways
- Not more complex than other network-based techniques
- Reusable for v4-to-v6 transition