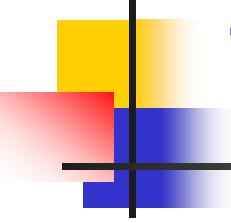


Approaches to Multi6

An Architectural View of Multi6 proposals

Geoff Huston

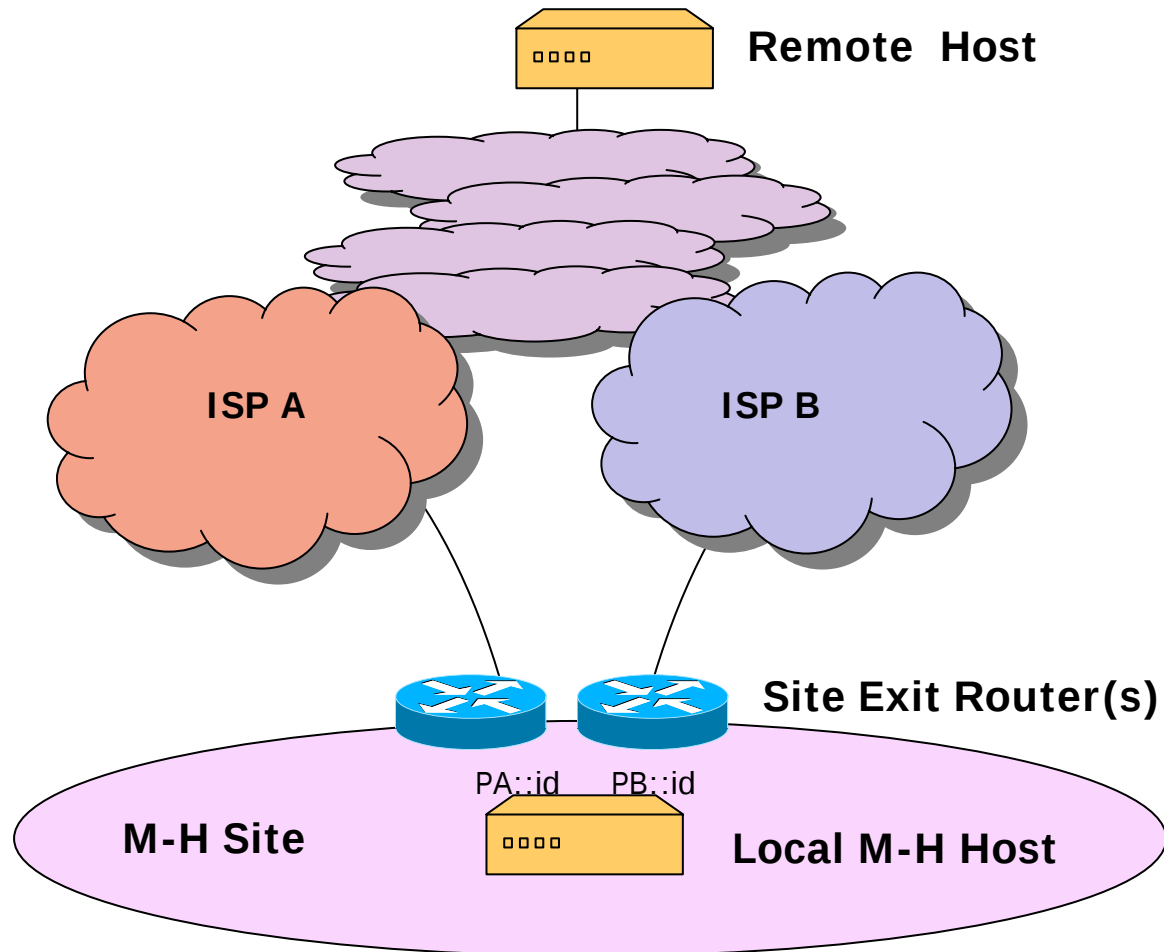
March 2004

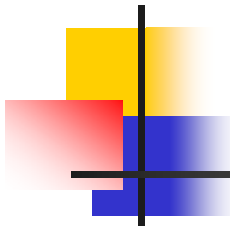


The Objective

- The desire is to generate a taxonomy of approaches to multi-homing in V6
- The taxonomy is to be based on an architectural analysis of the solution space
- Individual approaches can then be analysed against this architectural taxonomy

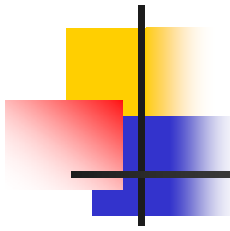
The Problem Space





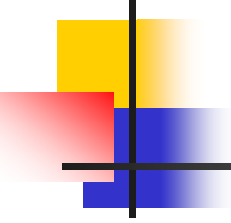
Functional Goals

- RFC3582 enumerates the goals as:
 - Redundancy
 - Load Sharing
 - Traffic Engineering
 - Policy
 - Simplicity
 - Transport-Layer Surviveability
 - DNS compatibility
 - Filtering Capability
 - Scaleability
 - Simplicity
 - Legacy compatibility
- draft-lear includes some 30 additional questions relating various aspects of the proposals in the areas of:
 - Interaction with routing
 - Aspects of an ID/Locator split, if used
 - Changes to packets on the wire
 - Names, Hosts, endpoints and the DNS

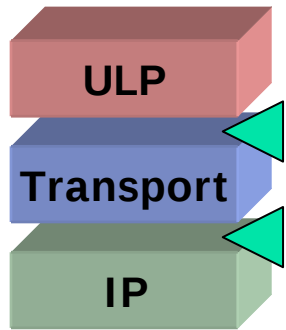


Generic Approaches:

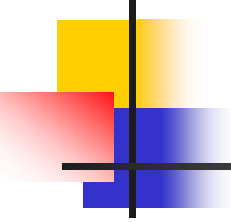
- Insert a new level in the protocol stack (identity element)
 - New protocol element
- Modify the Transport or IP layer of the protocol stack in the host
 - Modified protocol element
- Modify the behaviour of the host/site exit router interaction
 - Modified forwarding architecture



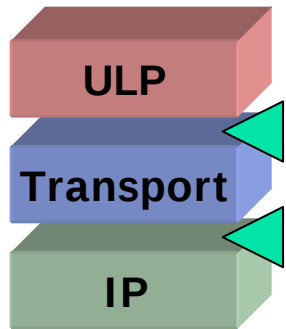
New Protocol Element



- Define a new Protocol element that:
 - presents an identity-based token to the upper layer protocol
 - Allows multiple IP address locators to be associated with the identity
 - Allows sessions to be defined by an identity peering, and allows the lower levels to be agile across a set of locators



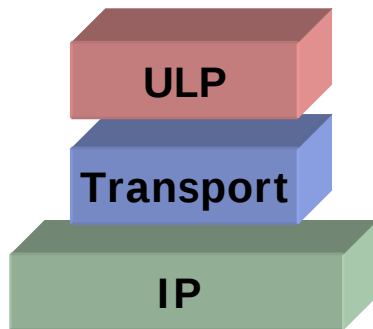
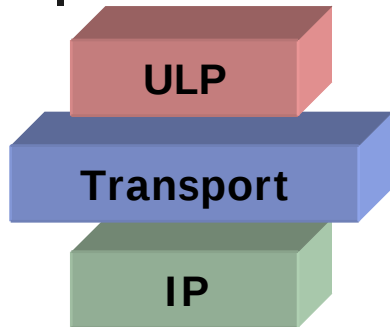
Protocol Element Implementation



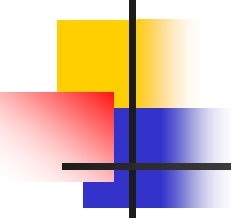
- “Conventional”
 - Add a wrapper around the upper level protocol data unit and communicate with the peer element using this “in band” space
- “Out of Band”
 - Use distinct protocol to allow the protocols element to exchange information with its peer
- “Referential”
 - Use a reference to a third party point as a means of peering (e.g. DNS Identifier RRs)



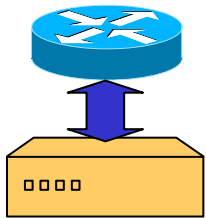
Modified Protocol Element Behaviour



- Alter the Transport Protocol to allow a number of locators to be associated with a session
 - e.g. SCTP
- Alter the IP protocol to support IP-in-IP structures that distinguish between current-locator-address and persistent-locator-address
 - i.e. MIP6



Modified Host / Router Interaction



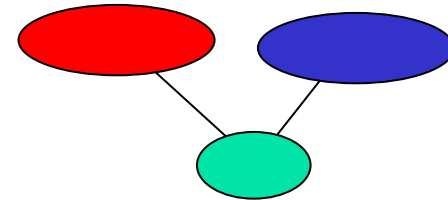
- Modify the interaction between the host and the Site Exit router to allow:
 - Source-based routing for support of host-based site-exit router selection
 - Site Exit router packet header modification
 - Host / Site Exit Router exchange of reachability information

None of the above:

Mapping to IPv4 Status Quo to IPv6

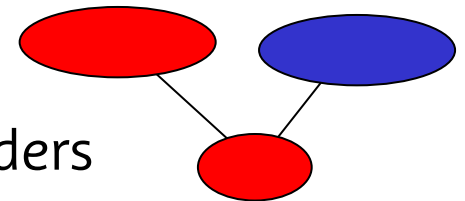
- Such as:

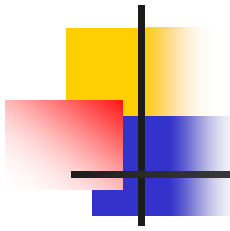
- Obtain a local AS
- Obtain PI space
- Advertise the PI space to all upstream providers
- Follow routing



- Or:

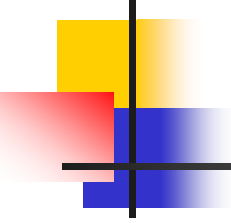
- Use PA space from one provider
- Advertise it to all other upstream providers
- Follow routing





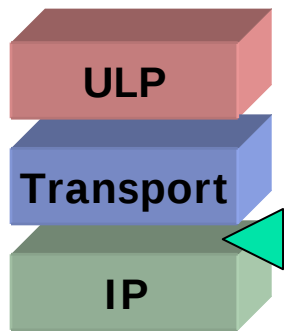
Common Issues

- Host based locator address selection
 - How to pick the “best” source locator for the reverse packet?
 - How to pick the “best” destination locator if there are more than one available?
- Detection of network element failure
 - How to detect reverse path failure?
- Session Persistence
 - How and when to switch locators for active sessions ?

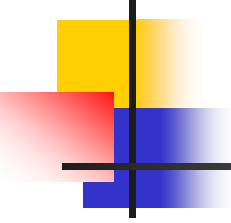


Proposals for a new Protocol Element

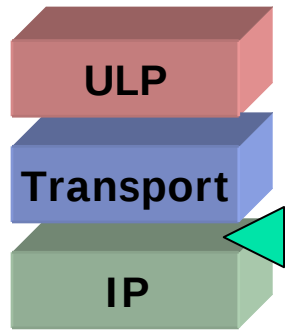
■ HIP:



- Shim between Transport and IP layer
- Presents a stable identity to the transport layer
- Allows multiple locators to be bound to the identity, and communicates this binding to the remote end (HIP protocol)
- Allows the local host to switch source locators in the event of network failure to ensure session surviveability



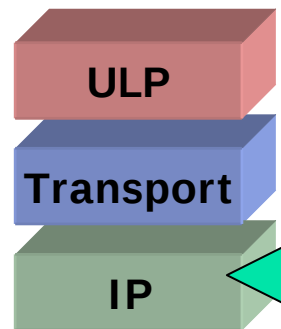
Proposals for a new Protocol Element

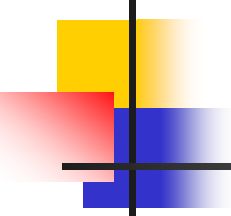


- NOID +
- SIM (CBID 128) +
- CB64:
 - Addition of an identifier shim layer to the protocol stack.
 - The identifier / locator mapping may be contained in the DNS (NOID) or may be contained within a protocol exchange (SIM), or a hybrid approach (CB64)
 - Permits Site Exit routers to rewrite source locators on egress
 - (i.e. includes elements of host / Site Exit Router interaction)

Identity Protocol Element Location

- It appears that the proposals share a common approach:
 - Above the IP forwarding layer (Routing)
 - Below IP fragmentation and IPSEC (IP Endpoint)





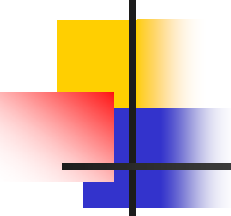
Proposals for an Identity Protocol Element

Hierarchically Structured Space

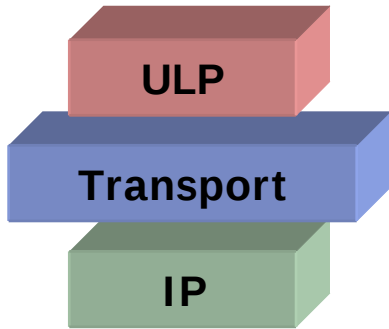
- Use identity tokens lifted from a protocol's "address space"
 - DNS, Appns, Transport manipulate an "address"
 - IP functions on "locators"
 - Stack Protocol element performs mapping
- FQDN as the identity token
 - Is this creating a circular dependency?
 - Does this impose unreasonable demands on the properties of the DNS?
- Structured token
 - What would be the unique attribute of a novel token space that distinguishes it from the above?

Unstructured

- Unstructured token
 - Allows for self-allocation of identity tokens (opportunistic tokens)
 - How to map from identity tokens to locators using a lookup service?



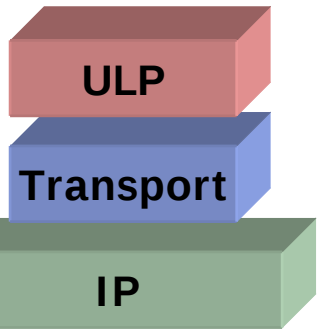
Proposal for a Modified Transport Protocol



- SCTP:
 - Host-based solution that sets up multiple locators for a session
 - Changes locators on end-to-end heartbeat failure
 - Depends on IPSEC for operational integrity of locator exchange

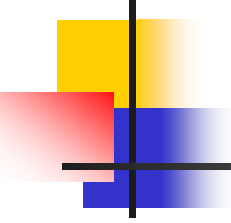


Proposal for a Modified IP Layer

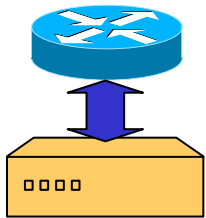


■ MIP6:

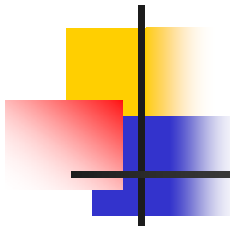
- Use one locator as the home address
- Allow a dynamic switch to an alternate locator as a session surviveability response
- An instance of a generic approach of packet encapsulation, where the outer encap is the current locator binding and the inner packet is the identifier peering.



Modified Host / Site Exit Router interaction



- Site Exit Anycast proposal
 - Allows local forwarding of outgoing packets to the 'matching' site exit router for the selected source address
- Local Site source locator-based forwarding
- Site Exit source address rewriting
 - May be used in combination with locator protocol element proposals
- Have upstream accept all of the site's sources and use host-based source locator selection

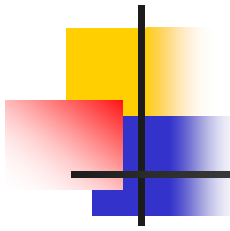


Common Issues

- Picking the ‘best’ source locator

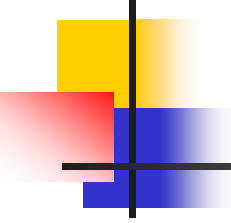
(how do know what destination works at the remote end?)

- Use each locator in turn until a response is received
- Use a identity peering protocol to allow the remote end to make its own selection from a locator set



Common Issues

- Picking the ‘best’ destination locator
 - Longest match
 - Use each in turn
- Picking the ‘best’ source / destination locator pair
 - As these may be related choices

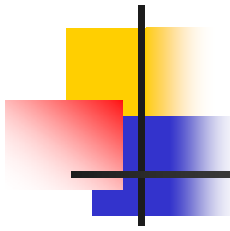


Common Issues

- Detecting network failure

(How does a host know that its time to use a different source and/or destination locator?)

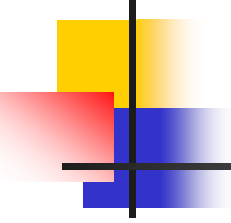
- Heartbeat within the session
- Modified transport protocol to trigger locator change
- Host / Router interaction to trigger locator change
- Application timeframe vs network timeframe
- Failure during session startup and failure following session establishment



Common Issues

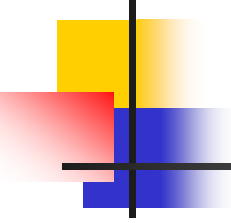
- Session Persistence

- Use one locator as the “home” locator and encapsulate the packet with alternative locators
- Set up the session with a set of locators and have transport protocol maintain the session across the locator set
 - Optionally delay the locator binding, or allow the peer dynamic change of the locator pool
- Use a new peering based on an identity protocol element and allow locators to be associated with the session identity



Common Issues

- Bilateral peer applications vs multi-party applications
 - What changes for 3 or more parties to a protocol exchange?
- Application hand-over and referral
 - How does the remote party identify the multi-homed party for third party referrals?



Security Considerations

- Not considered in the scope of this work
- Worthy of a separate effort to identify security issues in the various proposals following up on threats draft