L3 – Names, Addresses, and Routes

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References / Acknowledgements

[Shoch] A note on Inter-Network Naming, Addressing, and Routing by John F. Shoch, Internet Experiment Note # 19, Notebook Section 2.3.3.5, Xerox PARC, January 1978.

[Hauzeur] Hauzeur, Bernard M., A Model for Names, Addressing, and Routing, ACM Transactions on Office Information Systems, Vol. 4, No. 4, October 1986, Pages 293 - 311.

[Clark-Address] David D. Clark, Karen Sollins, John Wroclawski, and Ted Faber, Addressing Reality: An Architectural Response to Real-World Demands on the Evolving Internet, SIGCOMM-2003. (Read Sec 3.4)

Presentation Overview

New Approaches

Implementation

Mappings

Definitions

The Key Terms

- Name
- Route / Path
- Address
- Service
- User Description

A Name

Definition: *A name is a linguistic object that singles out a particular entity from among a collection of entities; A collection of entities that defines the naming domain.*

Ex: photon, gmail.com

- Not always a human-readable string
- Three interesting attributes – structure, time, and number

SSL Certificate - Name

- Used by the websites for secure exchange of information
- Name follows X.400 naming convention

A Route / Path

Definition: *A route is a list of names representing the path from source to destination.*

Ex: proxy → google.com → plus.google.com

10.1.1.25 → 74.125.236.[65 – 73],78 → 74.125.236.[65 – 73],78

- Routes changes possible for a named destination

An Address

Definition: An address is an intermediate form between a name and a route;

it is oriented to machine processing and used to generate the route.

Ex: 10.1.1.25, 24:b6:fd:35:2e:7d

- Name vs Address

  entity is denoted by name; communication object of the entity gets the address.

Hierarchical vs Flat Address Space

- Flat Address Space
  - Globally unique
  - (Global) Routing table is long

- Hierarchical Address Space
  - Sub-optimal routes
  - Easy maintenance

  Conclusions applicable to name space as well

A Simple traceroute

Origin: 67.222.132.196 [network-tools.com]
Destination: 74.125.227.96 [google.com]

Path:

Hop	IP Address	Host name
1	8.9.232.73	xe-5-3-0.edge3.dallas1.level3.net
2	4.69.145.140	ae-3-80.edge2.dallas3.level3.net
3	4.59.36.14	google-inc.edge2.dallas3.level3.net
4	72.14.233.65	-
5	209.85.240.91	-
6	74.125.227.96	dfw06s16-in-f0.1e100.net

Trace complete

Service

Definition: service refers to a set of related software functionalities that can be reused for different purposes, together with the policies that should control its usage.

Ex: email, voip, web hosting, DNS

- Typically deployed on servers (in cloud??)

User Description

- User requirement
  - Phone call
  - Video conferencing
  - File exchange
  - Website on www

- Multiple services may satisfy user requirement
  Ex: FTP, µTorrent, DC++ all provide file tranfer

- Very dynamic

Example – BITS Student Scenario

- User requirement: file transfer to anywhere on the web
- Service providers: dropbox, rapidshare, BITS network
- Services: FTP, P2P, email, www
- Servers/nodes: ftp.bits-goa.ac.in, rapidshare.com, …
  (names)
- Paths: 127.0.0.1 → 10.1.1.25 → 80.239.151.4, …
- Addresses: 10.1.1.223, 80.239.151.4, …

Home Work

Which category – name, address, path, server, service, user description - do the following concepts fall into:

- URL (Uniform Resource Locator)
- URI (Uniform Resource Identifier)
- URN (Uniform Resource Number)
- URC (Uniform Resource Characterization)
- Magnet link
- Torrent

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Understand this

The 'name' of a resource indicates *what* we seek,
an 'address' indicates *where* it is, and
a 'route' tells us *how to get there*.

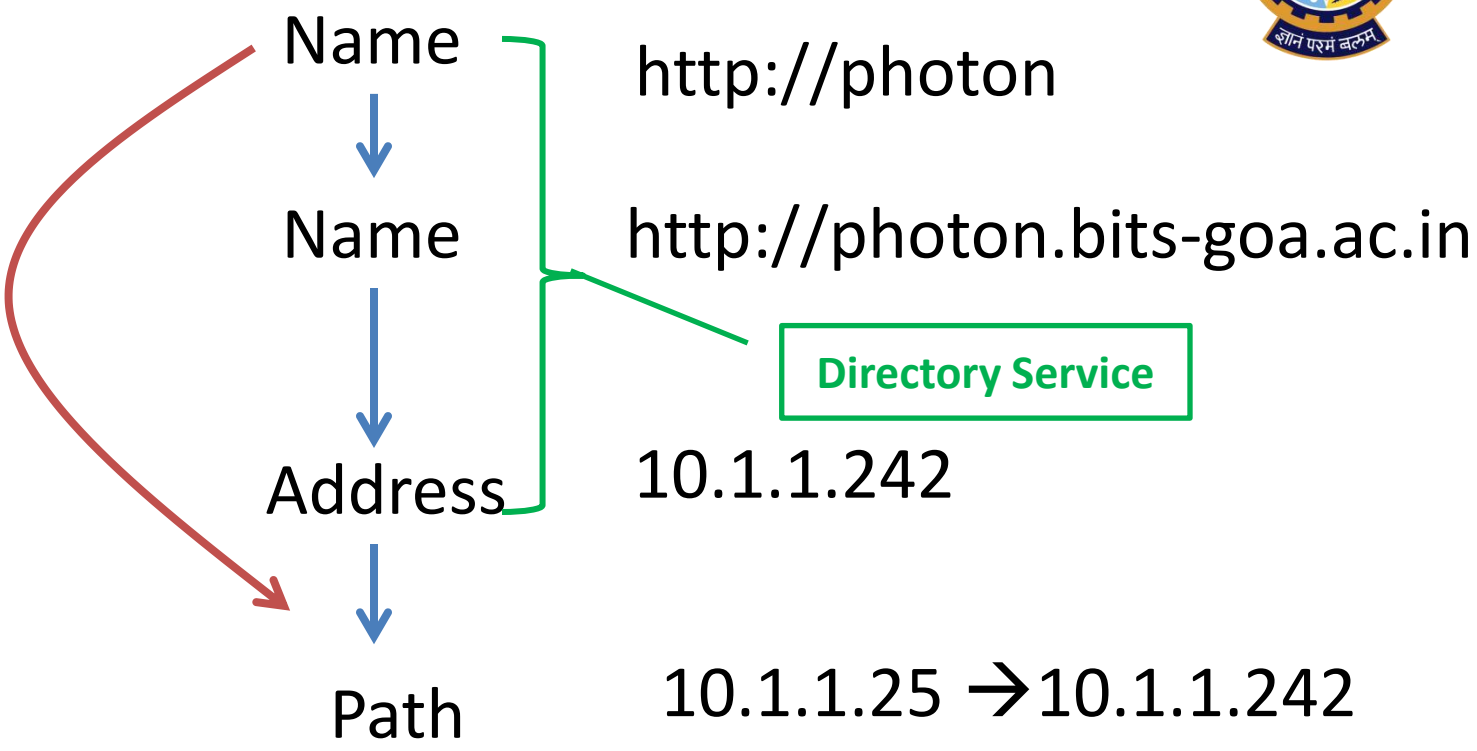
- John F. Shoch,
Internet Experiment Note #19

Implications

a *name* may be used to derive an *address*, which may then be used to derive a *route*.

A name at one layer may generate a route at a lower layer.

Mapping



- This translation is possible at the following nodes: user, service, and server/node

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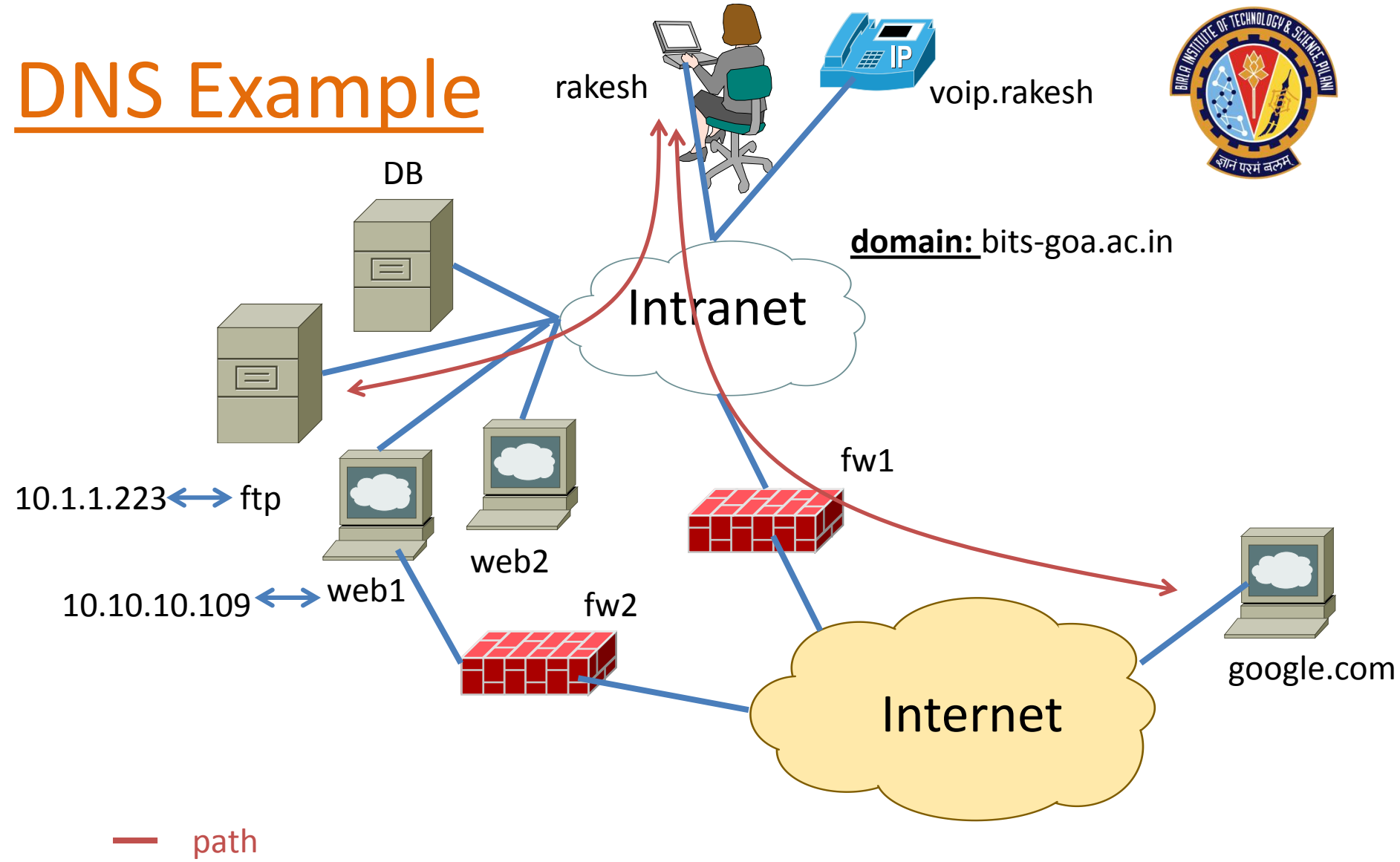
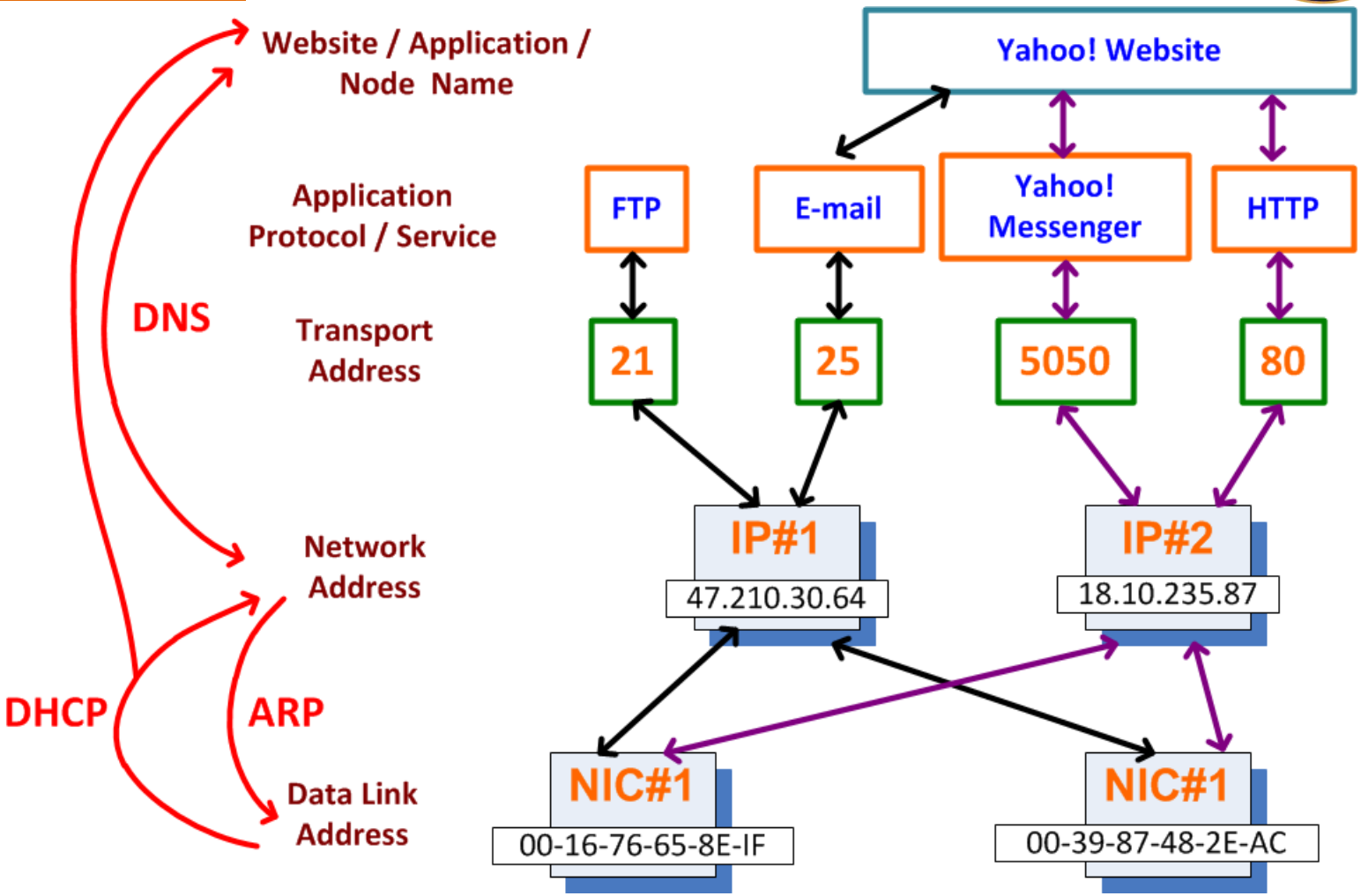
DNS Example


rakesh
IP
voip.rakesh
DB
domain: bits-goa.ac.in
Intranet
10.1.1.223
ftp
web2
fw1
10.10.10.109
web1
fw2
Internet
google.com
path

The Participants According to rfc1498

1. Service and Users.
2. Nodes.
3. Network attachment points.
   - the term "ip address" is an identifier of a network attachment point.
4. Paths.
   - These run between network attachment points, traversing forwarding nodes and communication links.

Names/Addresses Used on the Internet

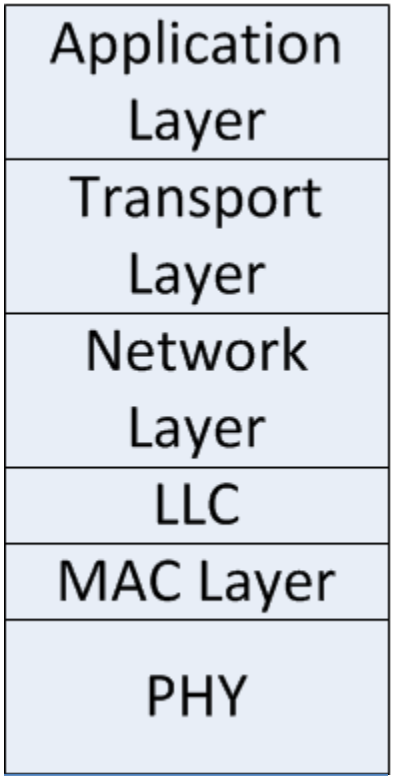


Names and Addresses for Layers

Application Layer	Domain Name
Transport Layer	
Network Layer	IP
LLC	
MAC Layer	MAC
PHY	

Where are the ports??

Names and Addresses at Layer Boundaries



Intended for multiplexing different protocol stacks

What is the scenario for 3G connection??

Ideas from Real World

1. Widgets / Mashups (WebApps) for:
   - User requirements
2. URIs for:
   - Resource and web service descriptions
3. Domain names and extensions for:
   - Servers / Nodes
4. Ports for:
   - Services on a particular server
5. Addresses for:
   - IP, Ethernet and translations
6. Mapping service for:
   - Domain name to IP translation

The Connectivity Scenario

- Service on multiple nodes
- Multiple services on single node
- Nodes with multiple network attachments
- Multiple nodes with same network attachment
- Multiple paths between any two network attachments

*network attachment ~ IP address

Complications With IPv4

- Addresses are no longer globally (spatially) unique locators
  - NAT, Cloud Computing
- Addresses are no longer all temporally unique locators
  - DHCP, Mobile IP

- Multicast and Anycast
- Switching of service providers

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Ideal Scenario

Names (Identifiers) should be assigned at birth, never change, and never be re-used.

Addresses (Locators) should describe the host's position in the network's topology, and should change whenever the topology changes.

Late Binding Idea

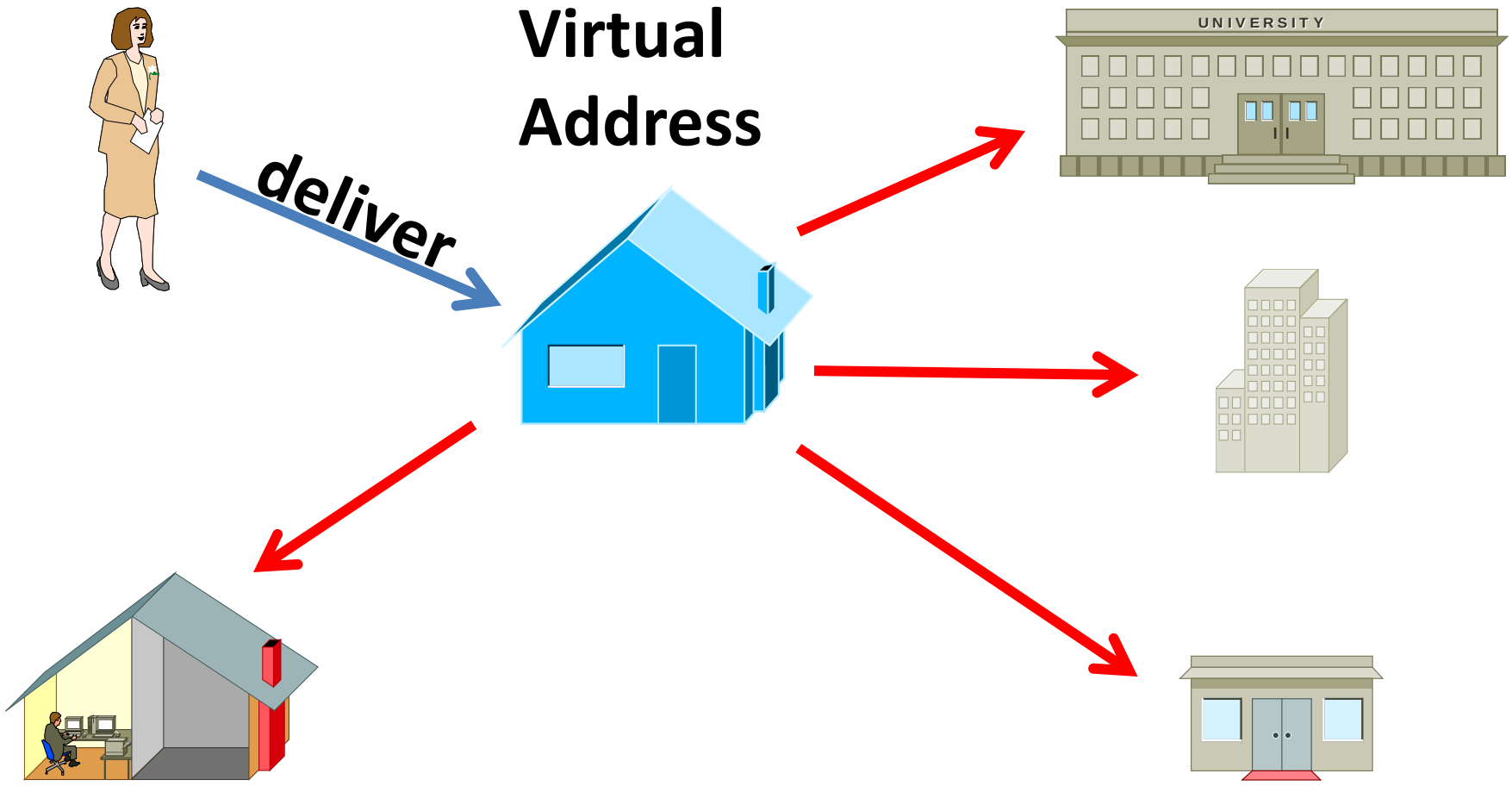
All problems in computer science can be solved by another level of indirection

- David Wheeler

... Except for the problem of too many layers of indirection

- Kevlin Henney

The Indirection Idea



The Indirection Implementation