BBN TECHNOLOGIES

Internet Geolocation and Location-Based Services

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BBN Technologies

IETF GEOPRIV Co-Chair

Emergency Services Workshop Co-Chair

Agenda

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- Drivers for geolocation and LBS
- Collaboration between layers

Evolution of Internet Services

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- Make static content available
- Server-side customization (CGI/PHP/ASP)
- Client-side customization (XMLHttpRequest)
- Context-awareness
  - Geolocation
  - Presence
  - Social networking

Location-Based Services

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- Social networking
  - Loopt, BrightKite, Google Latitude
- Mapping/Navigation
- Asset management
- Place databases

How you get a loc-based service, I

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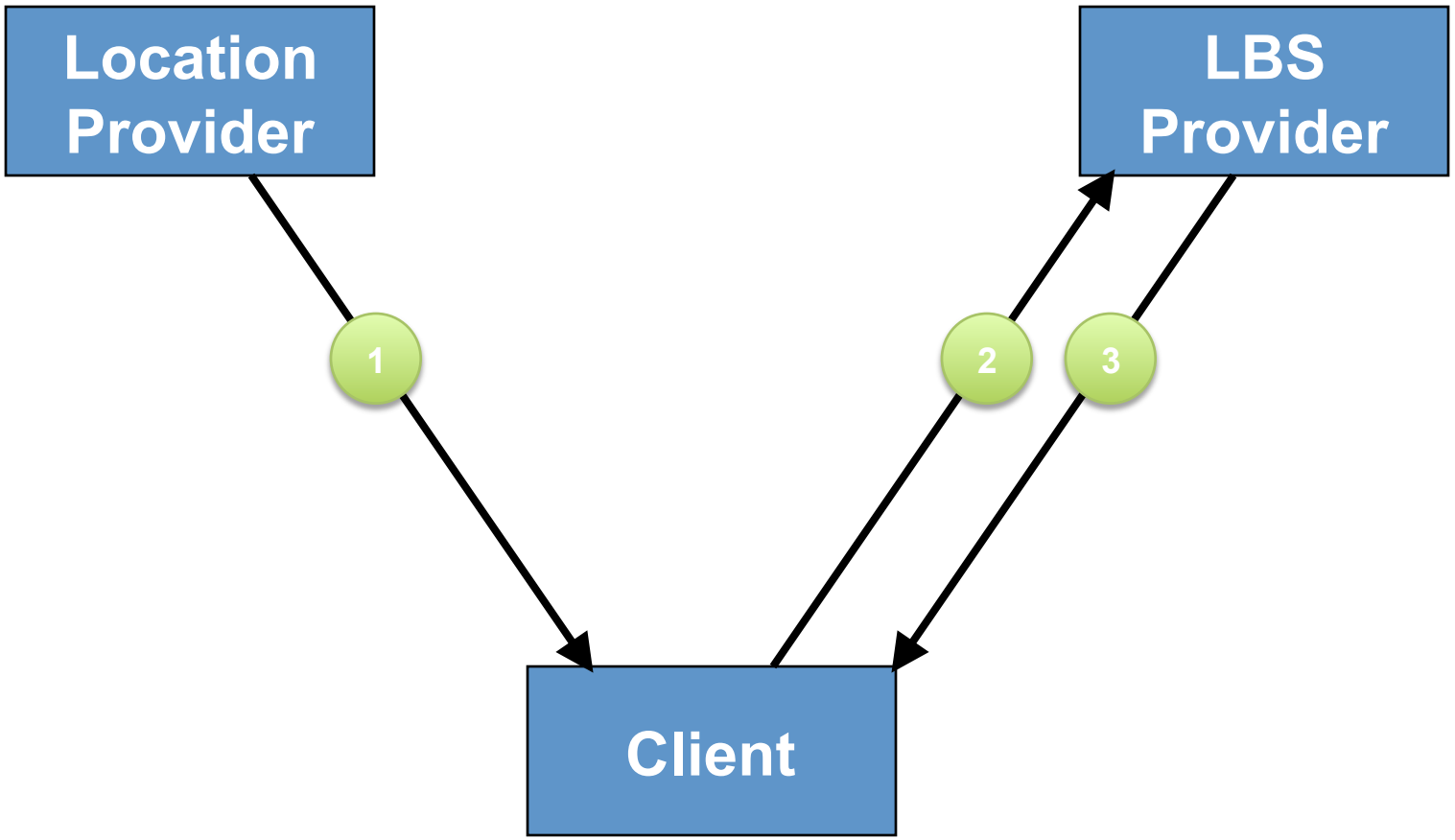

How you get a loc-based service, I

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1. Location Provider provisions a client device with the device's location
2. Client provides location to LBS Provider
3. LBS Provider renders a service (map, nearby coffee, etc.)

How you get a loc-based service, II

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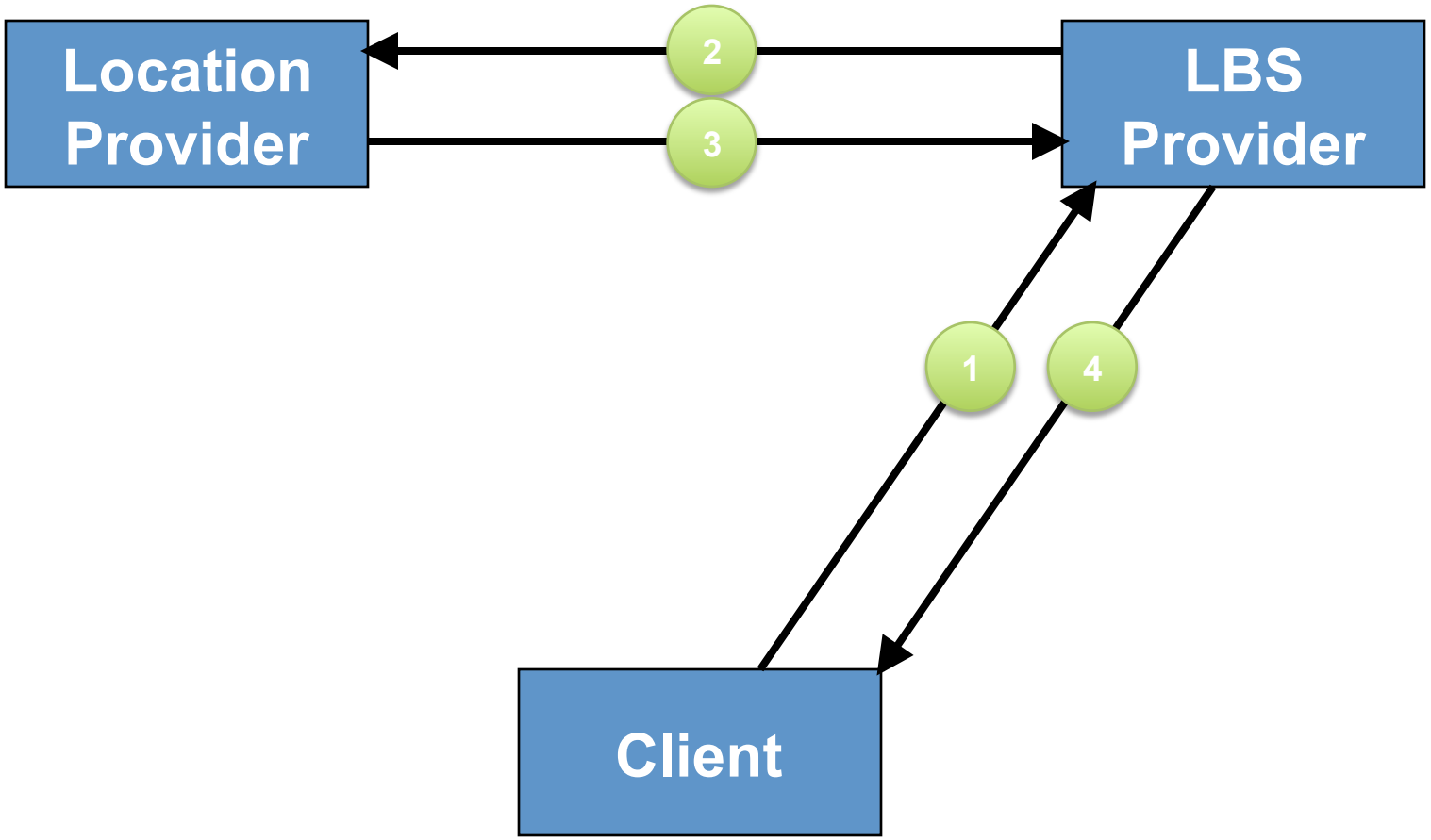

How you get a loc-based service, II

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1. Client asks for a location-based service
2. LBS provider asks Location Provider for the Client's Location
   - Severe scalability risks
   - Severe privacy risks
3. Location Provider returns location
4. LBS provider renders service

VoIP Emergency Calling

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- Calling for help is a critical feature of traditional telephone networks
  - 9-1-1, 1-1-2, 9-9-9, 1-2-2, etc.
- IP telephony needs to re-create this function
- Location of the caller is critical
  - To route the call to the proper responders
  - To dispatch responders to the caller
- **Emerging regulations are starting to require that ISPs provide location to customers and/or emergency authorities**

Location in Emergency Calling

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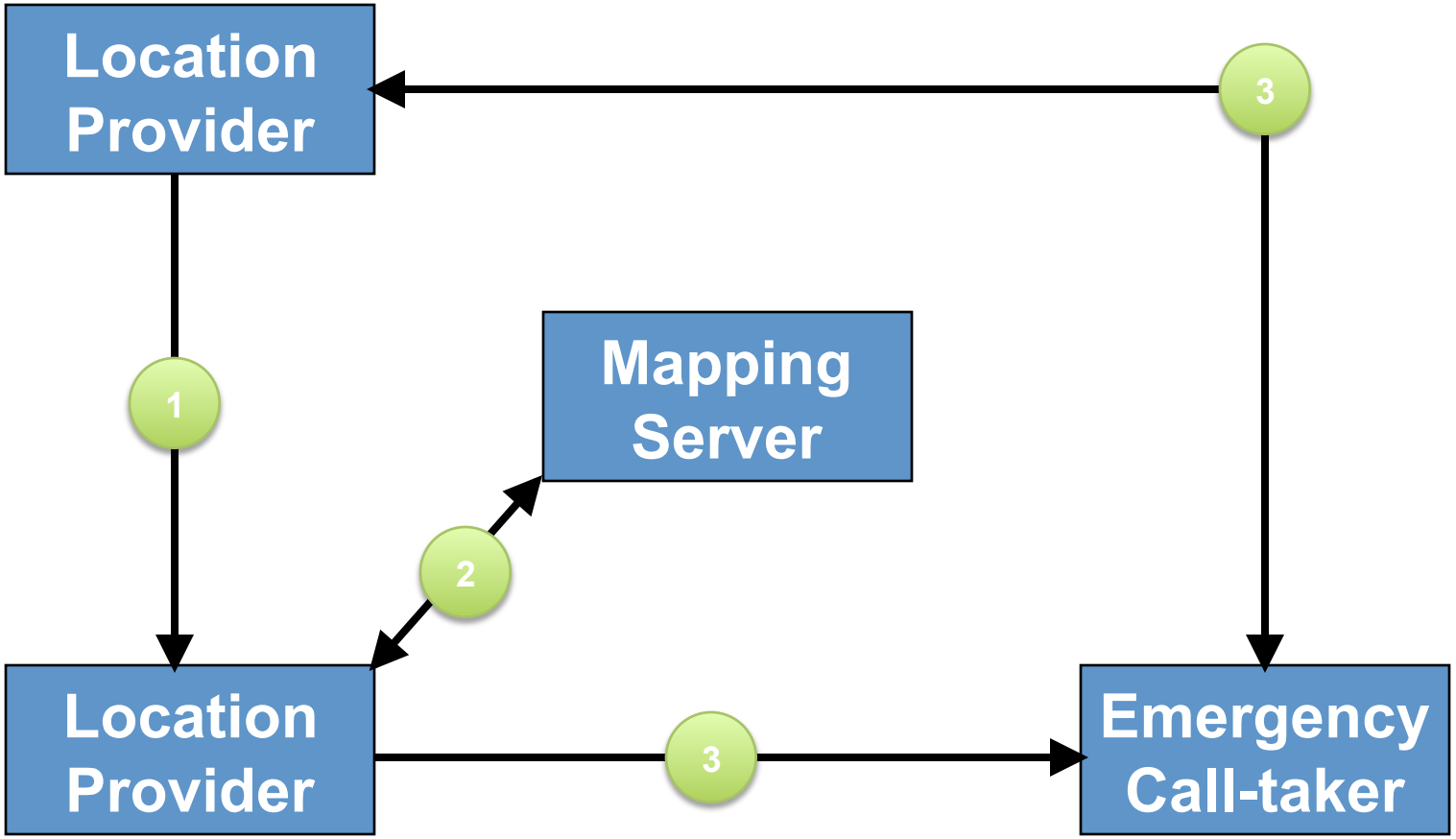

Location in Emergency Calling

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1. Location Provider provisions a client device with the device's location
2. Client uses that information to find what emergency authorities to call
3. Client places a call to the authorities
4. Authorities request updated location from the Location Provider

Drivers for Internet LBS

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1. Commercial
   - Selling access to location information
   - Selling services based on location information
2. Regulatory
   - Emergency calling
   - Public safety applications

Missing Link: Location Providers

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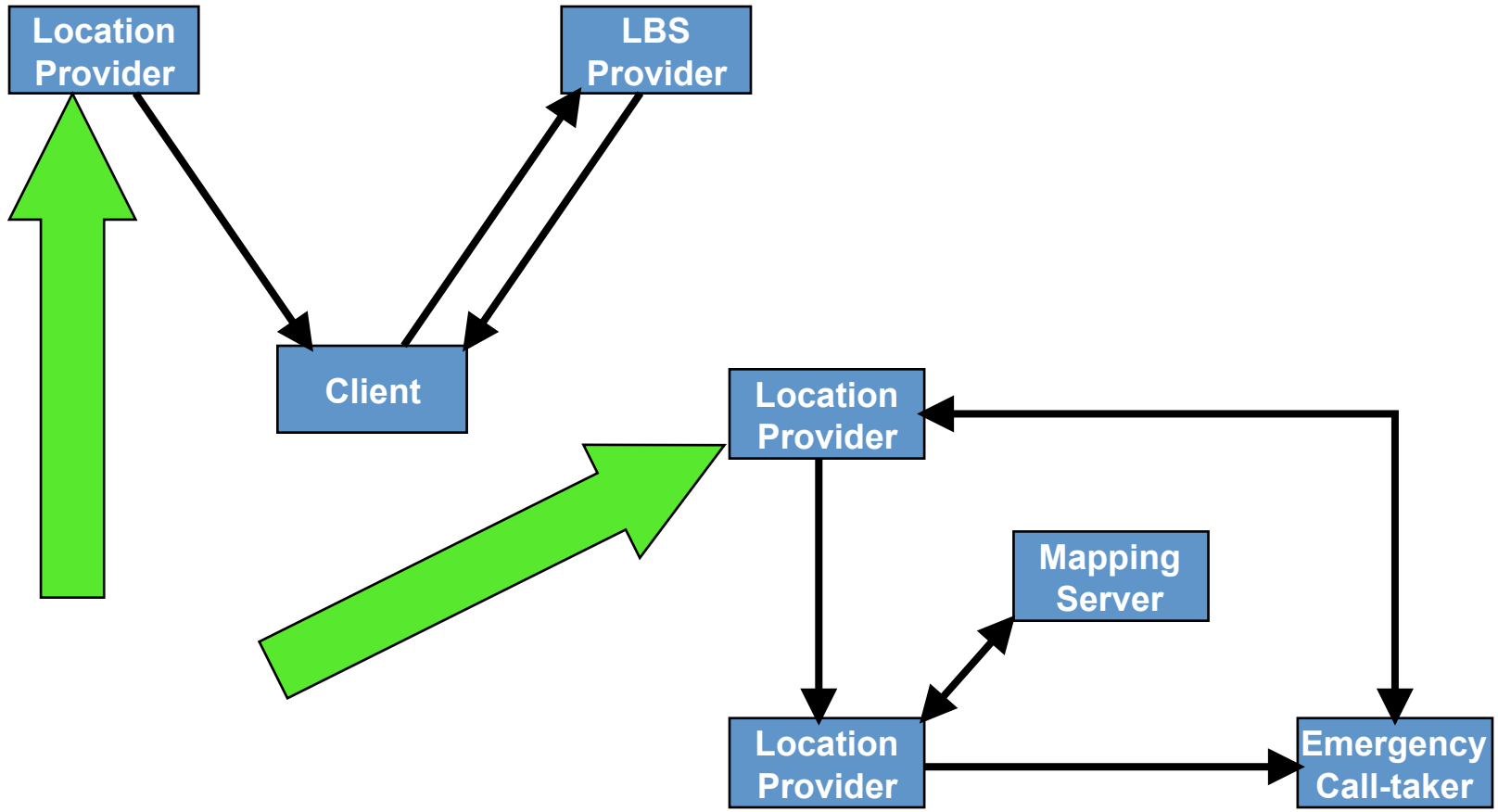

Geolocation in the Layers

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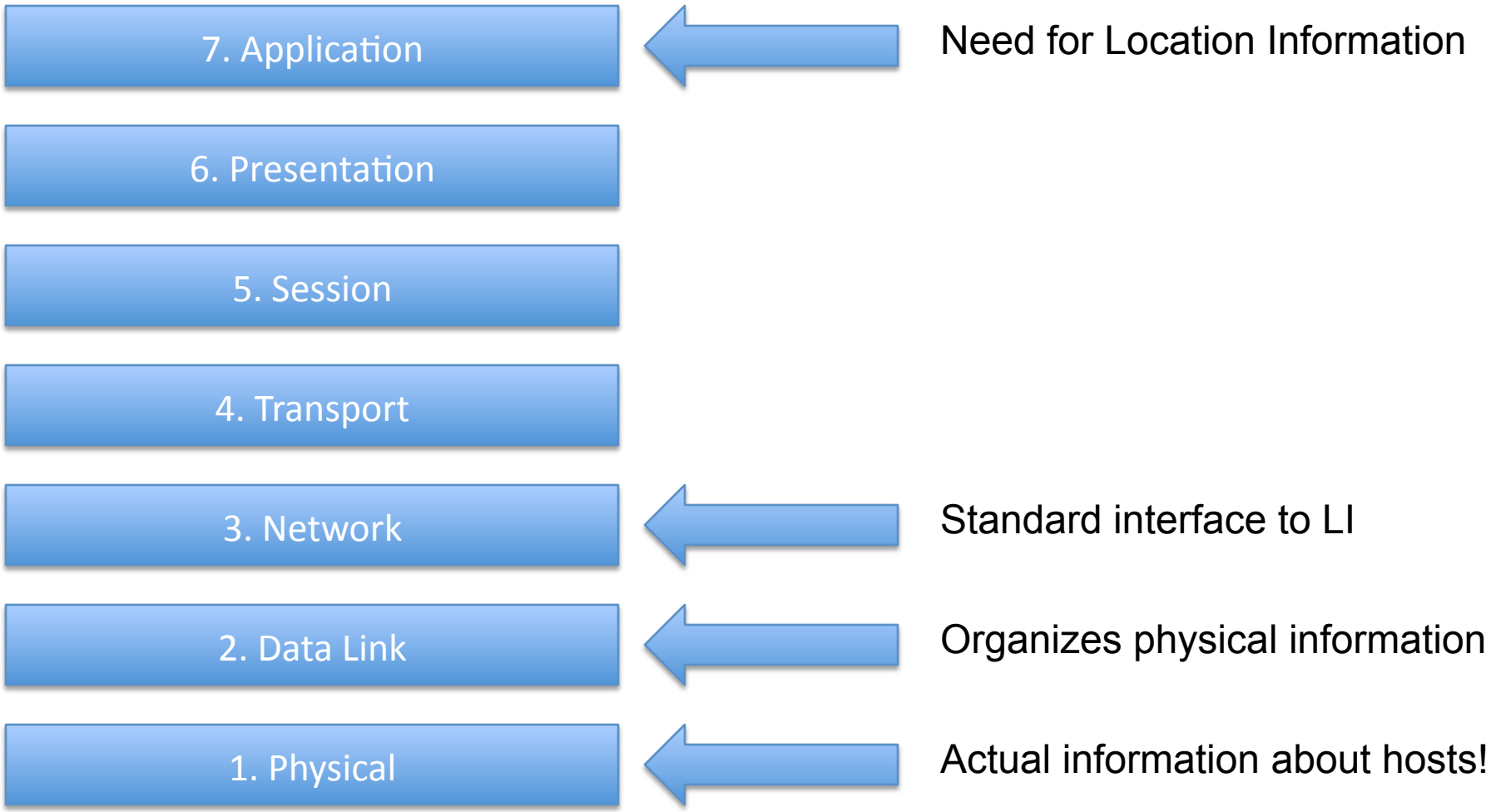

Networks as Location Providers

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- Being a Location Provider is hard for most entities on the Internet
  - Need physical information about the client
  - The Internet purposely ignores the physical world
- However, local networks are in a special position
  - Clients are physically connected
  - Lots of information to draw on
  - Commercial and regulatory drivers

Network Location Resources

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- Wired networks:
  - DSL / FTTx: Service address databases
  - Enterprise networks: Wire maps
- Wireless networks:
  - Base station locations
  - Network measurements
    - Signal strengths from clients
    - Time of arrival of signals
  - Legacy location resources (e.g., GMLCs)

LBS Example

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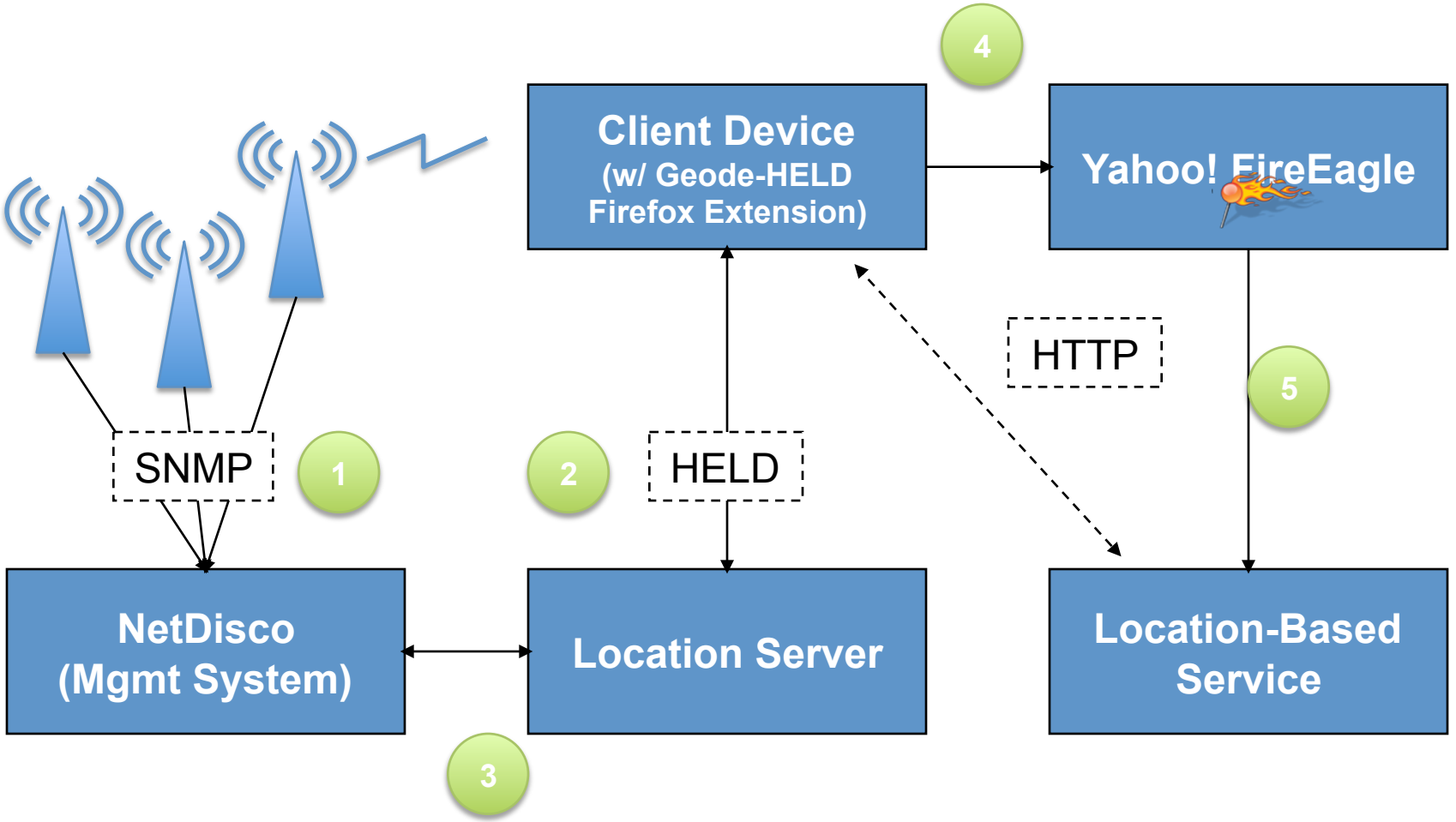

LBS Example

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1. 802.11 APs update the network management system over SNMP with MAC addresses of connected clients
2. Client device queries the LS for location
3. LS queries network management system for location of client's IP address
    1. Management system determines which AP is currently serving that IP address and returns the location of that AP
    2. LS returns location to client
4. Client updates FireEagle with current position
5. FireEagle updates authorized applications

Cross-layer models

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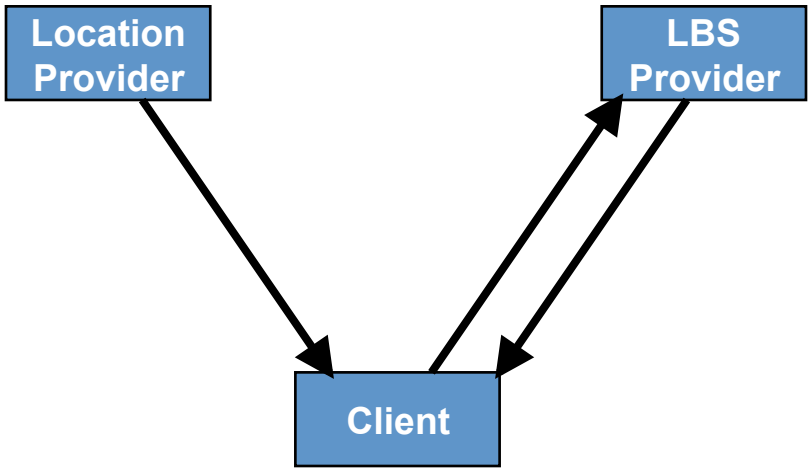
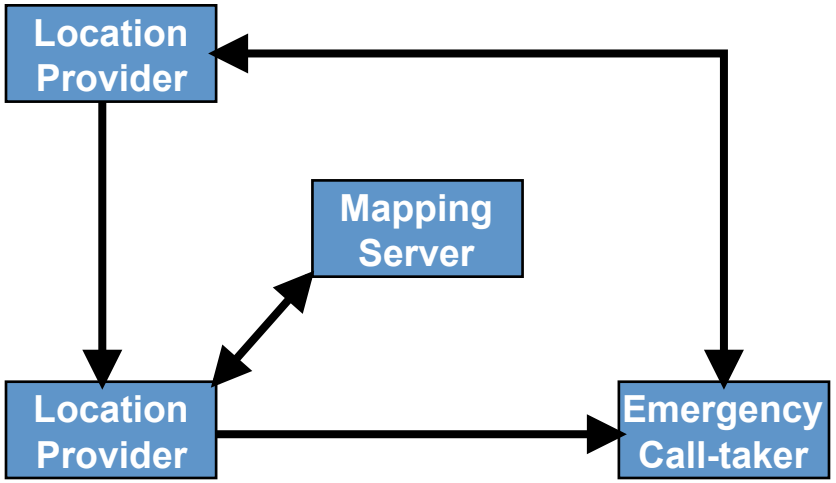
- Network-layer service exposing geolocation from link-layer information
- Direct advertising at link layer





Internet Location Technologies

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- IETF GEOPRIV working group is working on a framework for Internet location services
  - Protocols for positioning and location delivery and conveyance
  - Mechanisms to discover location resources
- DHCP extensions for configuring hosts with location
- HELD protocol supports advanced cases
  - Communication of network measurements
  - Link- and Application-layer target identifiers

Location Server Discovery

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- DHCP: Just add the option
- HELD requires explicit discovery
  - DHCP option for connected endpoints
  - DNS NAPTR records for the rest of the world

```
zonea.example.com.
IN NAPTR 100 10 "u" "LIS:HELD" (          ; service
    "!*.!http://lis.example.com:4802/”    ; regex
    .                                     ; replacement
)
```

Link-Layer Location

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- Several IEEE protocols can now inform clients of their location
- Basic use when local link strongly associated with geolocation
  - Wired and small-scale wireless (802.11)
  - Protocols support more advanced positioning

Link-layer protocols

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- LLDP-MED (802.1AB with TIA extensions) extends link-layer provisioning with geolocation information
- 802.11 extensions
  - 802.11k : AP location broadcast (for AP selection)
  - 802.11v : Location in link-layer configuration
- All use (variants of) DHCP location formats
- Unexplored territory with cellular links

Summary

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- Location information and LBS are becoming major applications in the Internet
  - Commercial and regulatory drivers
- Networks are in a unique position to transform Internet location
  - Accuracy and timeliness
  - Privacy management
- Network and link layers are channels from the physical layer to applications

References

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- Mailing lists
  - IETF GEOPRIV Working Group
  - Location implementors
- Location protocols
  - HELD (discovery), with extensions for positioning:
    - Network endpoint identifiers
    - Network measurements
    - GNSS assistance
  - DHCP for civic and geodetic location, and for location URIs
- Tools
  - Geode-HELD Firefox Extension
  - DHCP Geodetic encoder
  - DHCP Civic encoder
- SIP Location conveyance
- W3C Geolocation API
- XMPP extensions for publishing and requesting location

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Thank you!

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