Daedalus/GloMop Architectural Walkthrough

Daedalus Retreat, Lake Tahoe

June 18-20th, 1996

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Outline

- Motivation and overview
- Core architecture components
- Core architecture walkthrough
  - connection, document retrieval, vertical handoff, document refinement
- Extended architecture components
- Extended architecture walkthrough
  - connection and authentication, vertical handoff, horizontal handoff, dynamic adaptation, load balancing, domain and network services
- Summary, Open Issues

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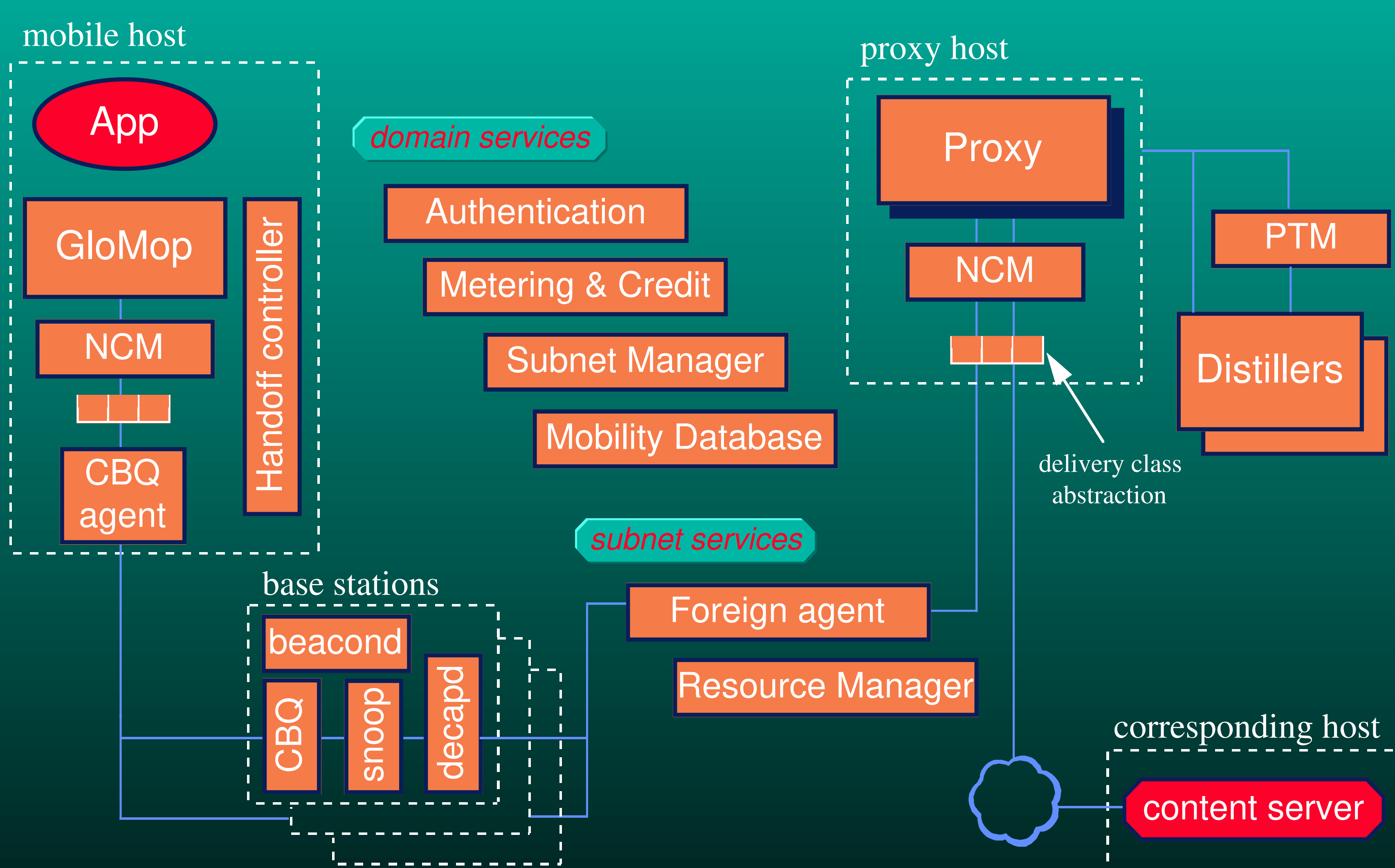
Motivation

- mobility-aware network services
  - seamless roaming (overlay IP)
  - efficiency of protocols and of handoff
- mobility-aware application services
  - dynamic adaptation to variability
  - enable a wide array of client devices
- mobility-aware domain services
  - resource discovery
  - load balancing
  - metering

Challenges

- cohabitate with existing infrastructure
  - Mobile IP, TCP, HTTP, Kerberos, ...
  - justify custom protocols
- a scalable architecture
  - network and proxies should support many clients
- integrable but independent components
  - pieces of the architecture should be able to function on their own
  - integration yields optimization and new capability

The Daedalus/GloMop Architecture



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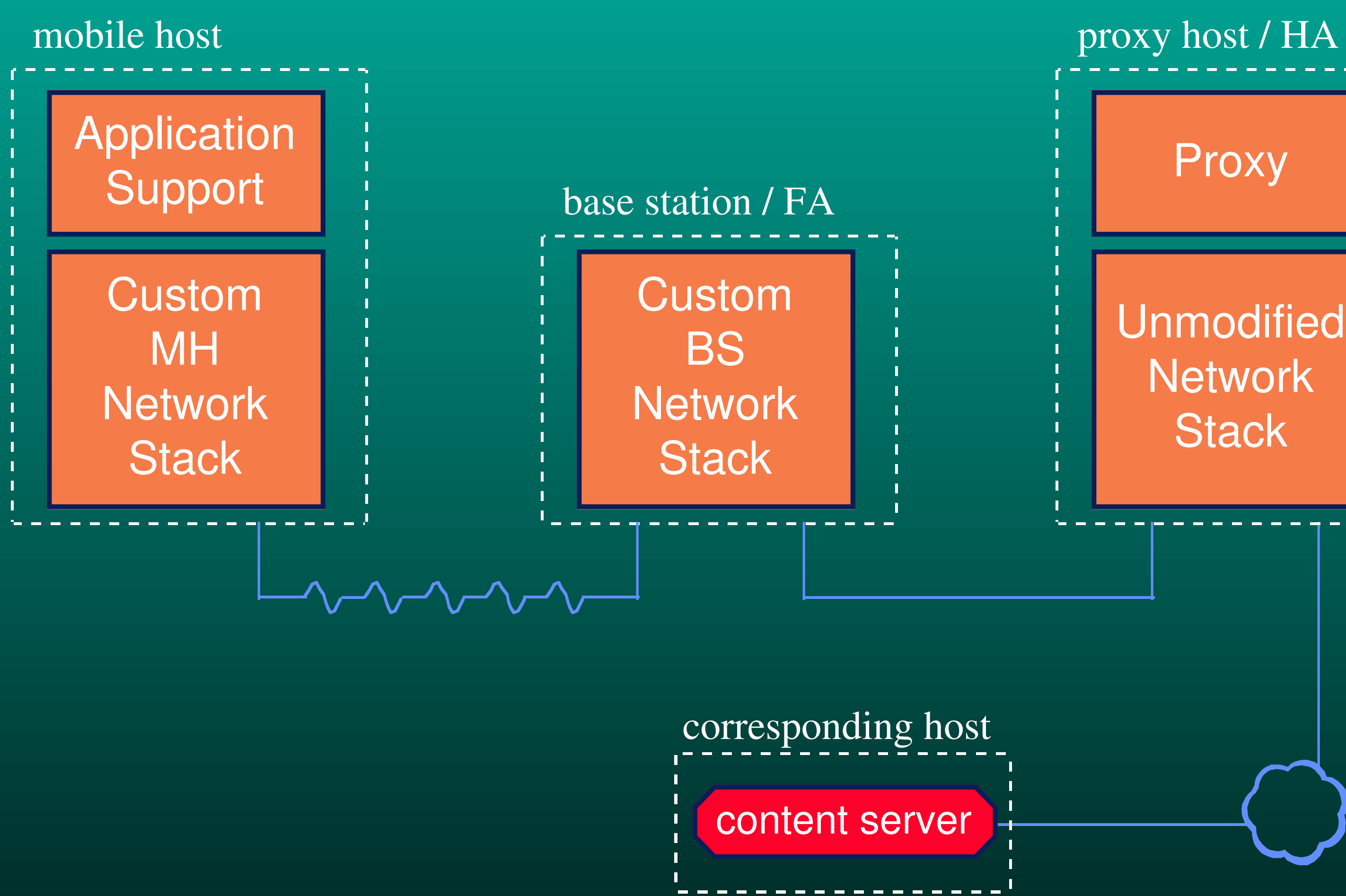

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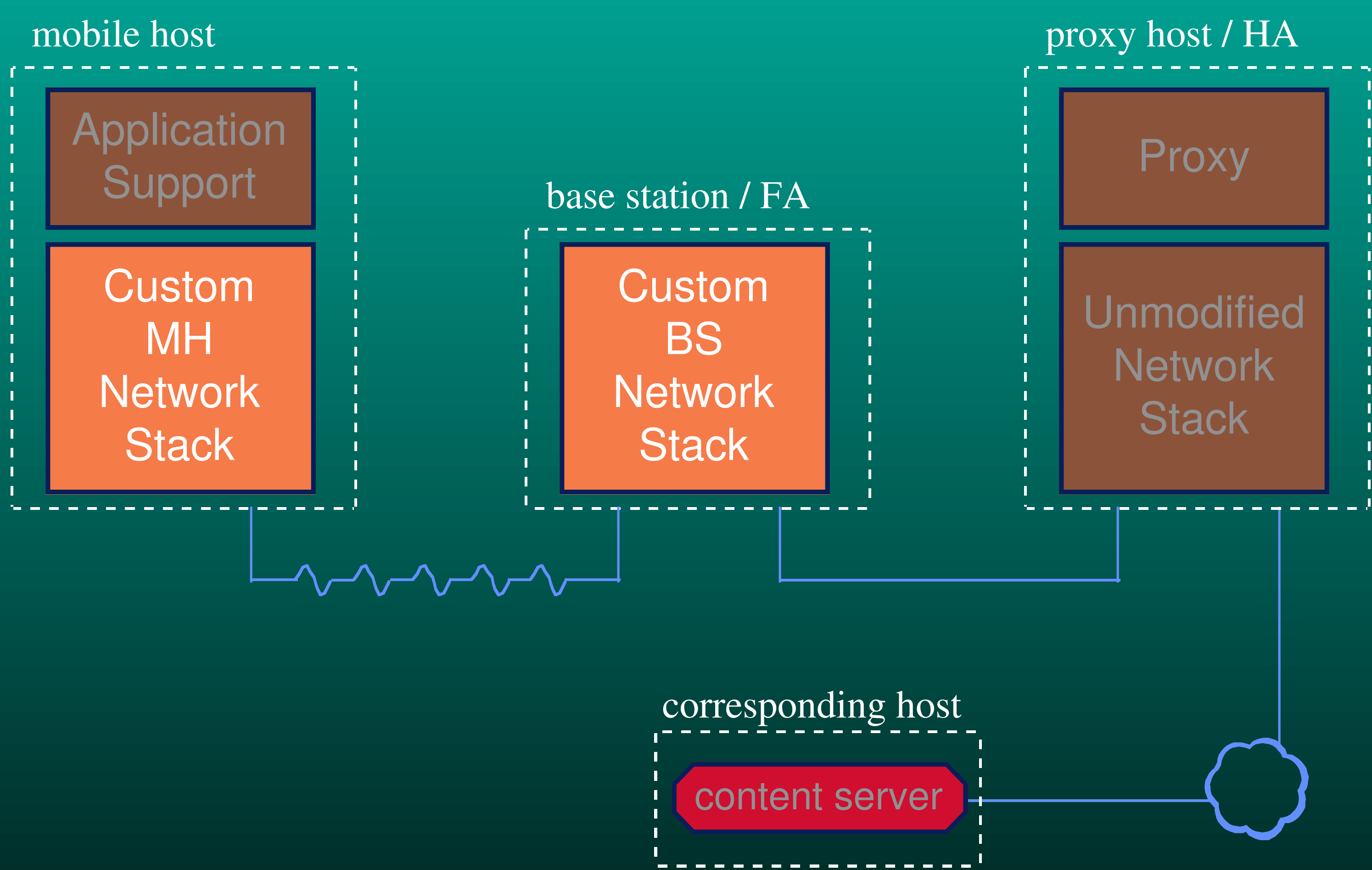
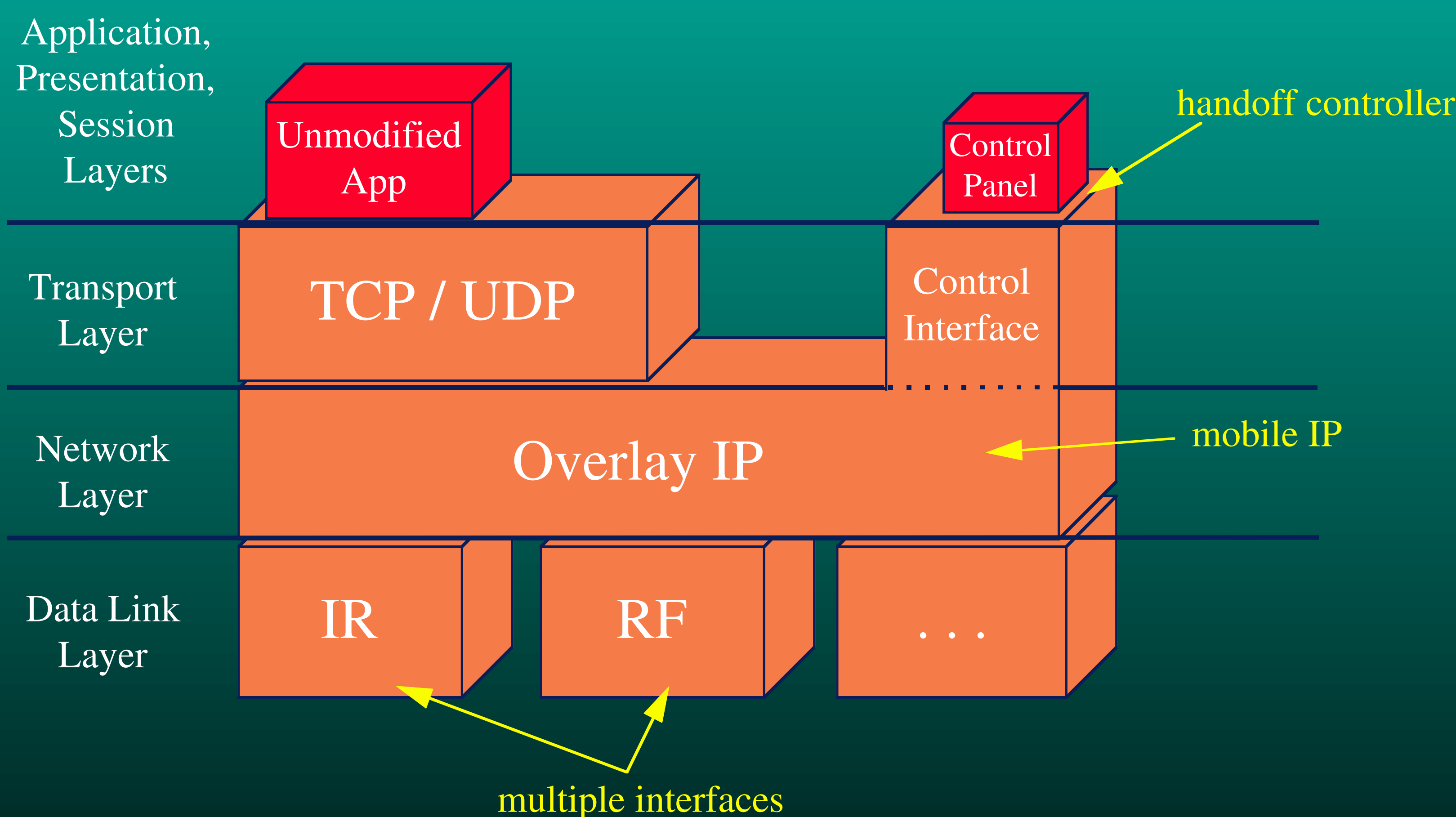
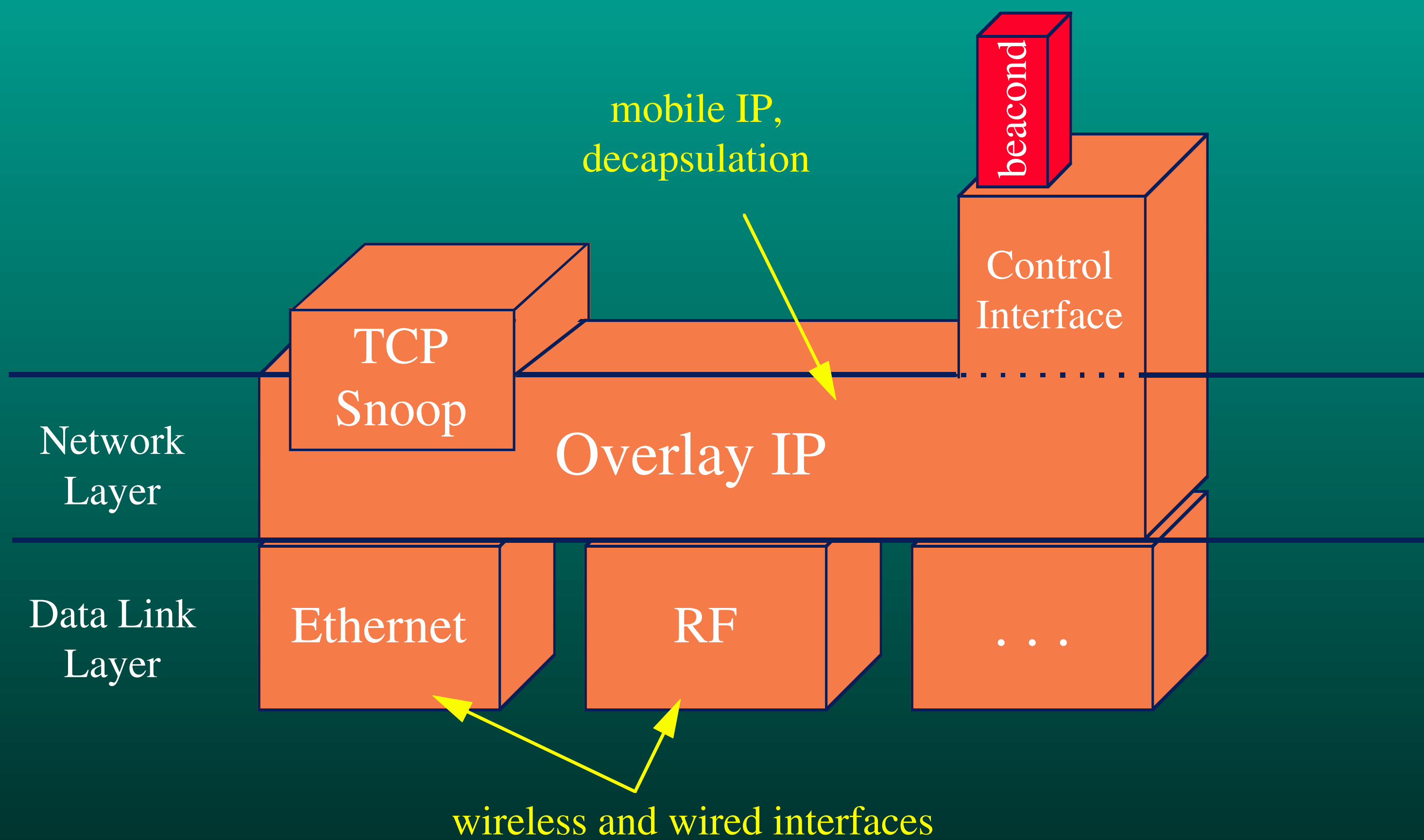


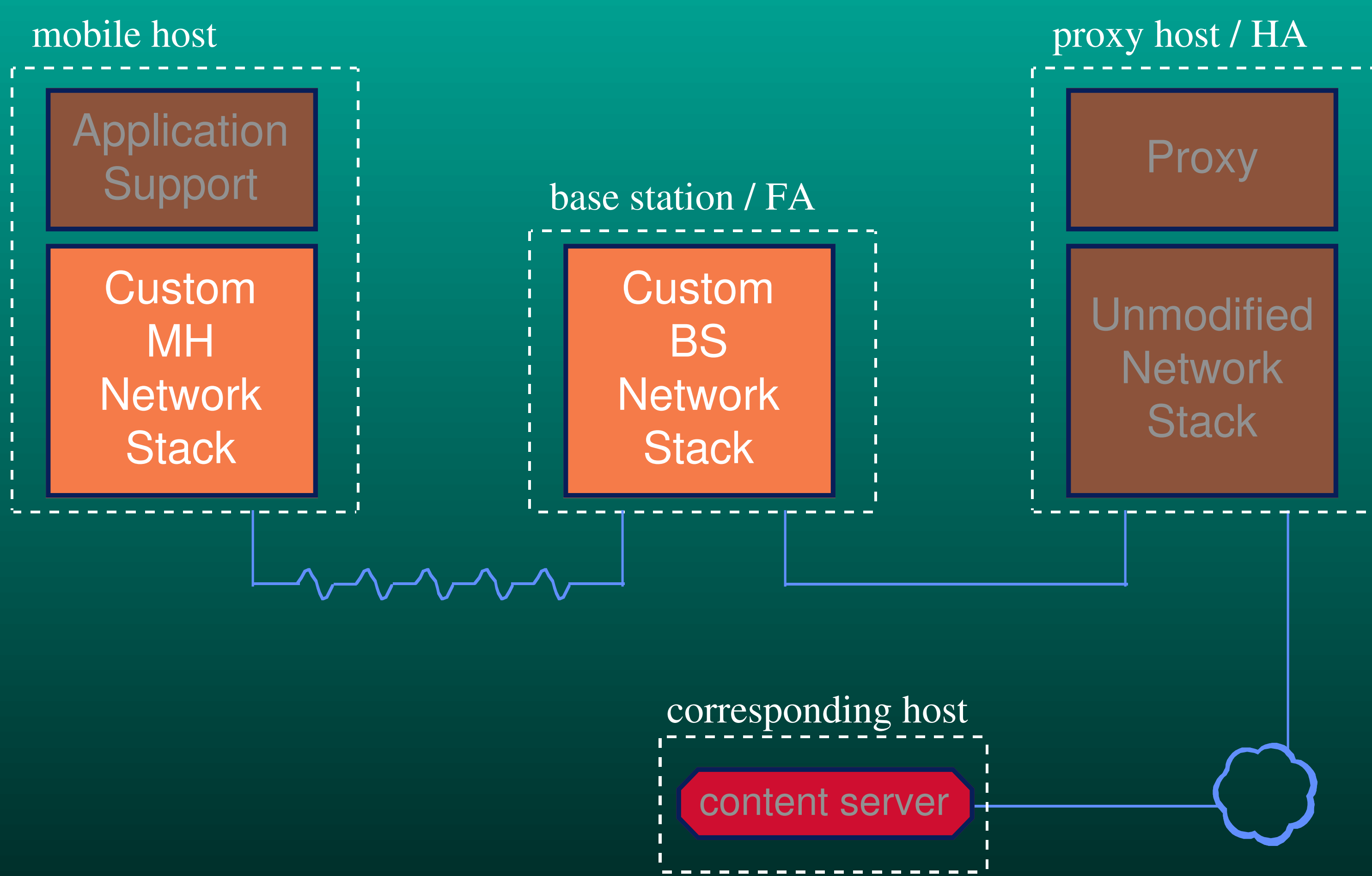
Core Daedalus Mobile Host Components



Core Daedalus Base Station Components



Core Architecture Components



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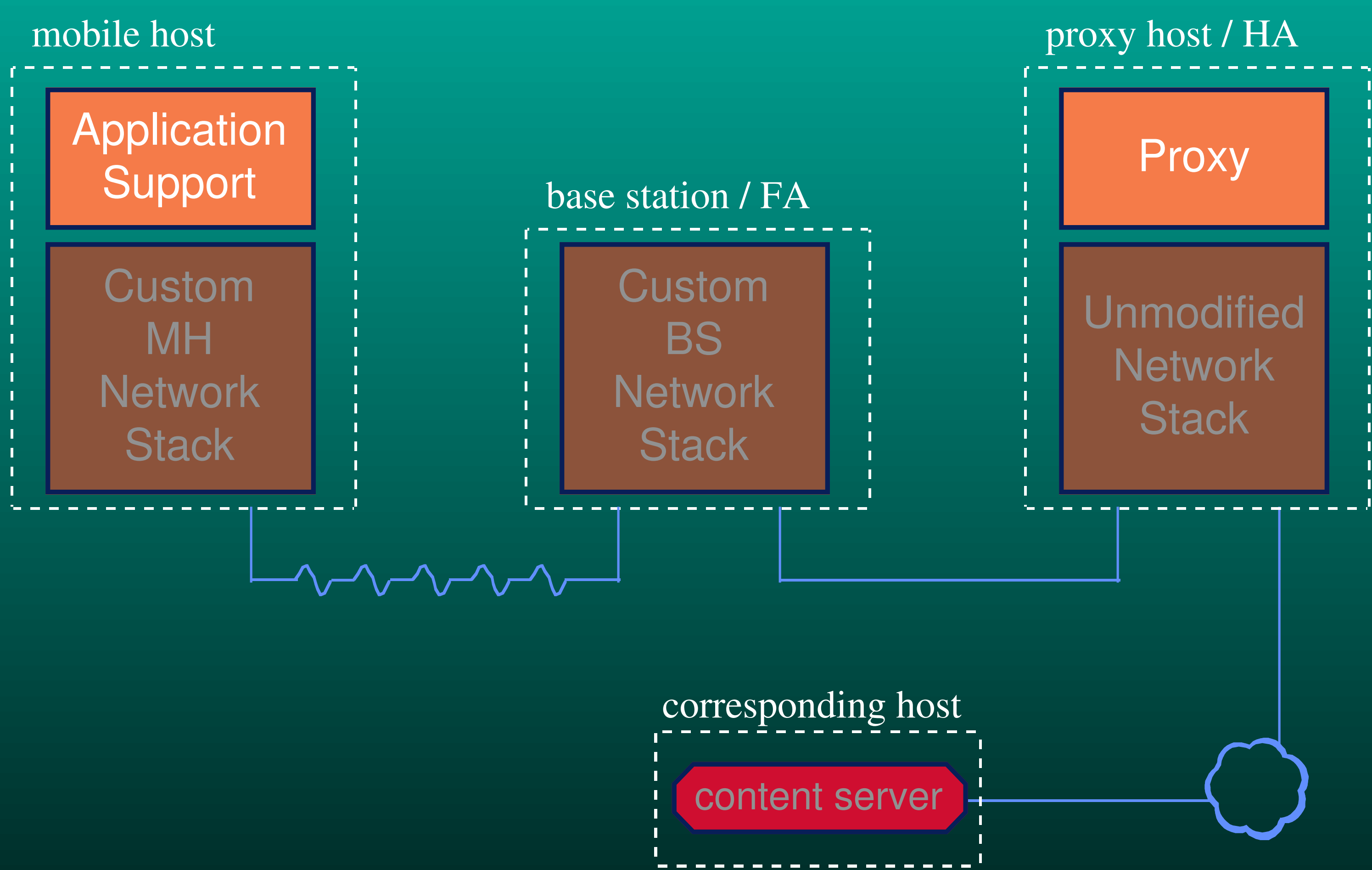
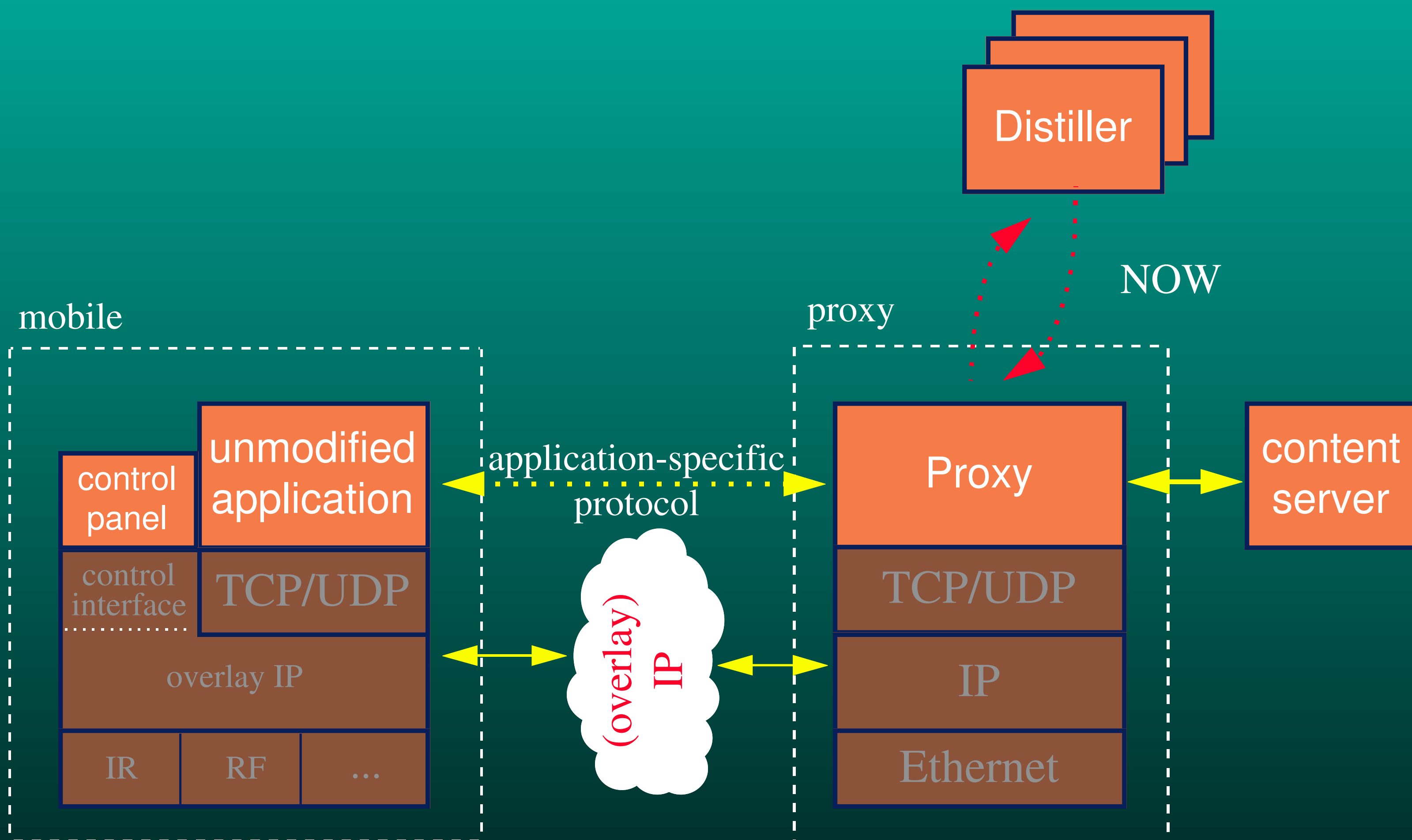


Core Proxy Architecture



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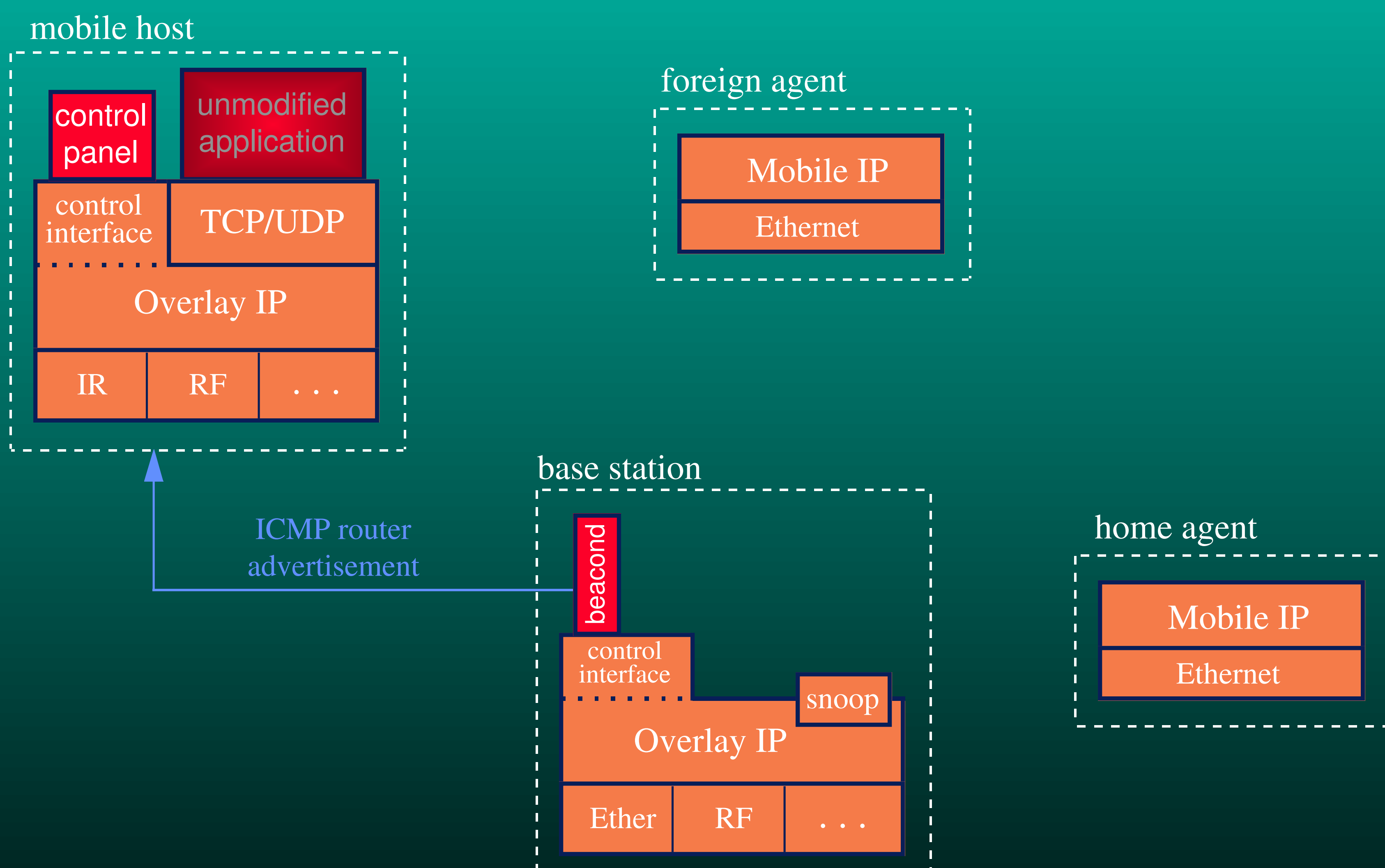
Connecting to the Network
(core architecture - Mobile IP)



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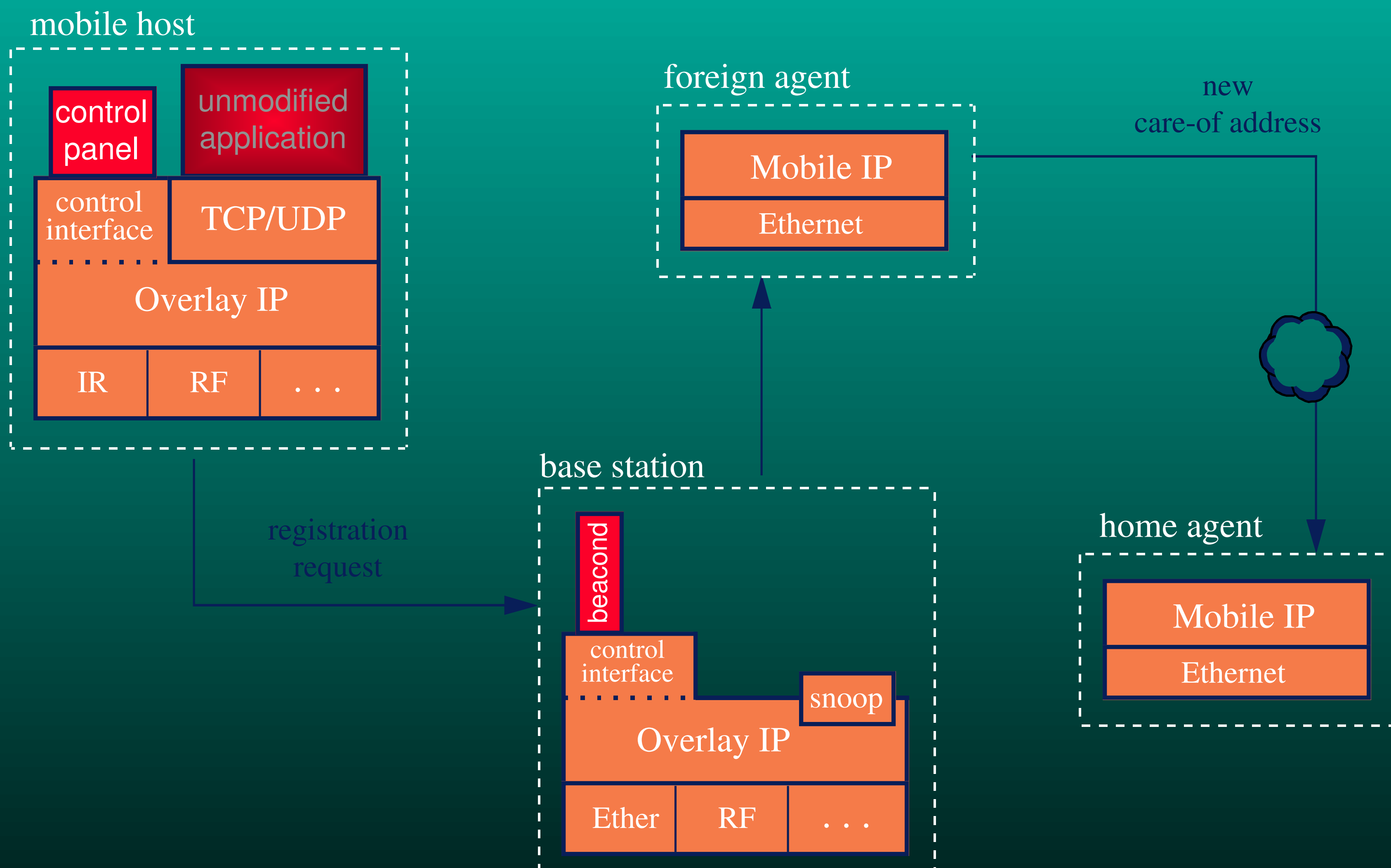

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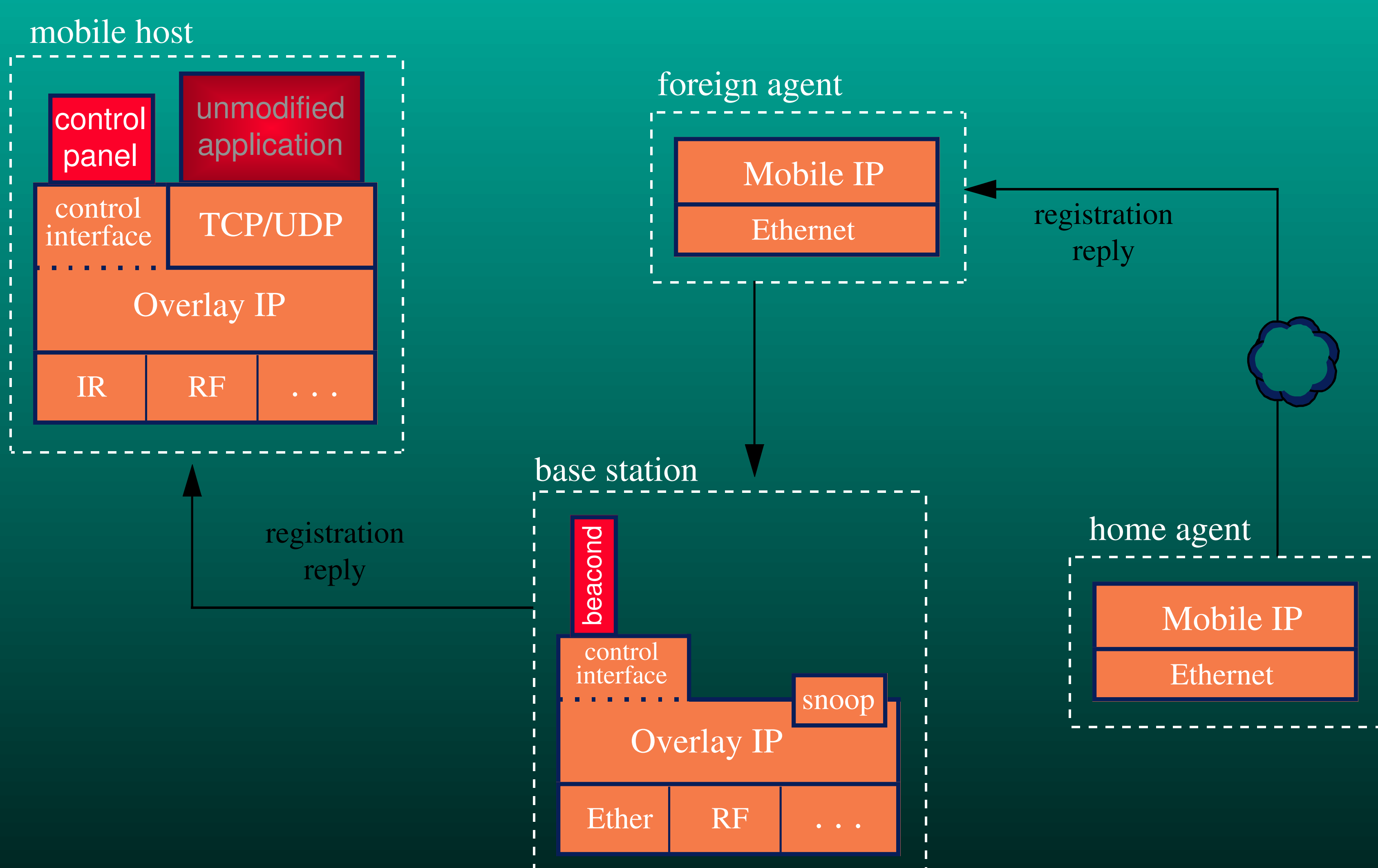
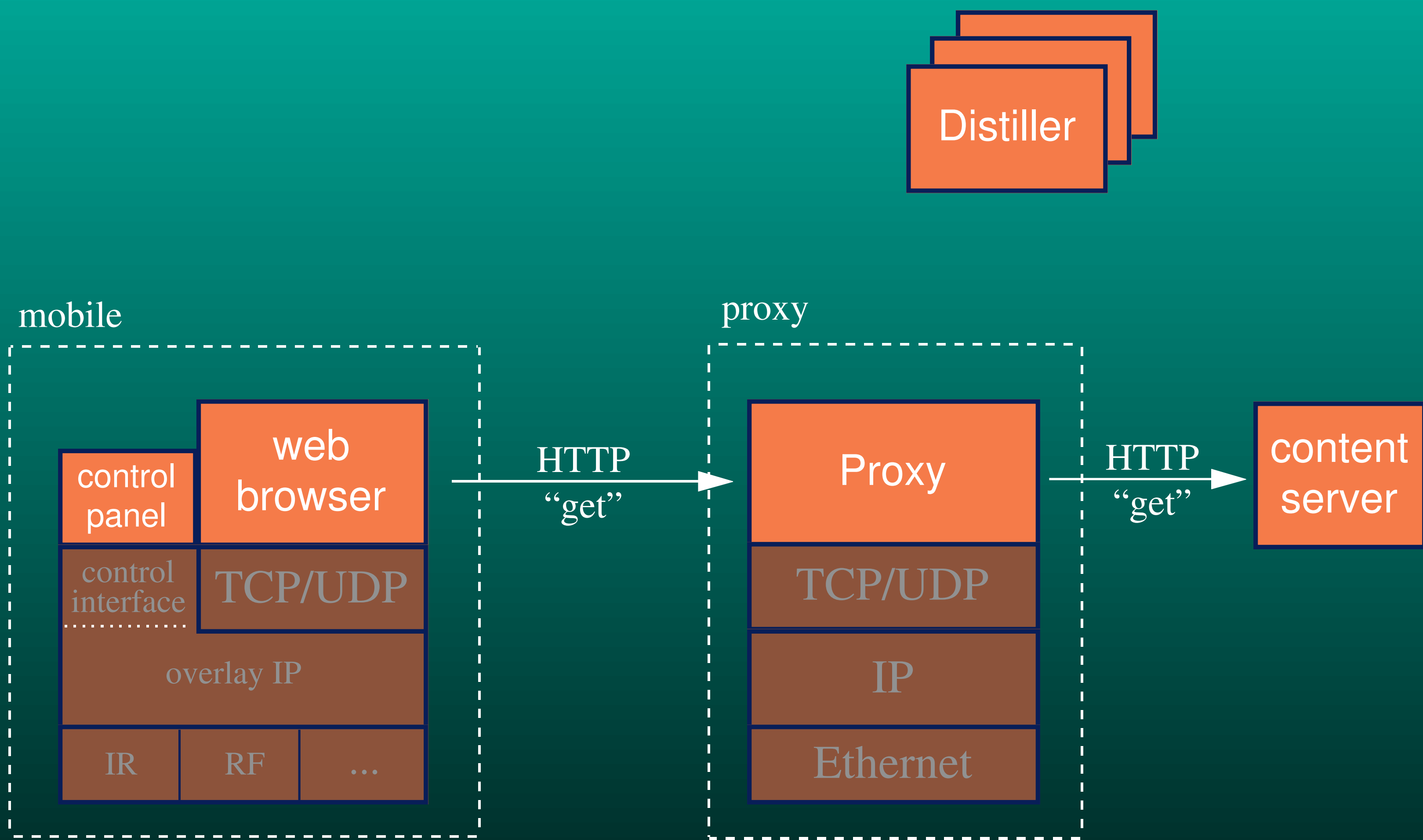
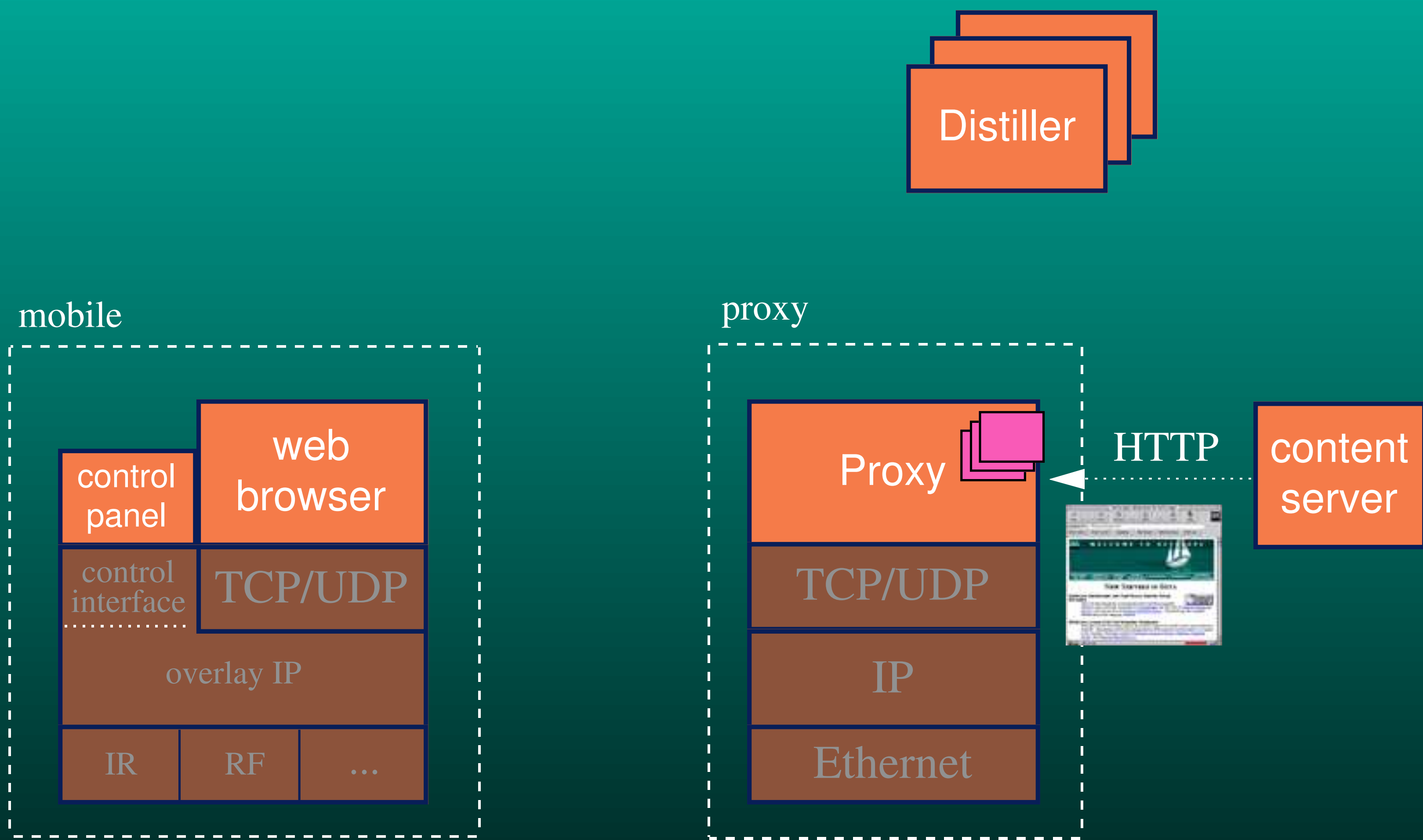


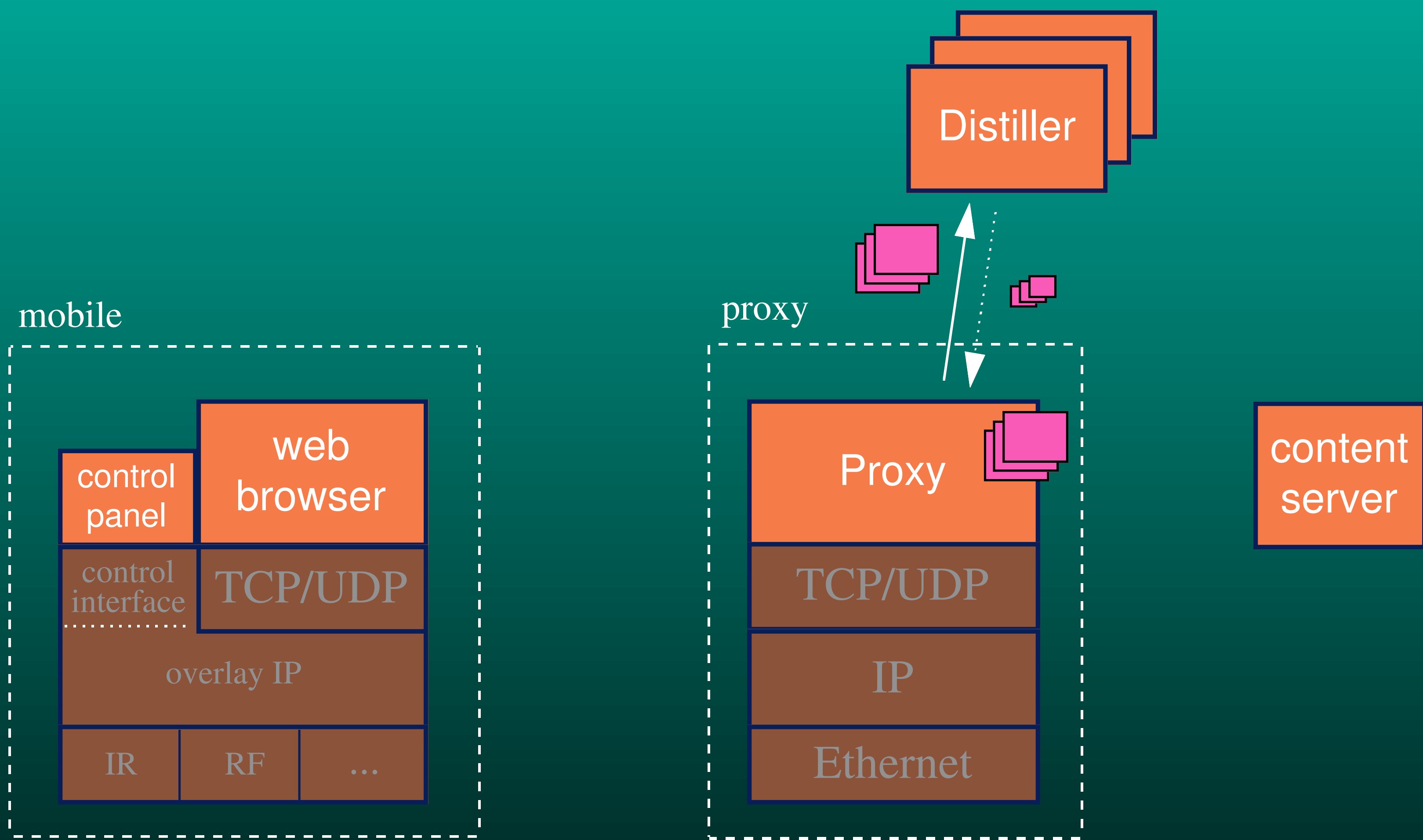
Document Request



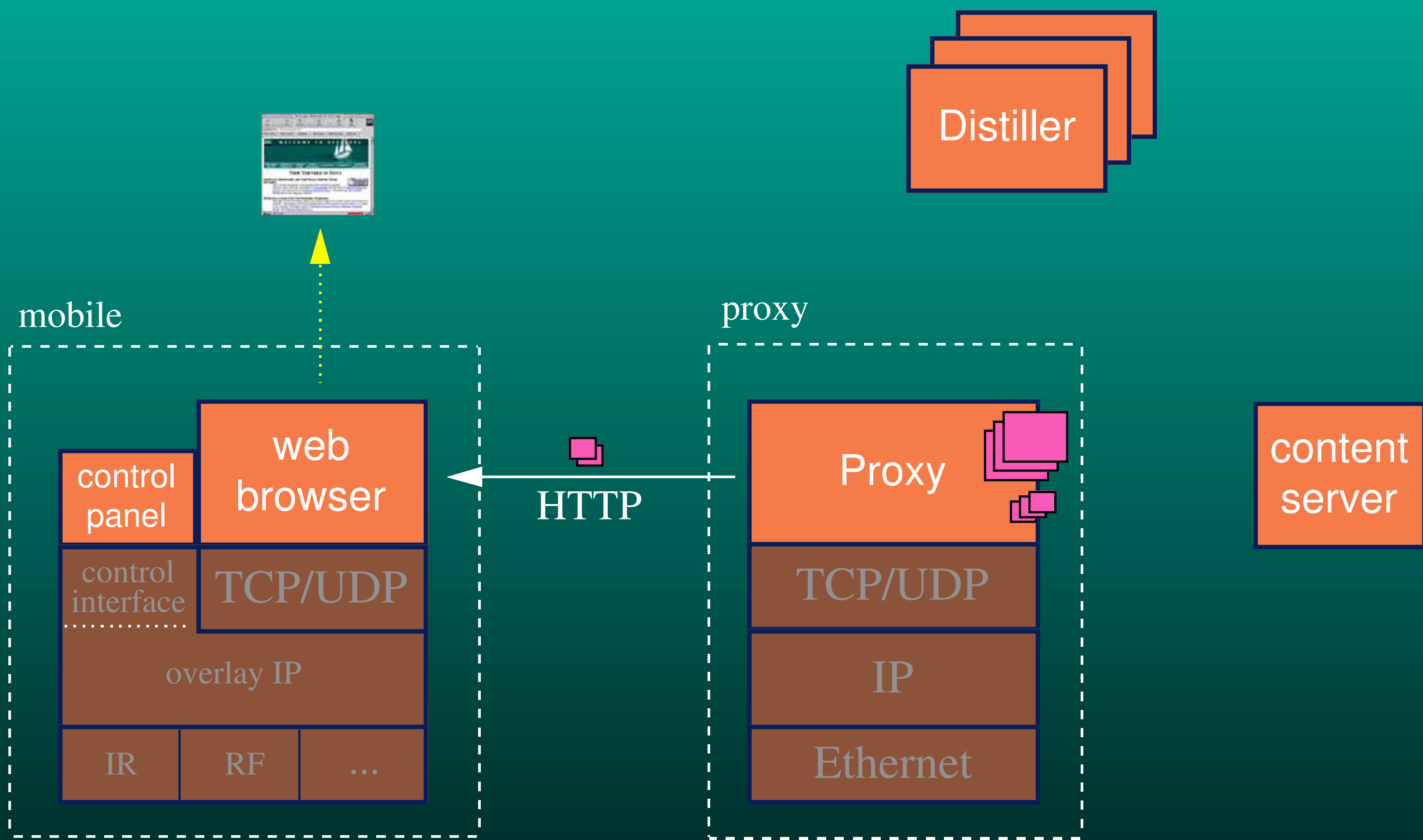
Document Download and 'Chunking'



Distillation

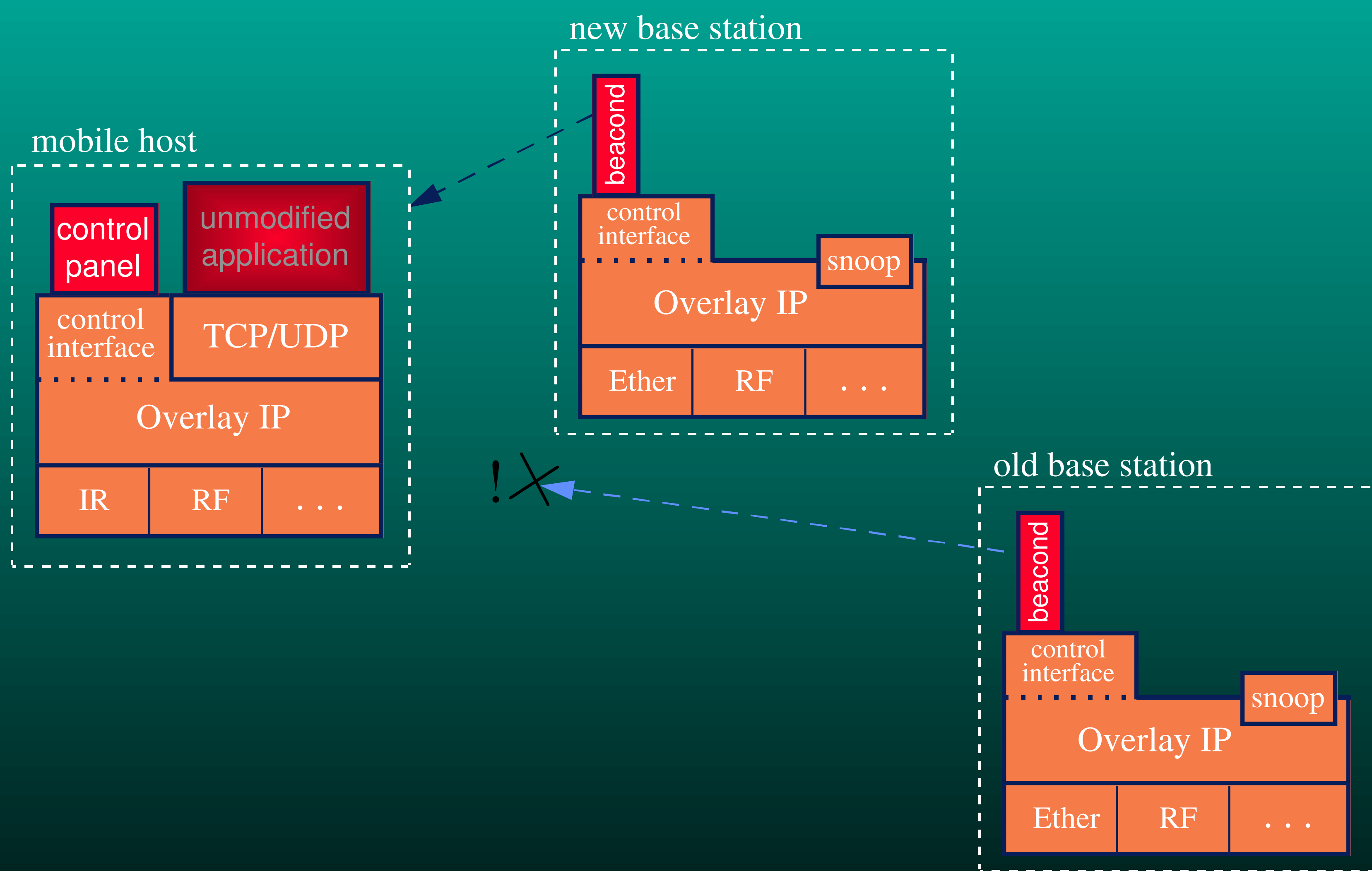


Document Upload

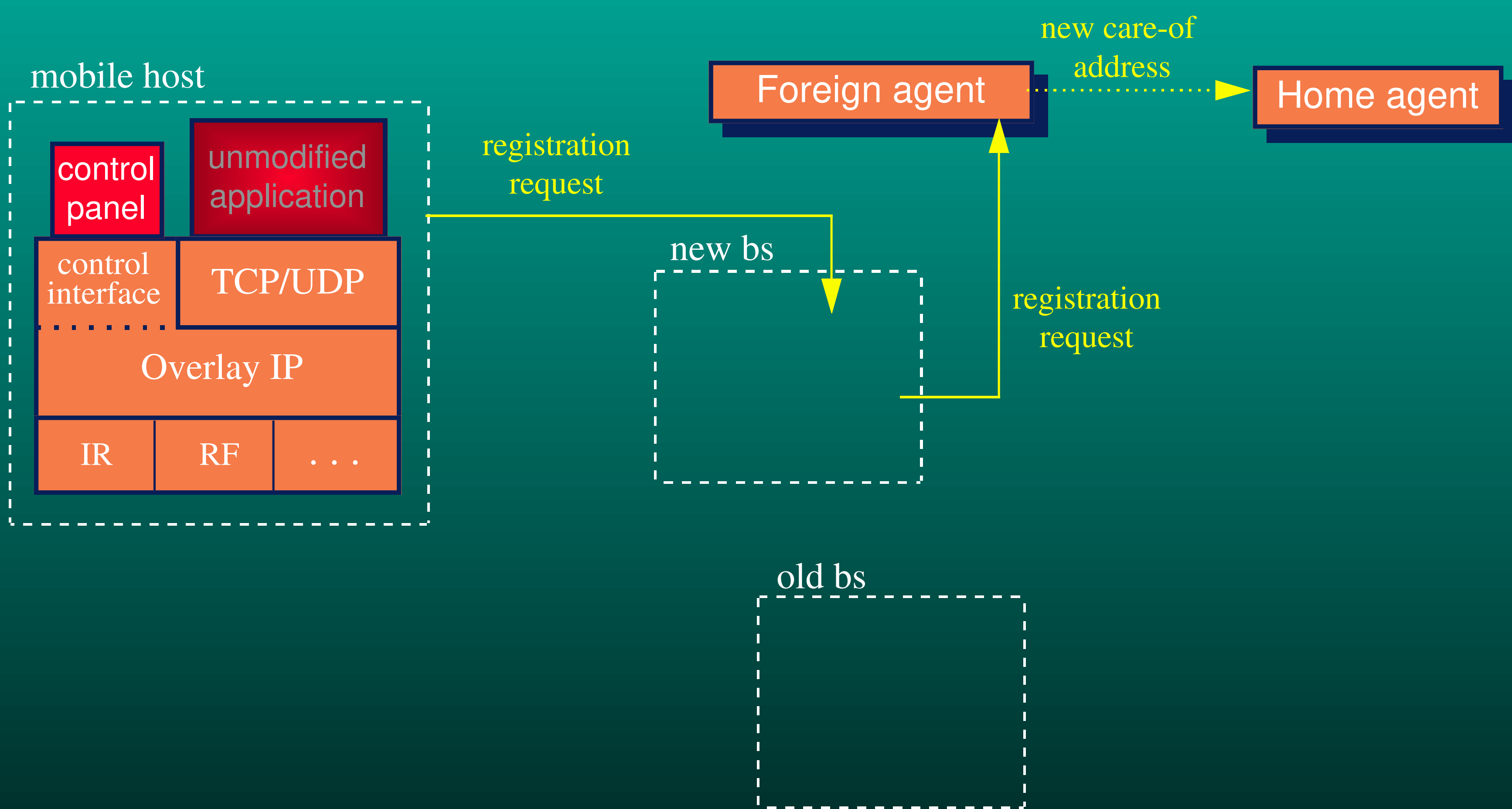


Vertical Handoff from IR to WaveLAN

(core architecture)



Handoff Subroutine
(core architecture)



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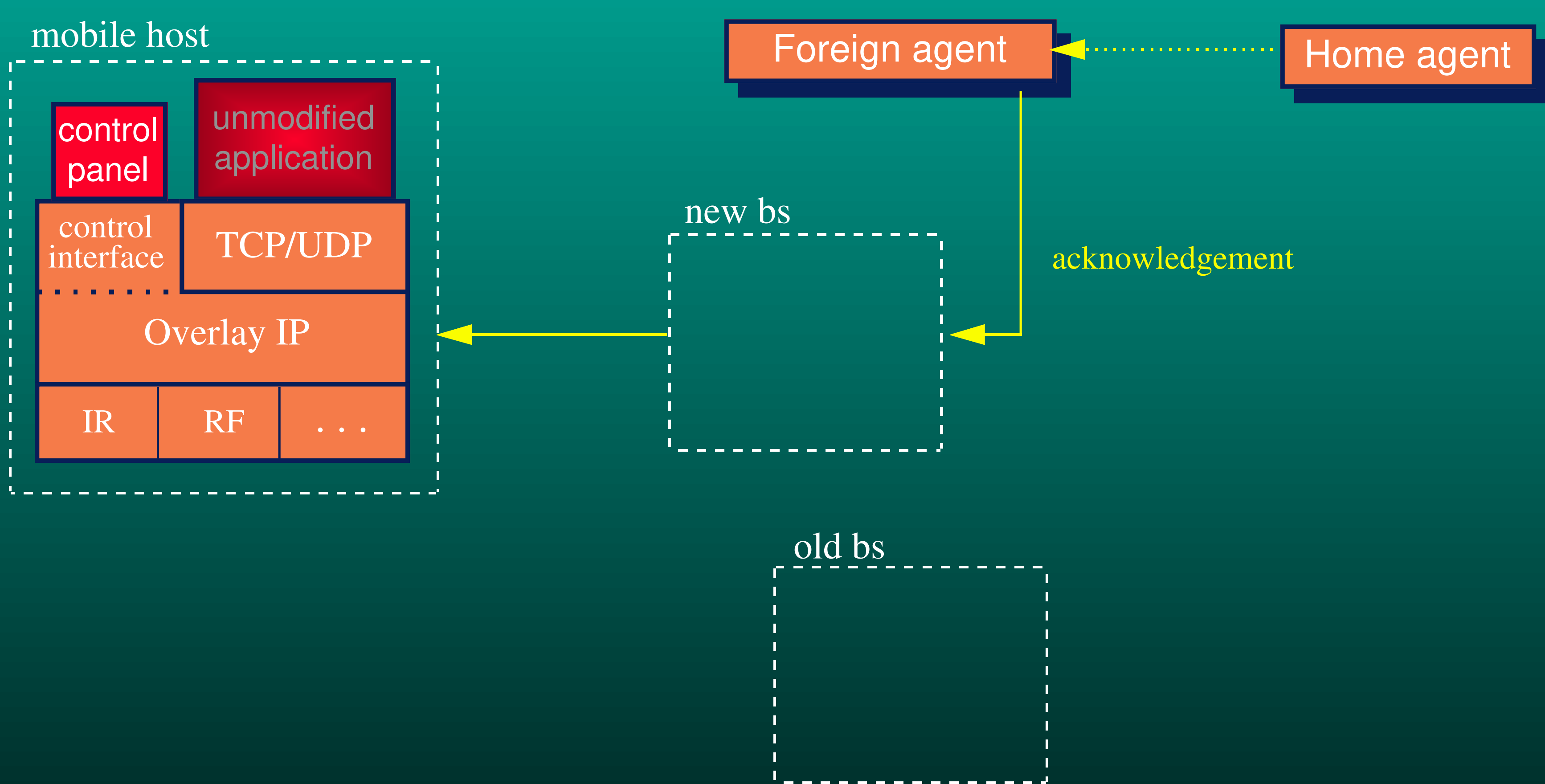

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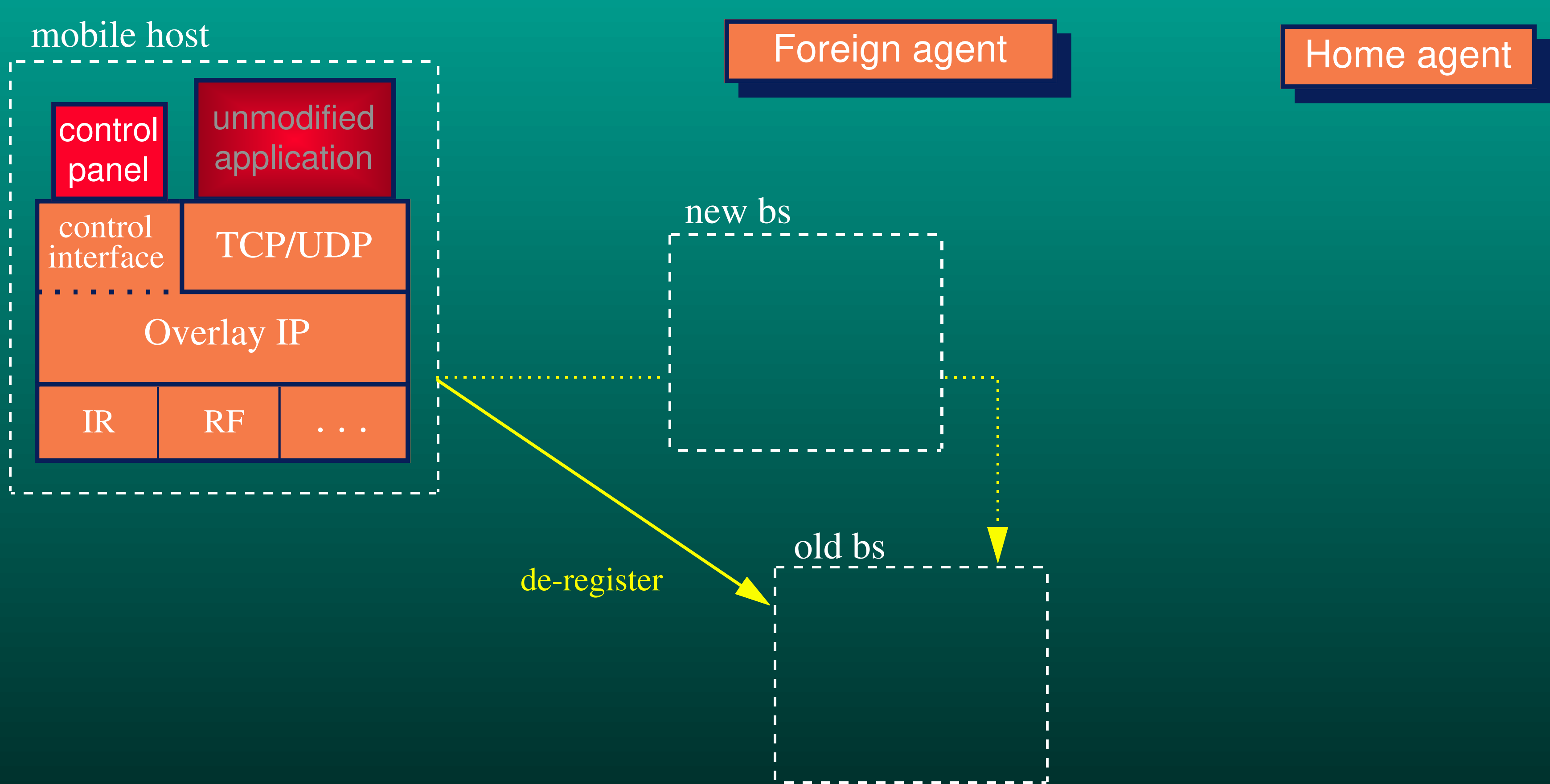
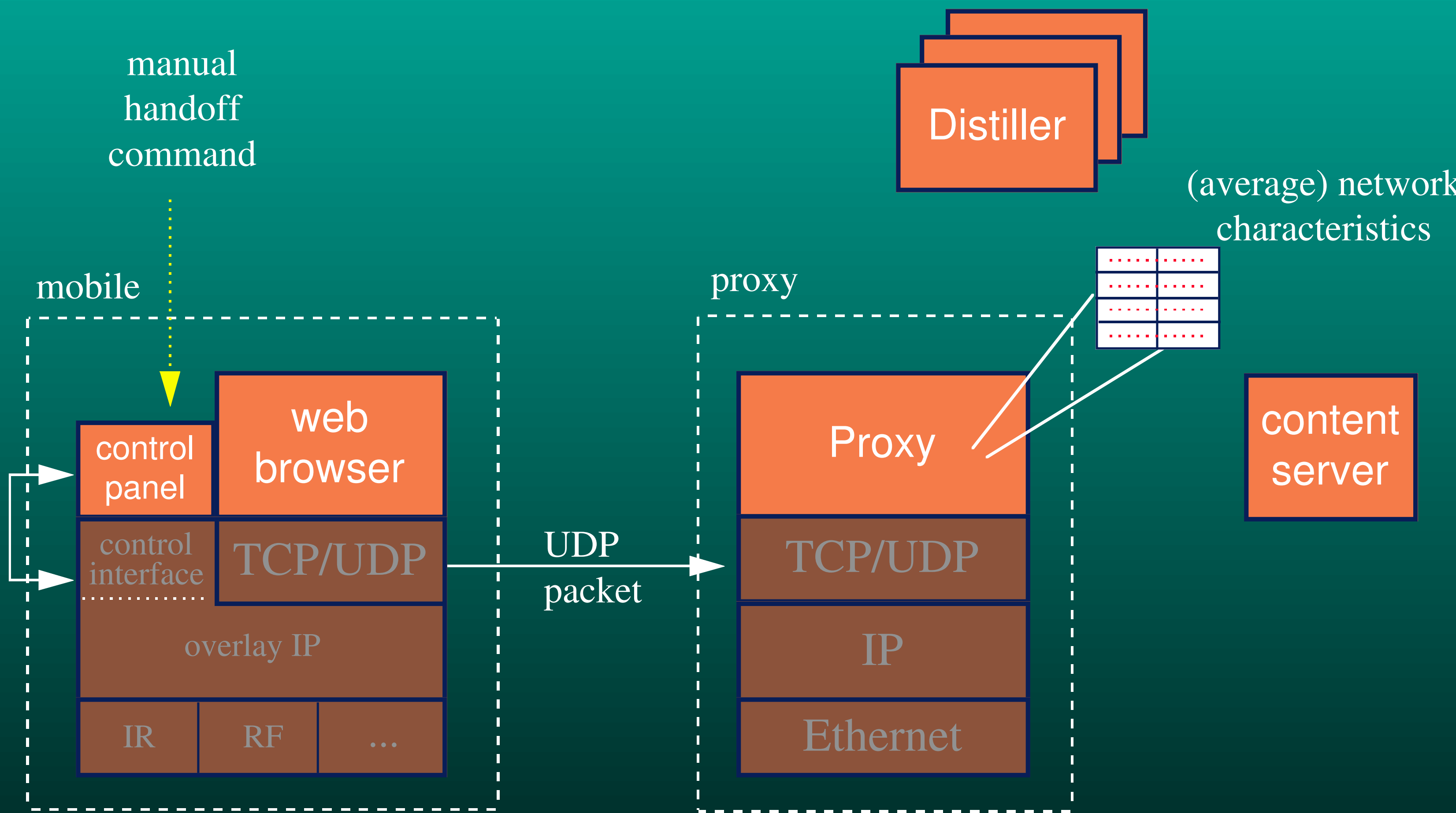
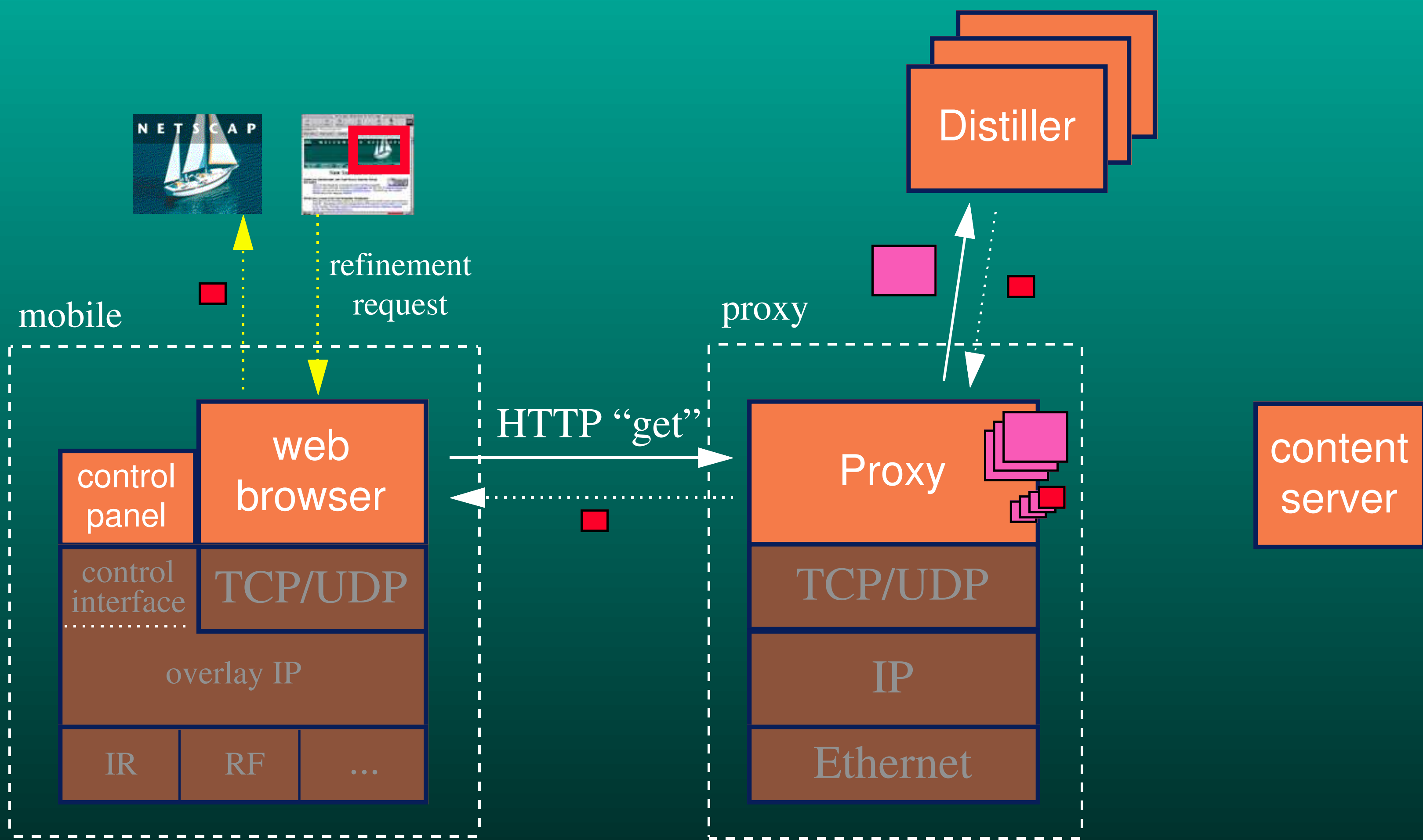


Handoff Notification and Dynamic Adaptation



‘Chunk’ Refinement



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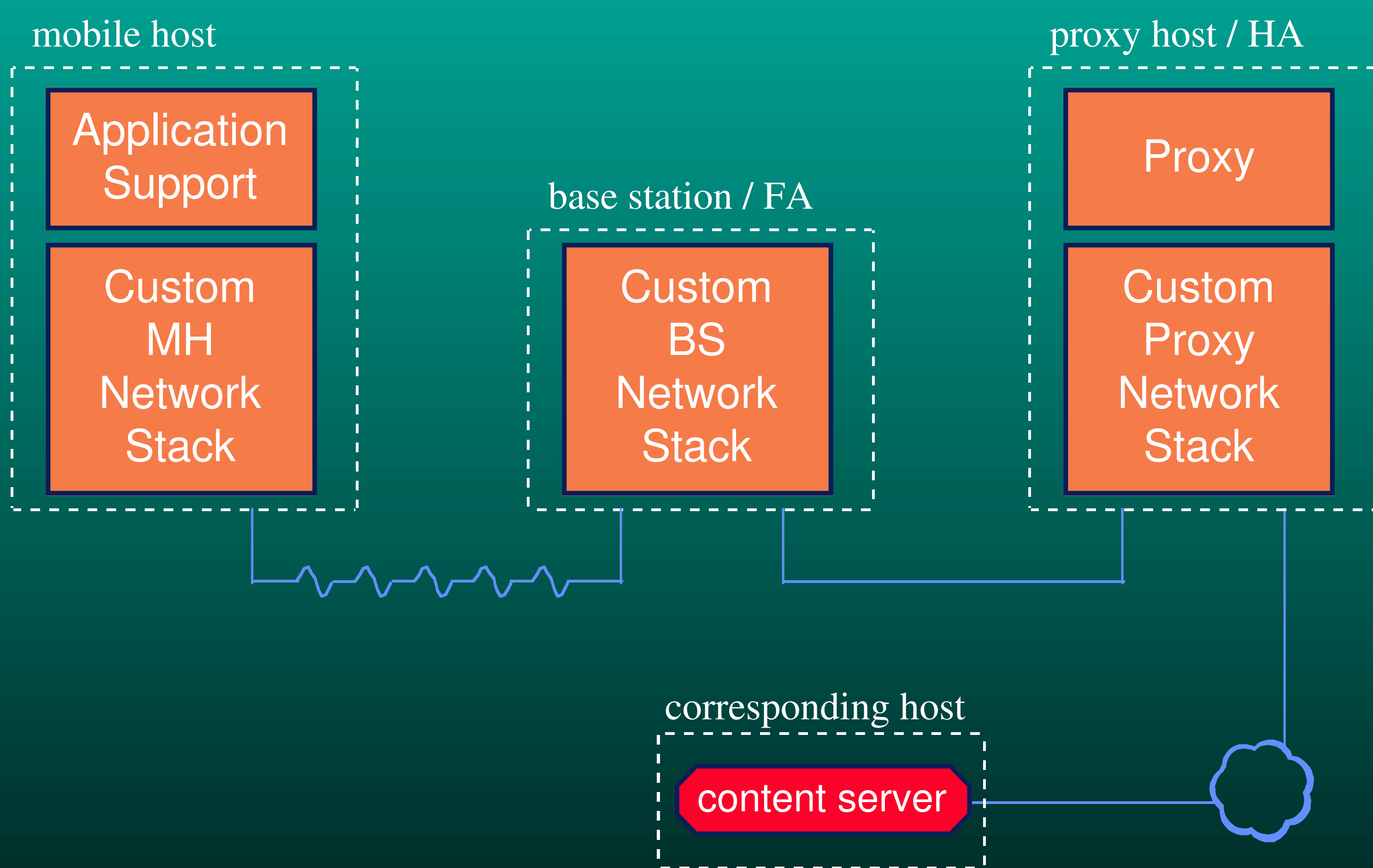
Extended Architecture Components



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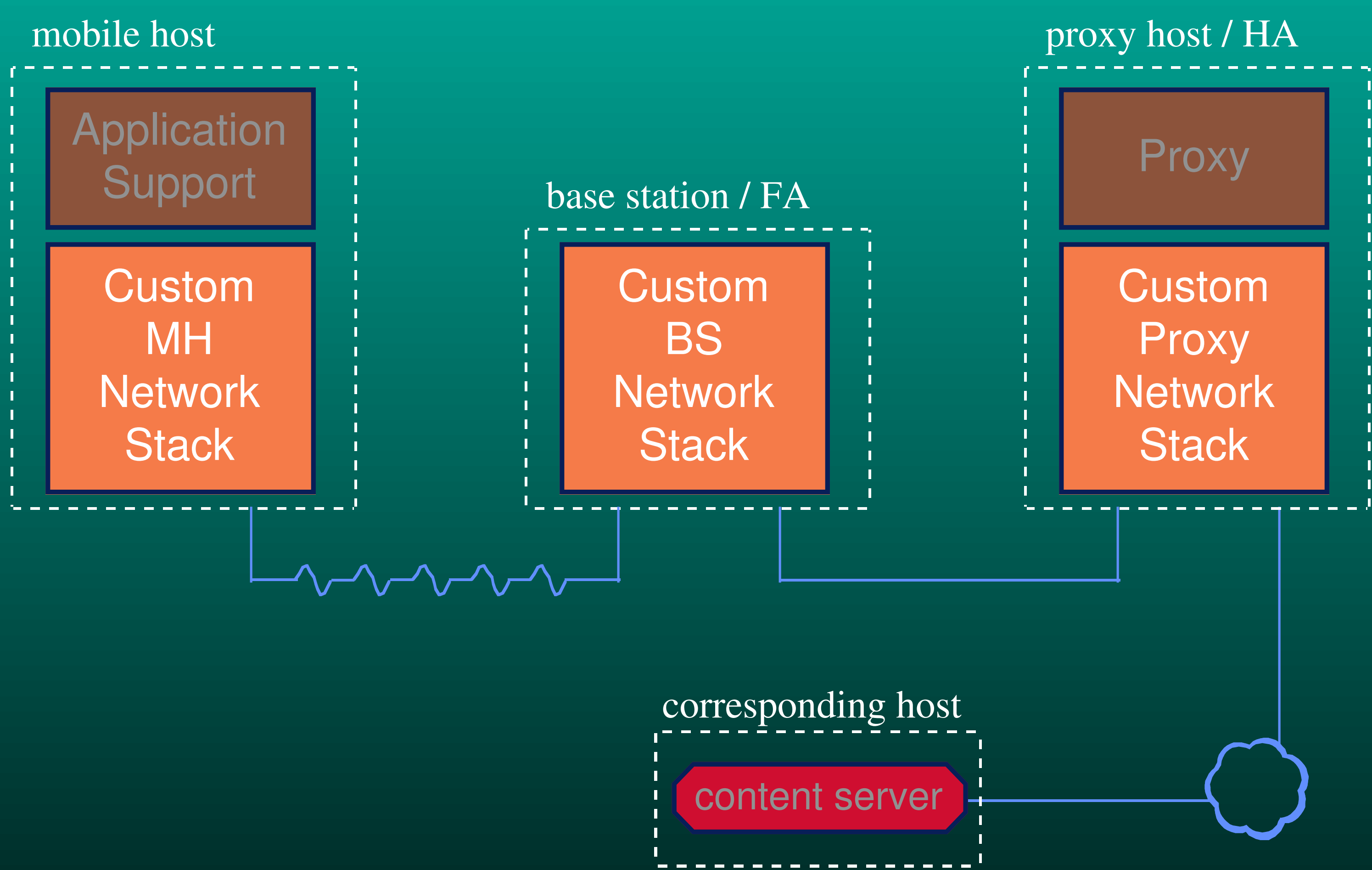
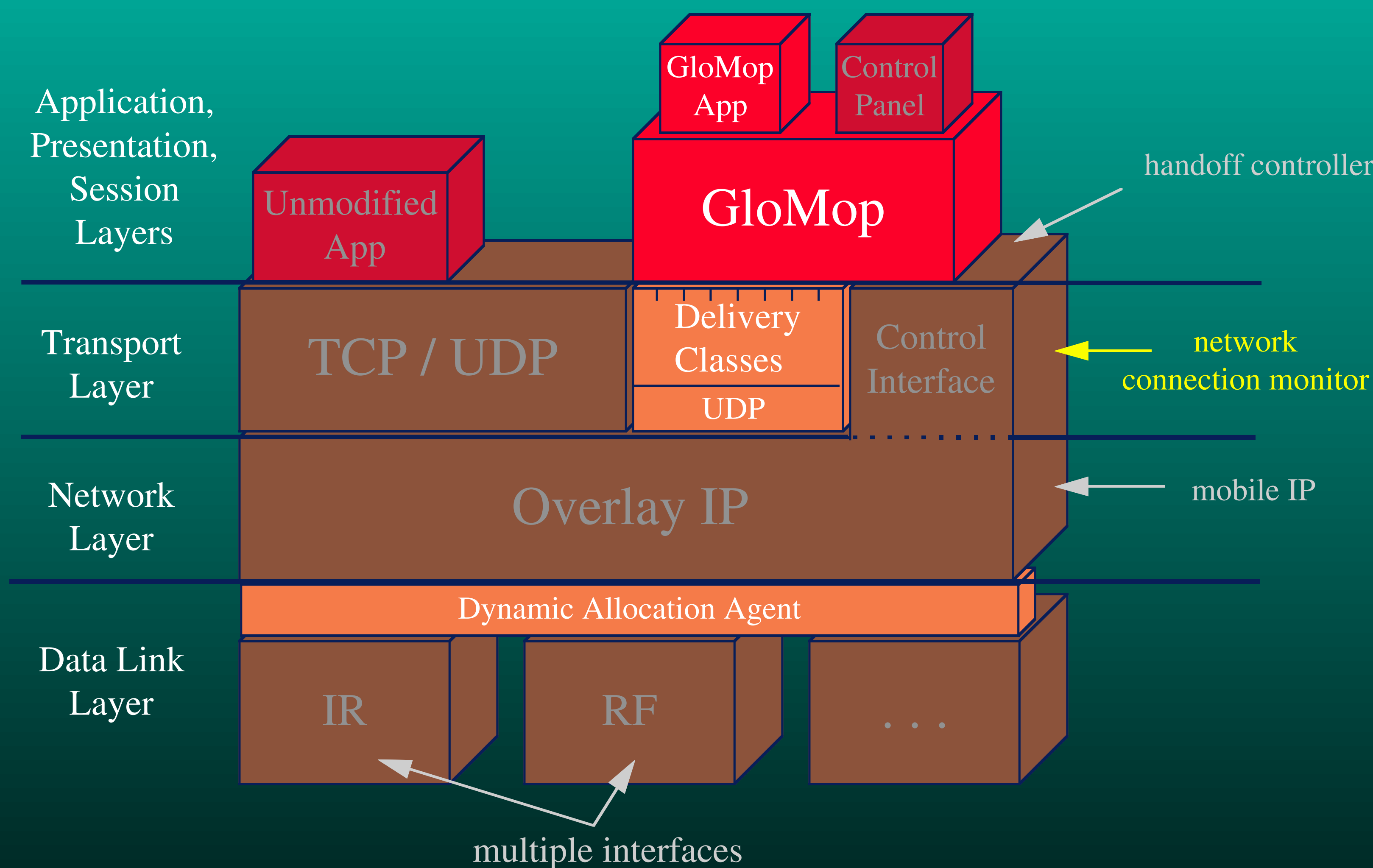
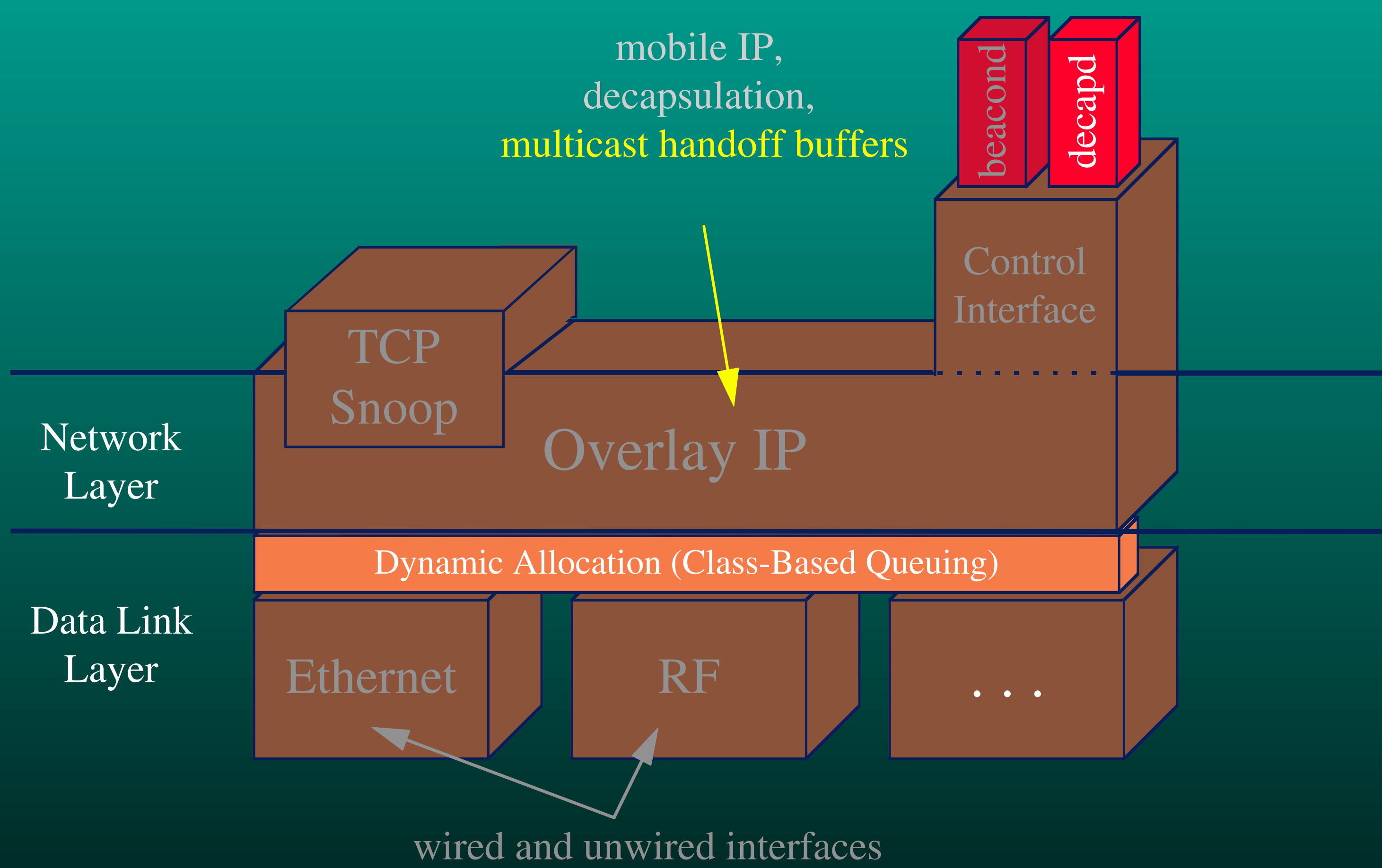


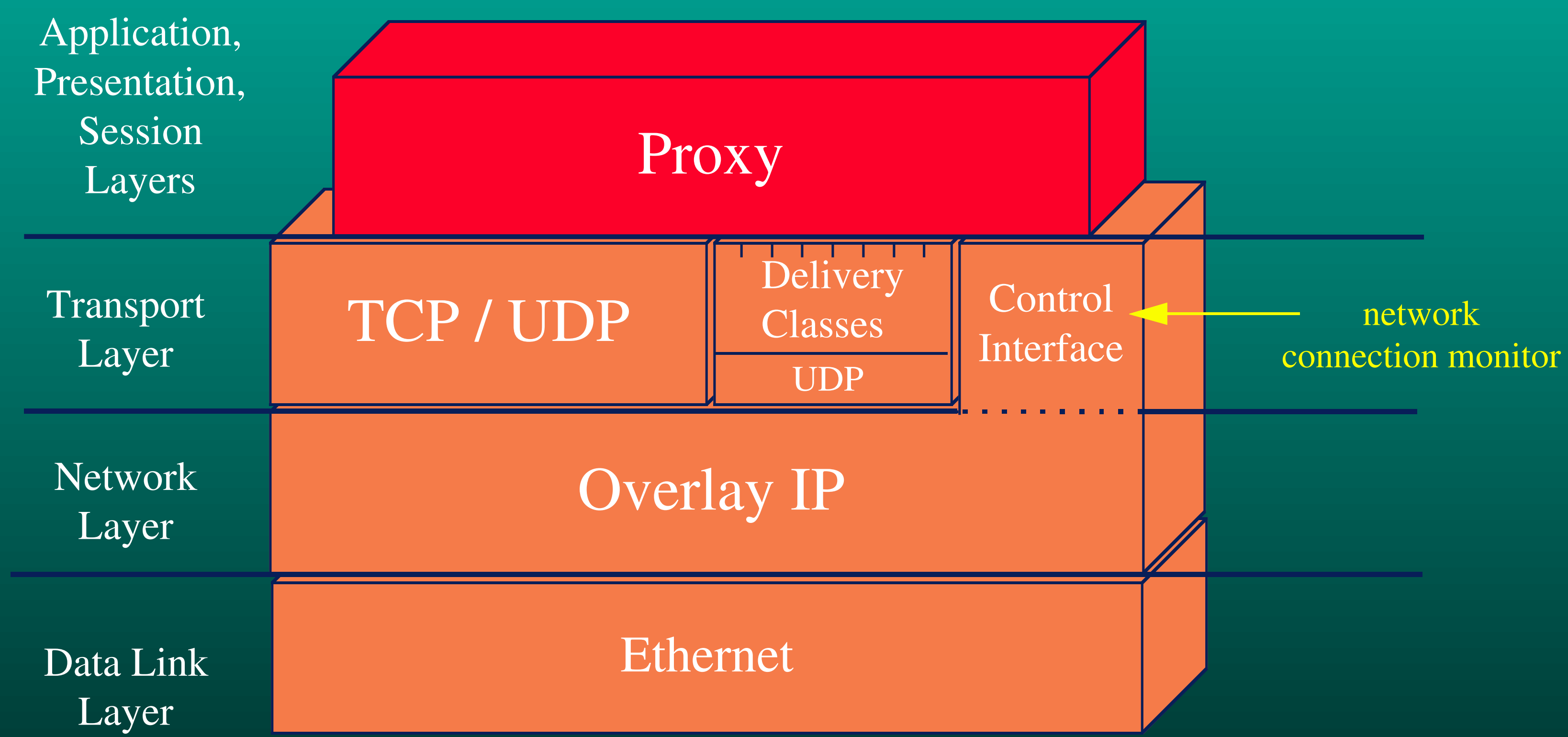
Extended Daedalus Mobile Host



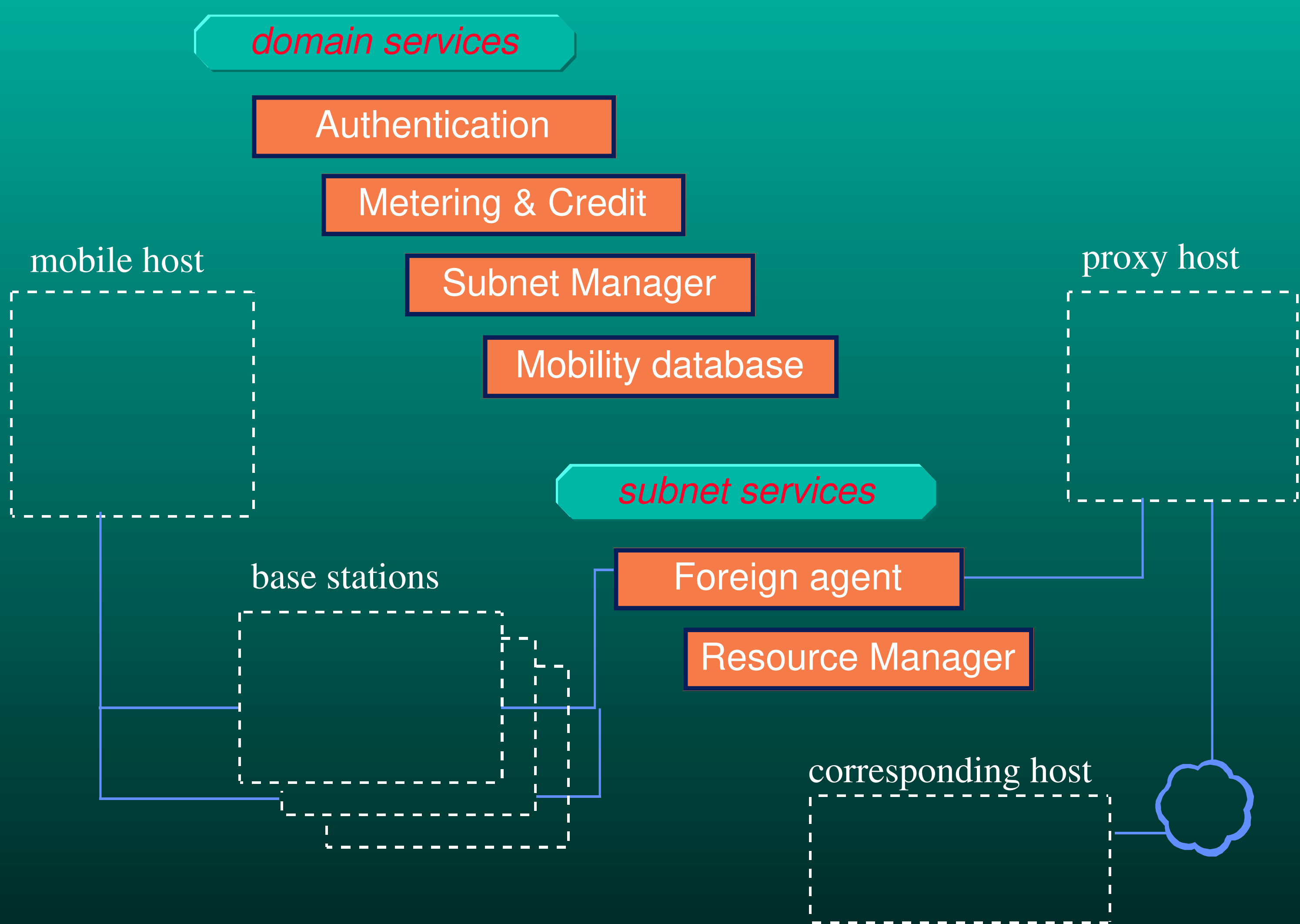
Extended Daedalus Base Station



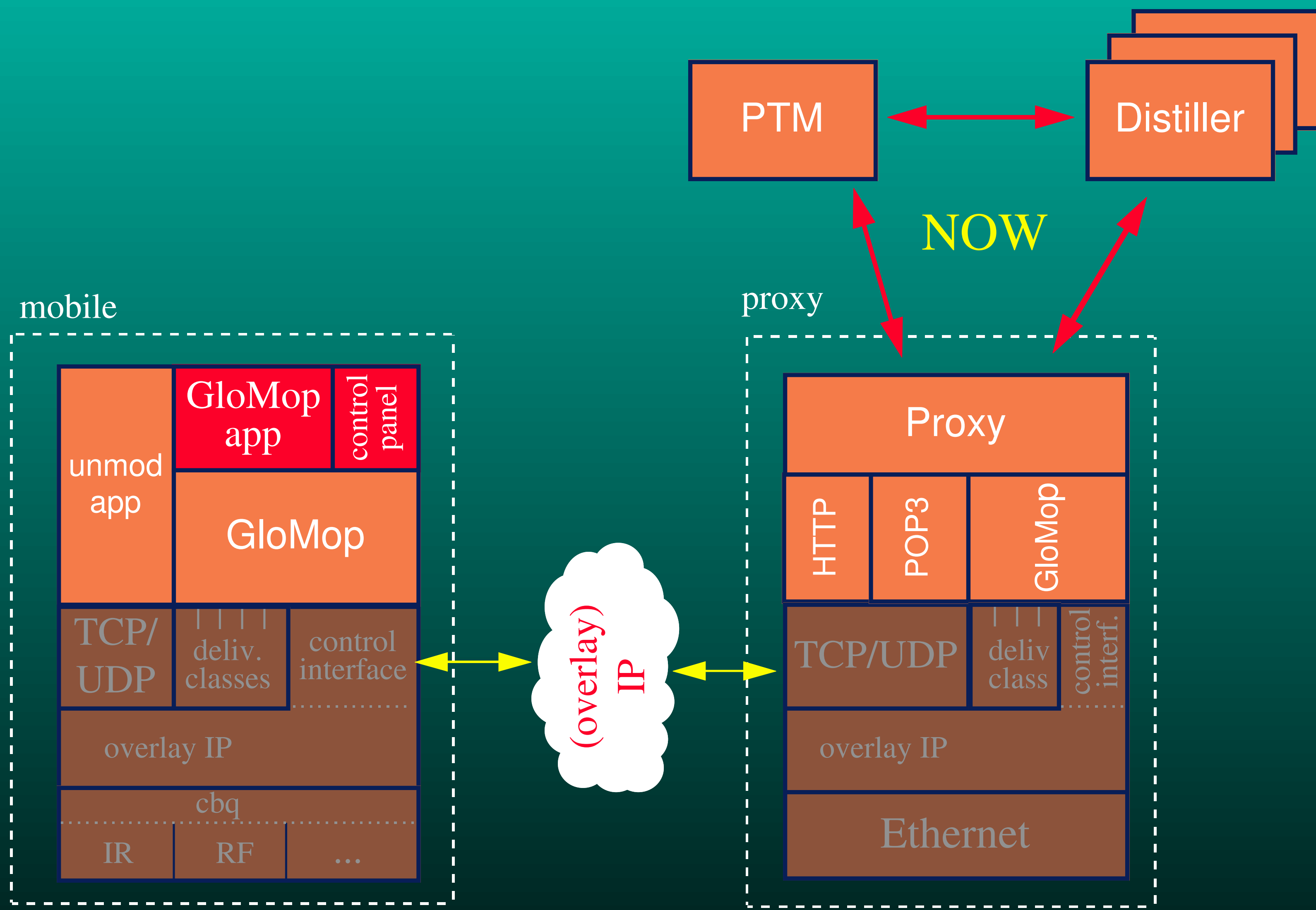
Extended Daedalus Proxy



Extended Service Architecture



Extended proxy architecture



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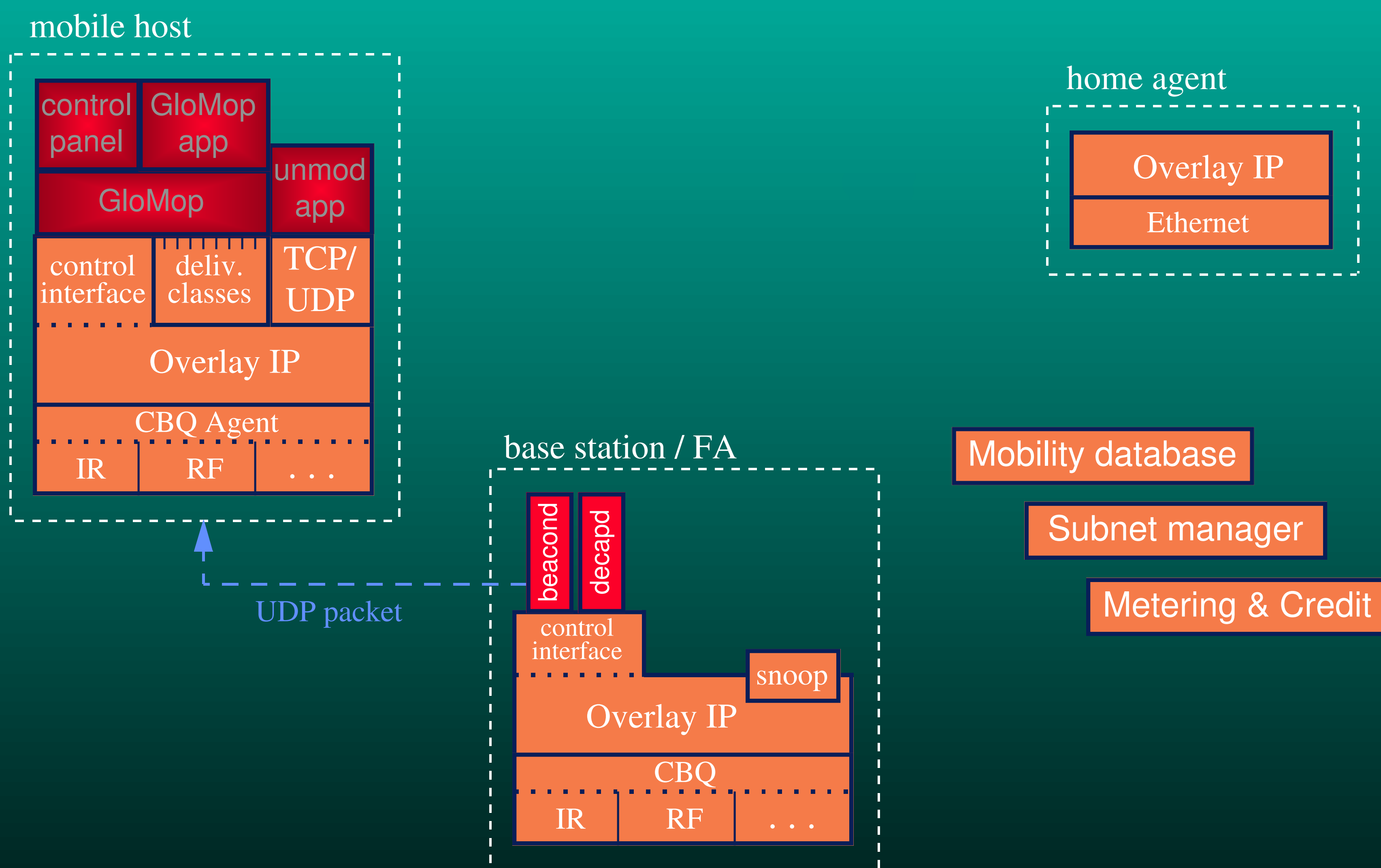
Connecting to the Network
(Multicast)



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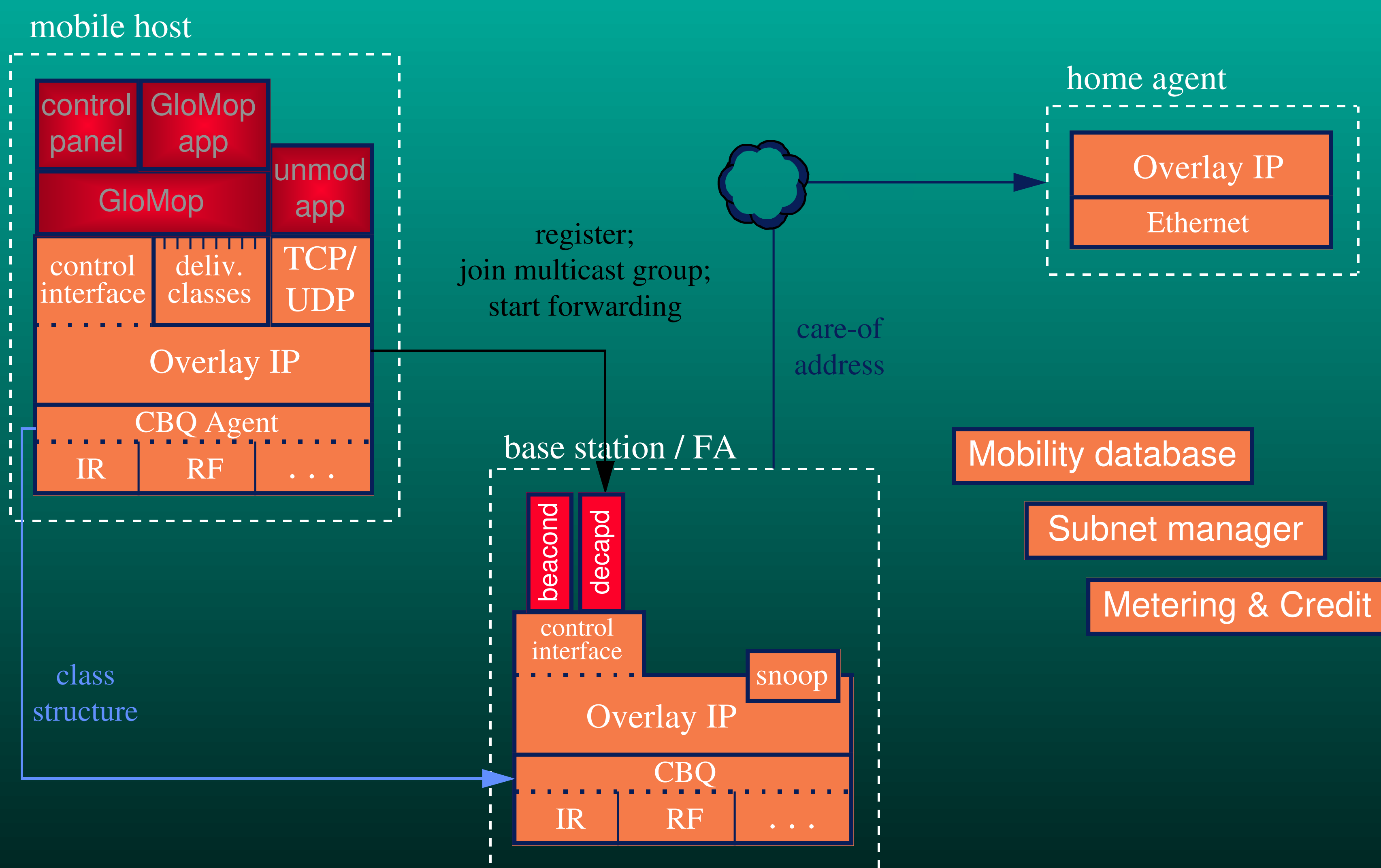

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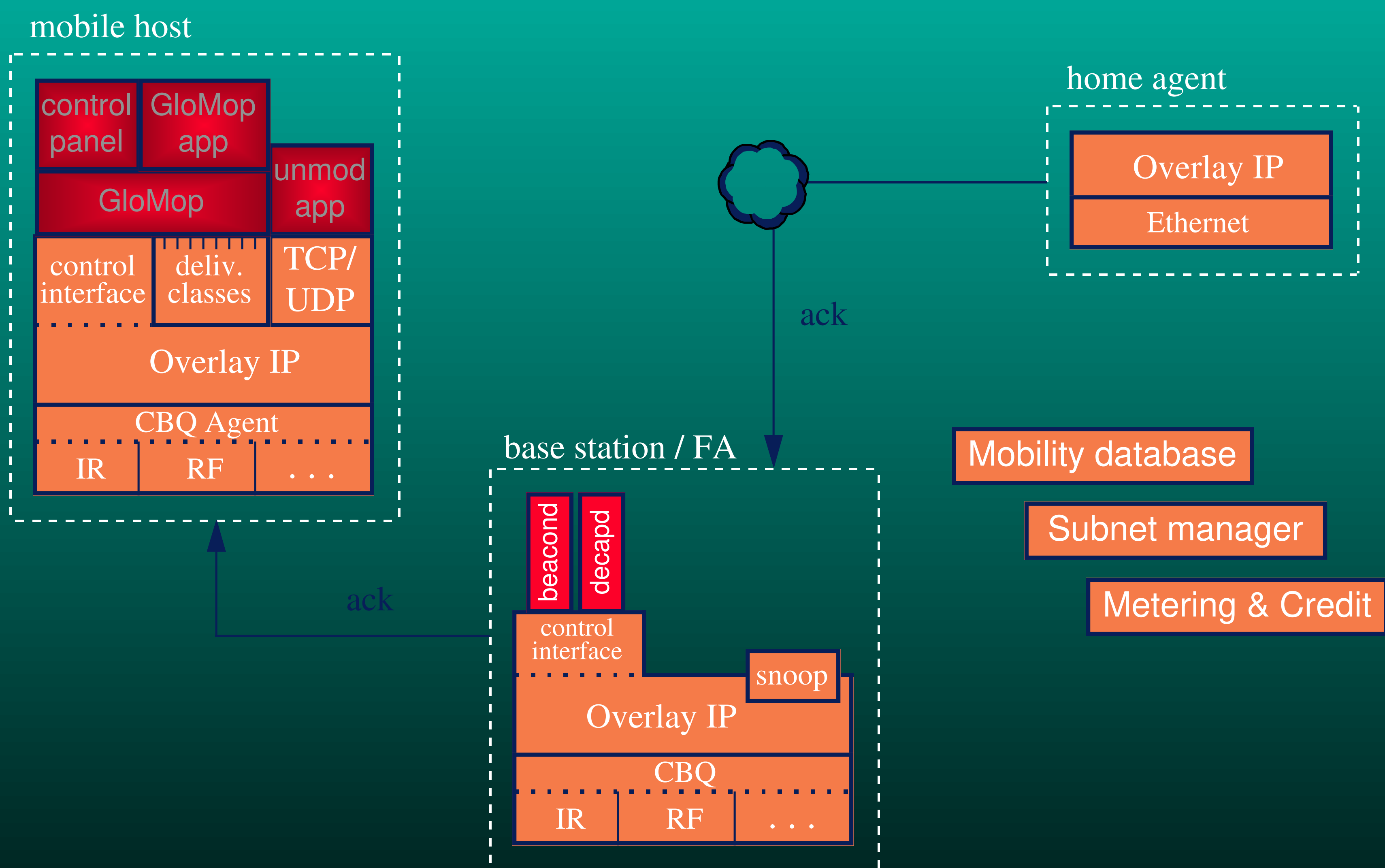

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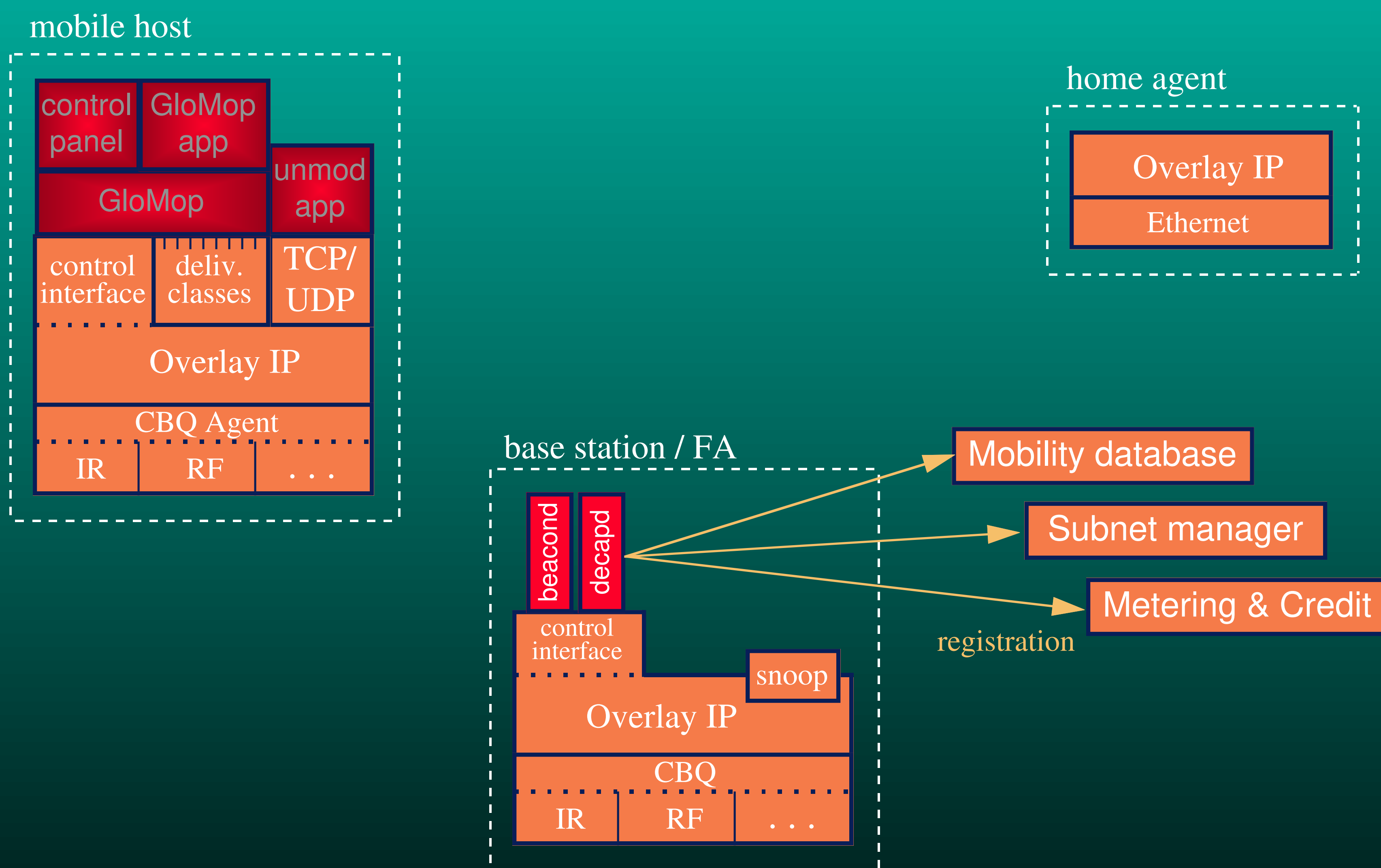
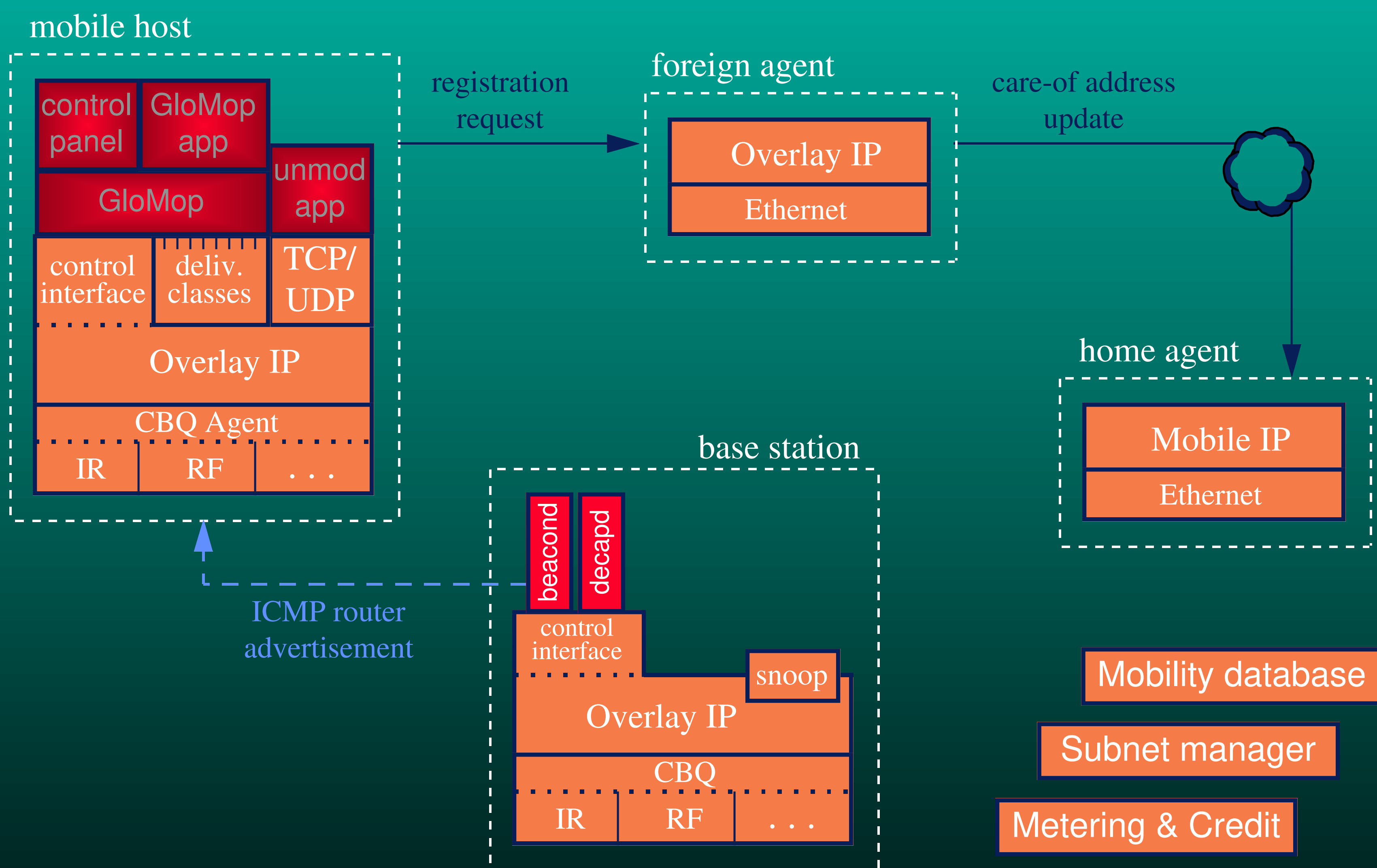


Connecting to the Network
(Hybrid)



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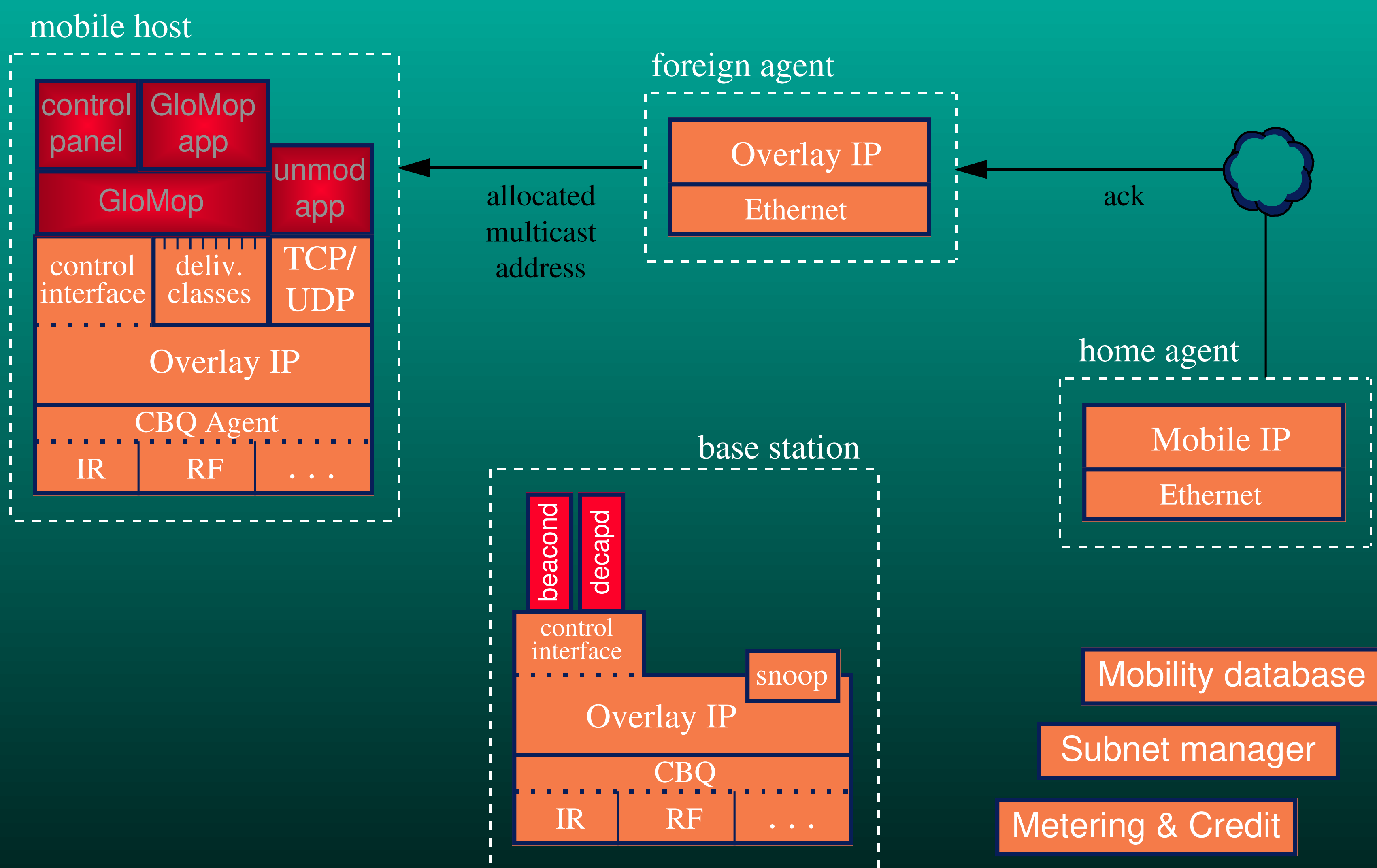

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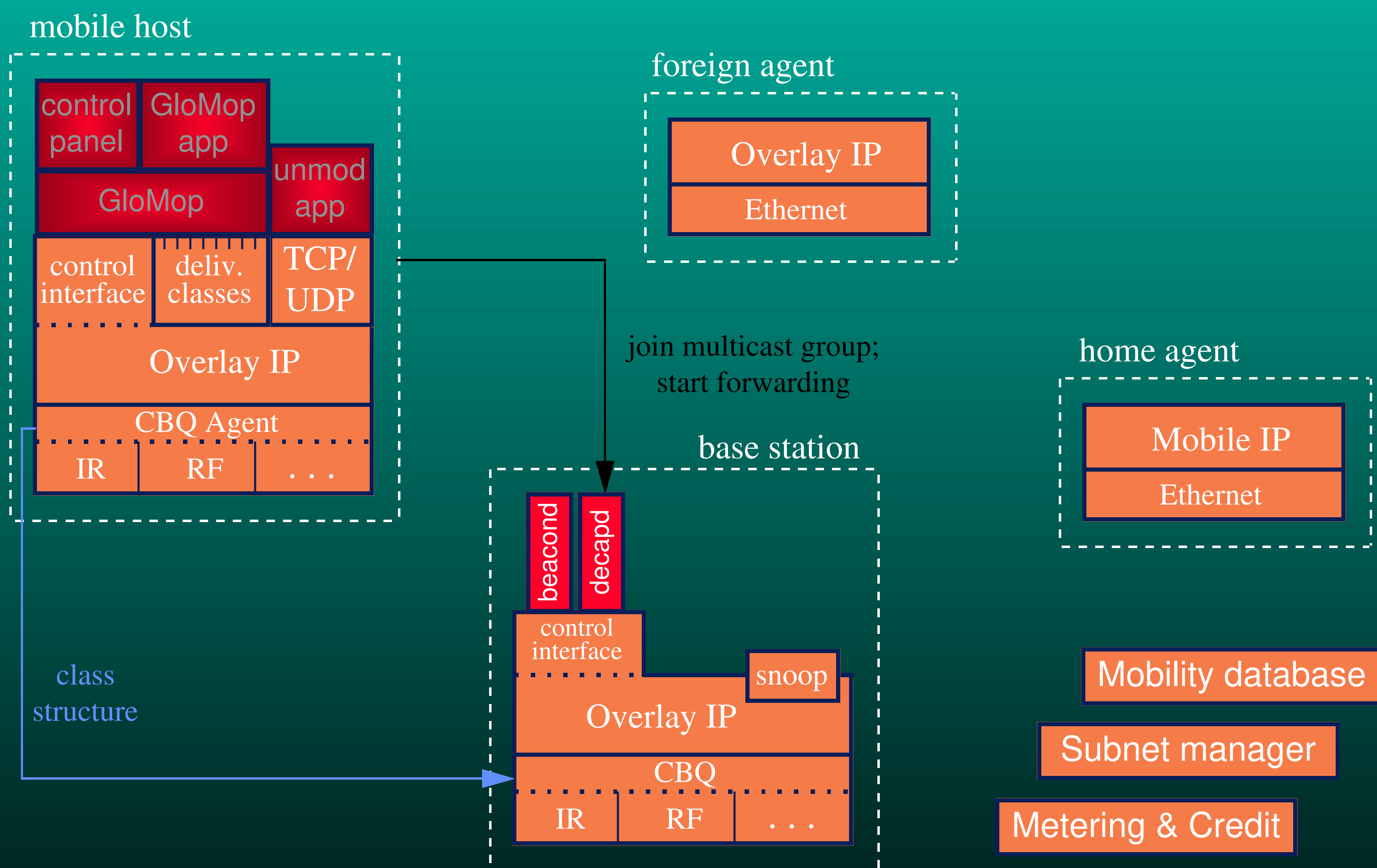

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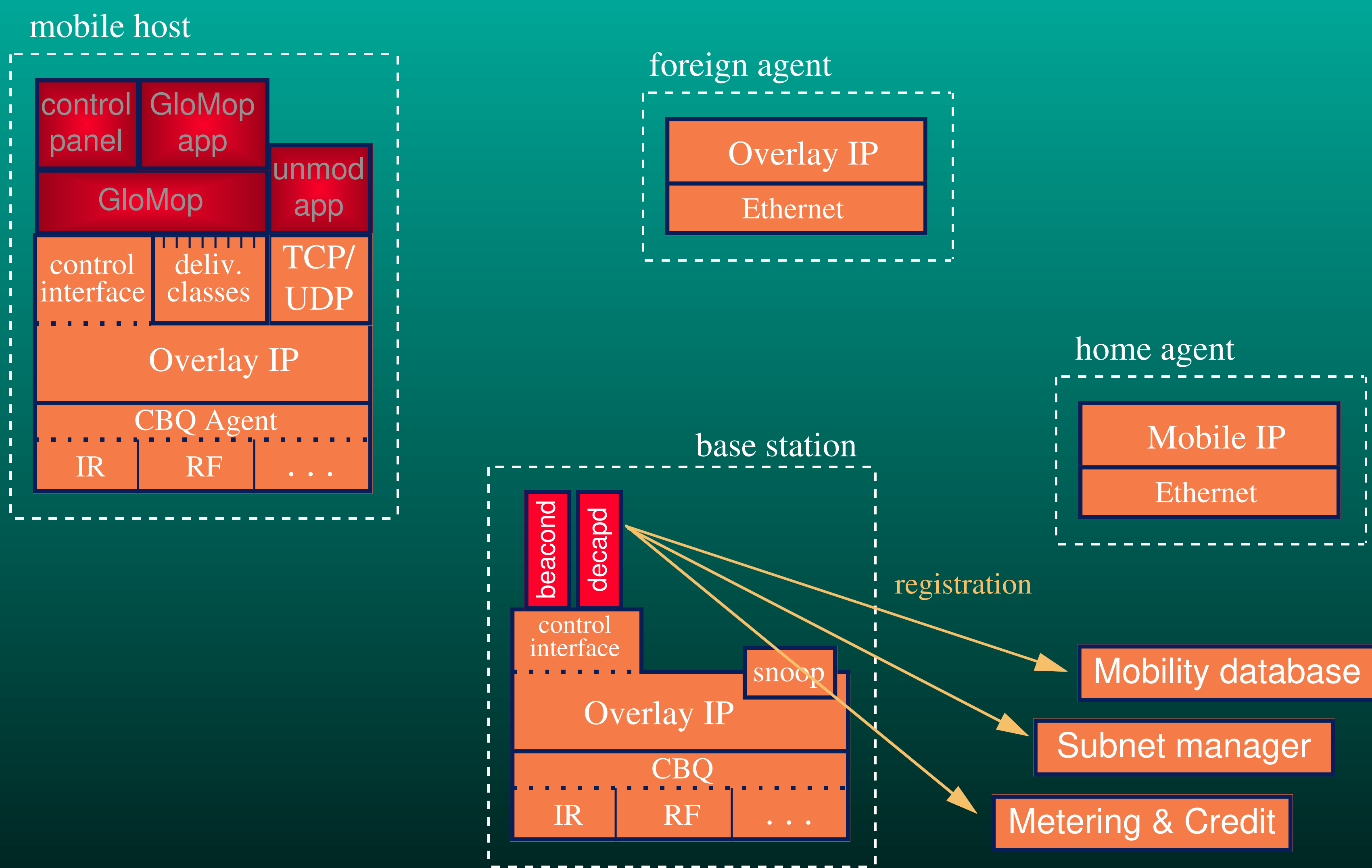


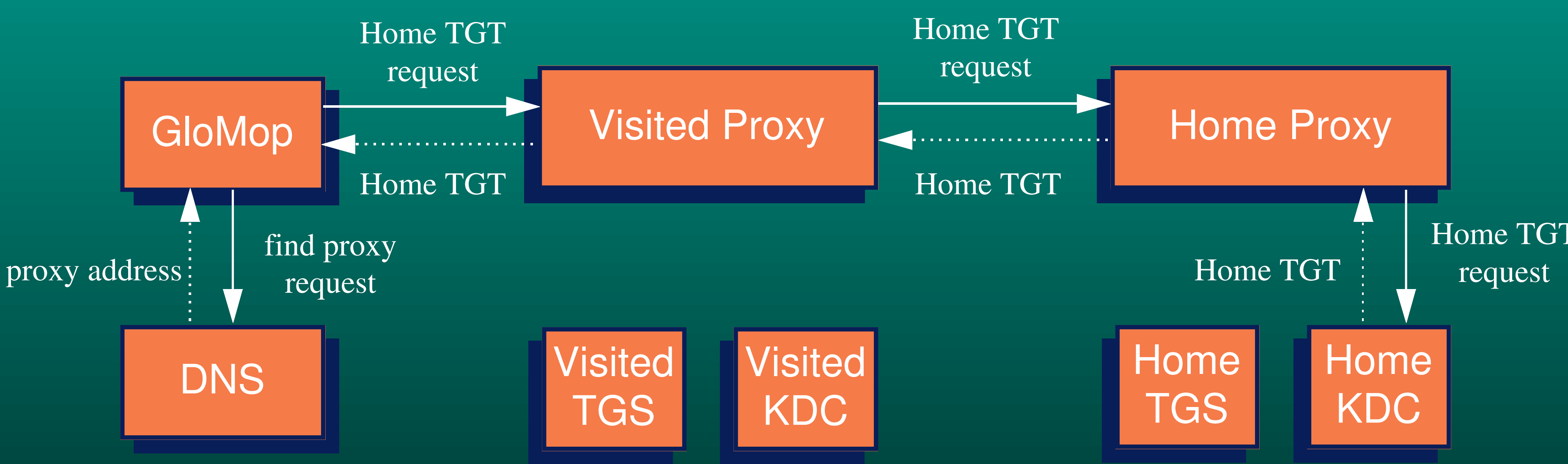
Kerberos Authentication

- centralized, secure database (KDC) holds secrets (DES key) only known by principles
- to access Kerberized services, principles are issued tickets for those services by the ticket-granting server (TGS)
- a ticket for the ticket-granting server (TGT) is issued by the KDC
- the TGT is encrypted with the issuee’s secret
- tickets contain session keys

Authenticated Proxied Services

- proxies are treated as principles
- clients access proxies by gaining tickets for their services
- cross-domain authentication is possible by having a foreign TGS listed as a principle in the local system
- Charon is a protocol that enables Kerberos for impoverished clients
- Charon also enables “indirect authentication”

Charon Authentication: Obtaining TGT for Visited Proxy



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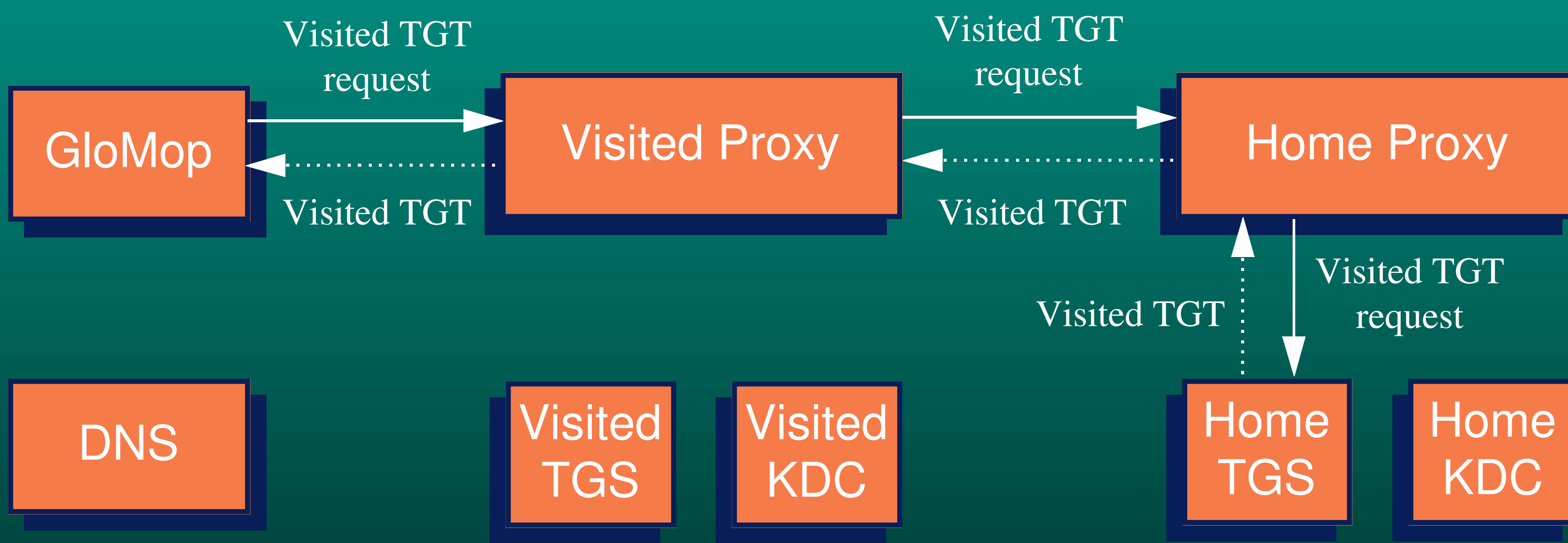
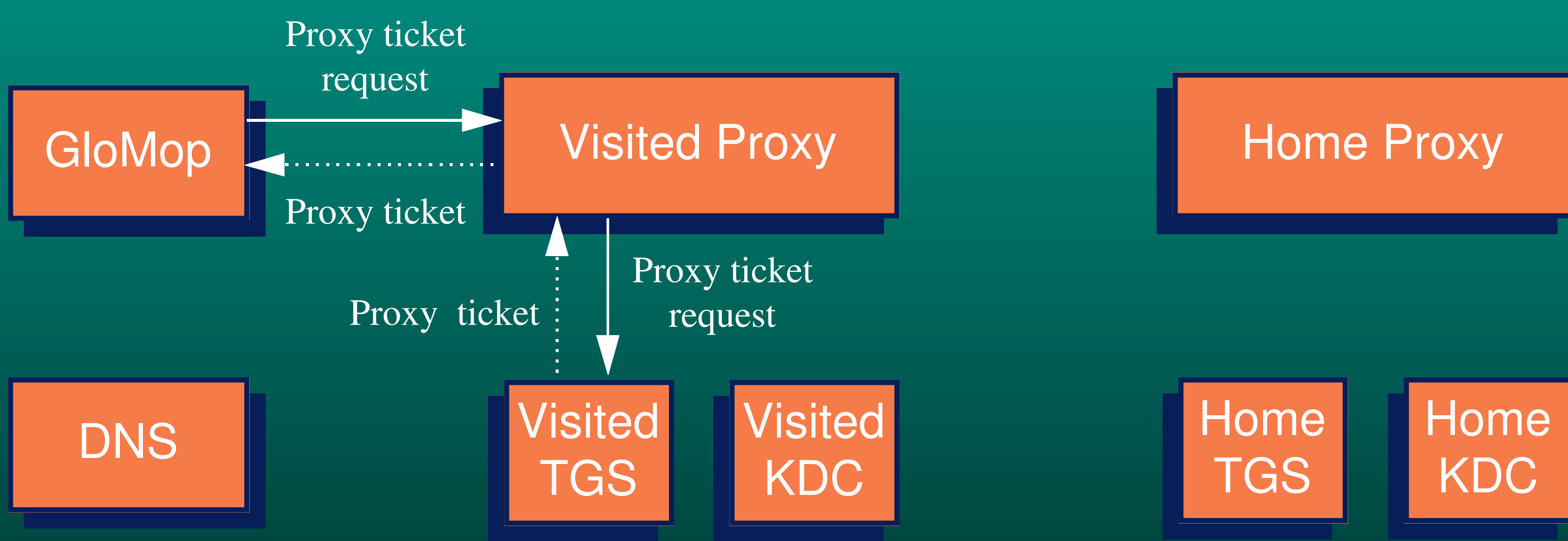
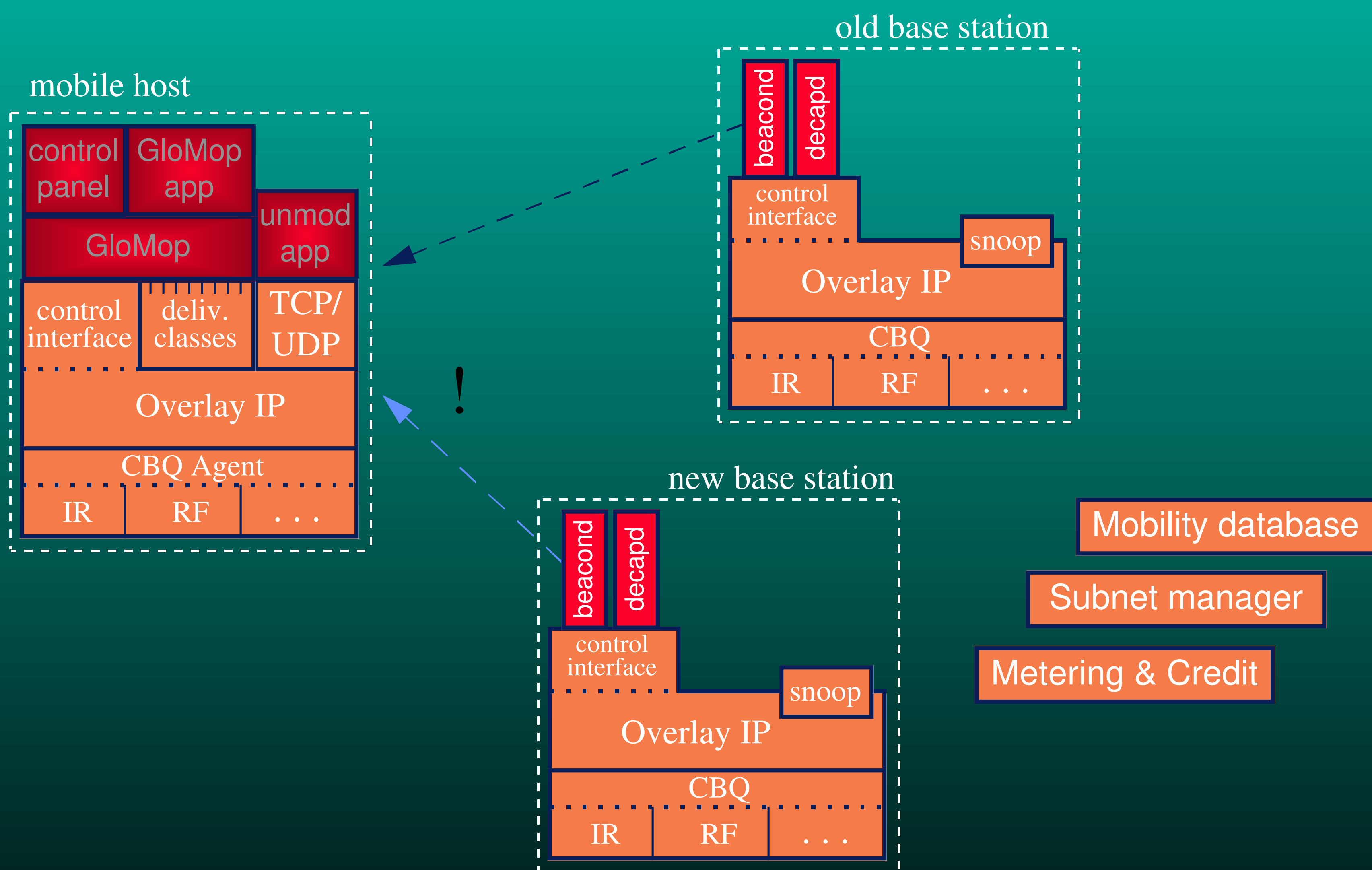


Charon Authentication: Obtaining Session Key with Visited Proxy



Handoff from IR to WaveLAN

(load balancing)



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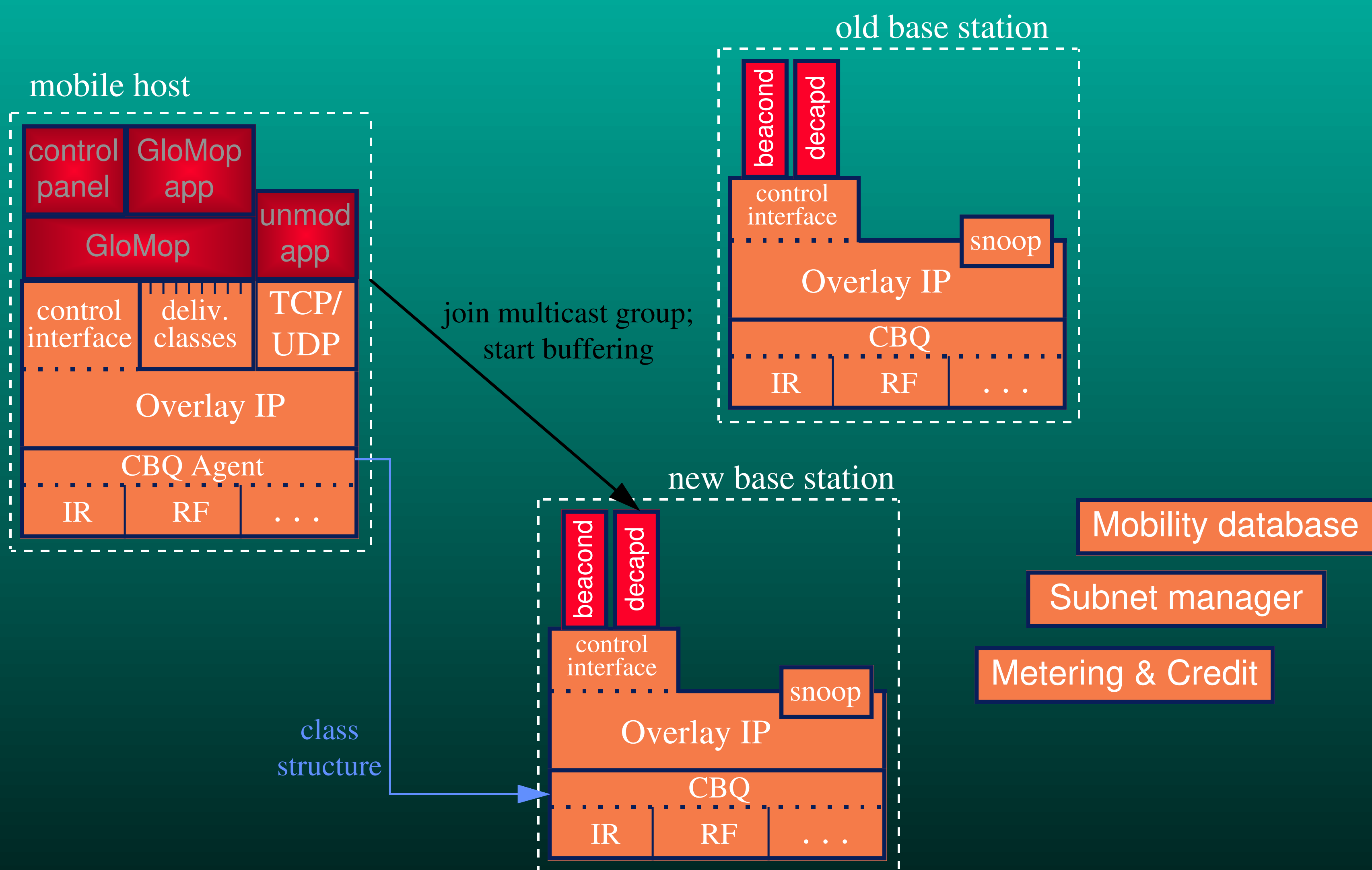

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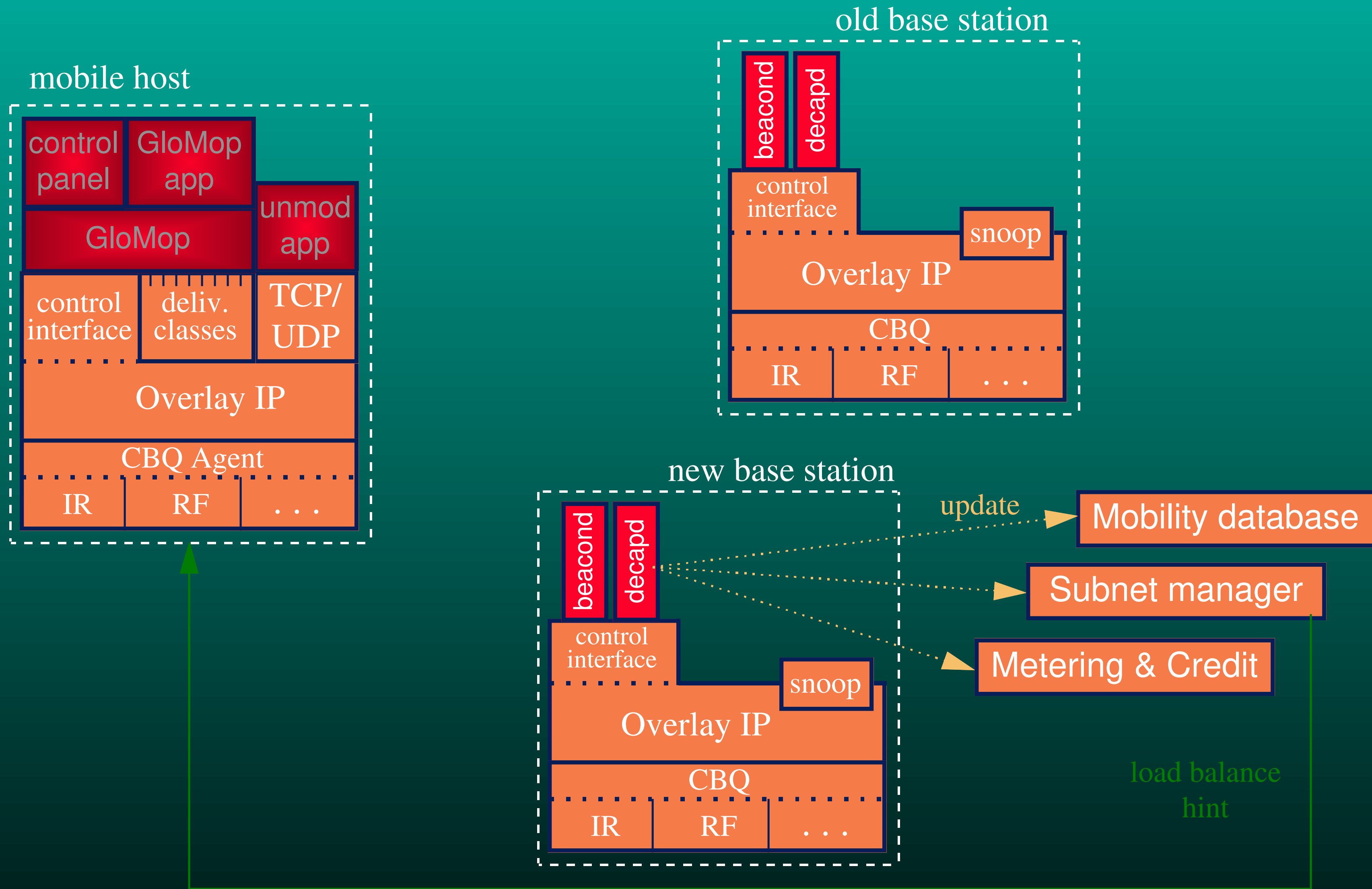
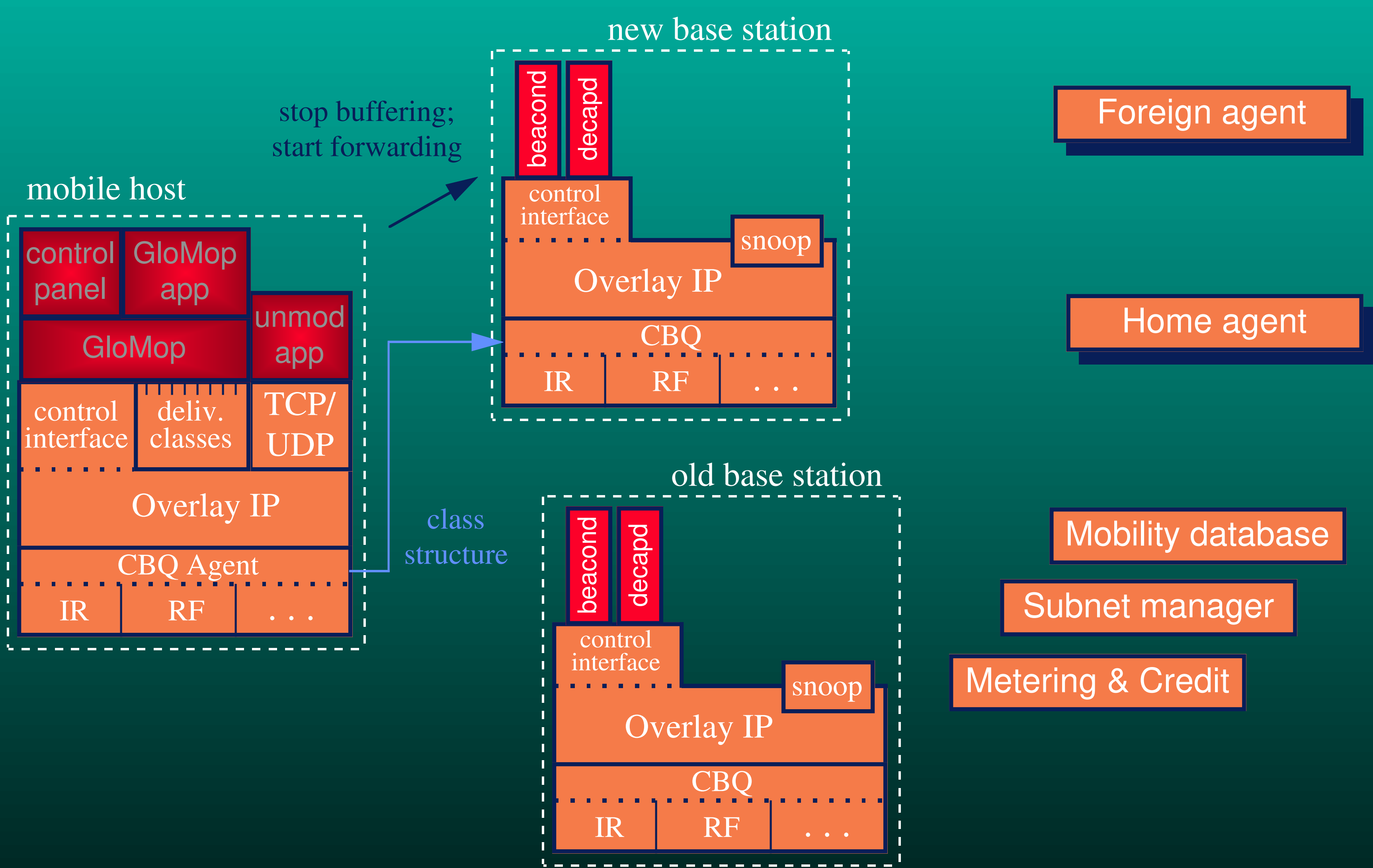


Extended Handoff Subroutine



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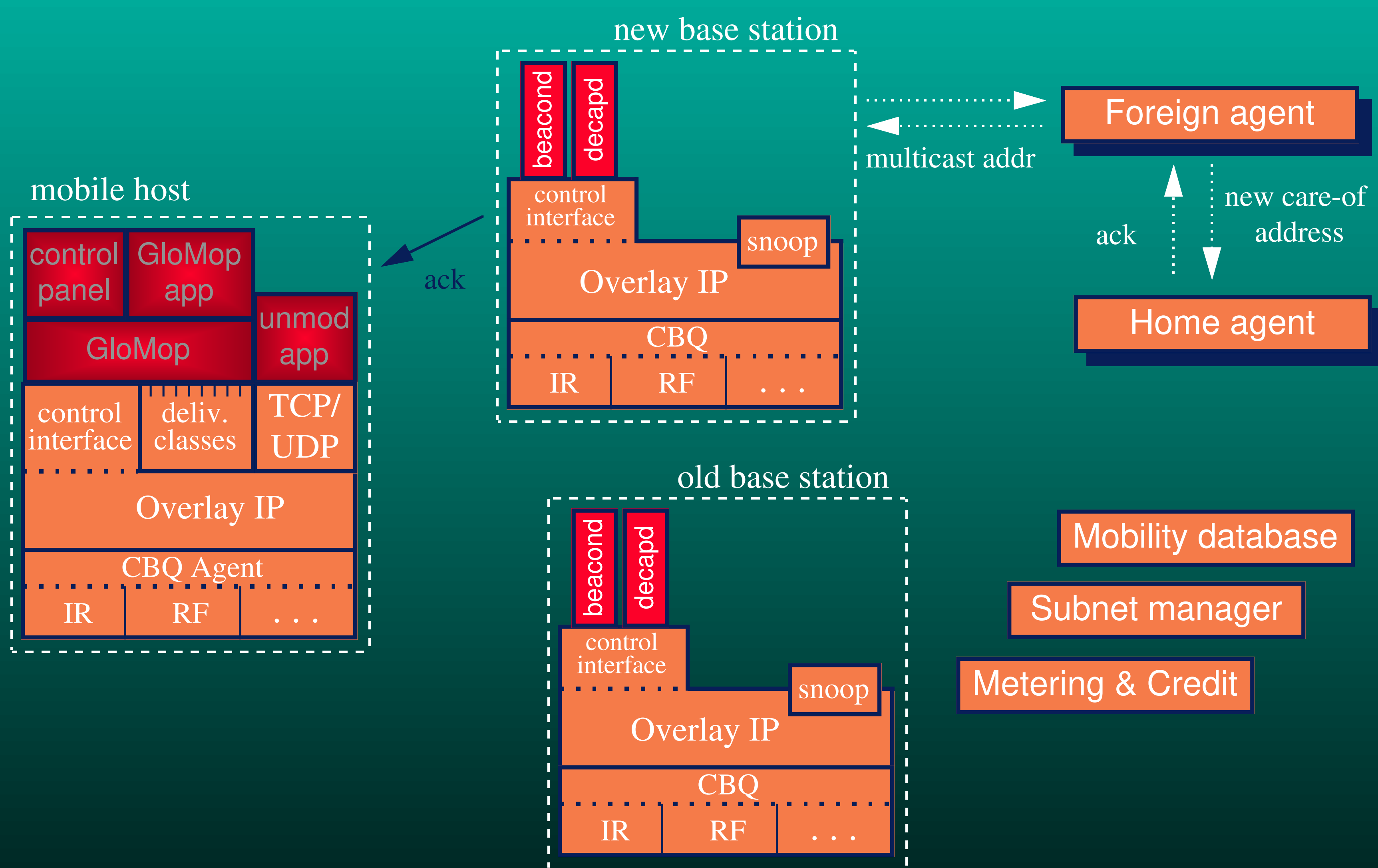

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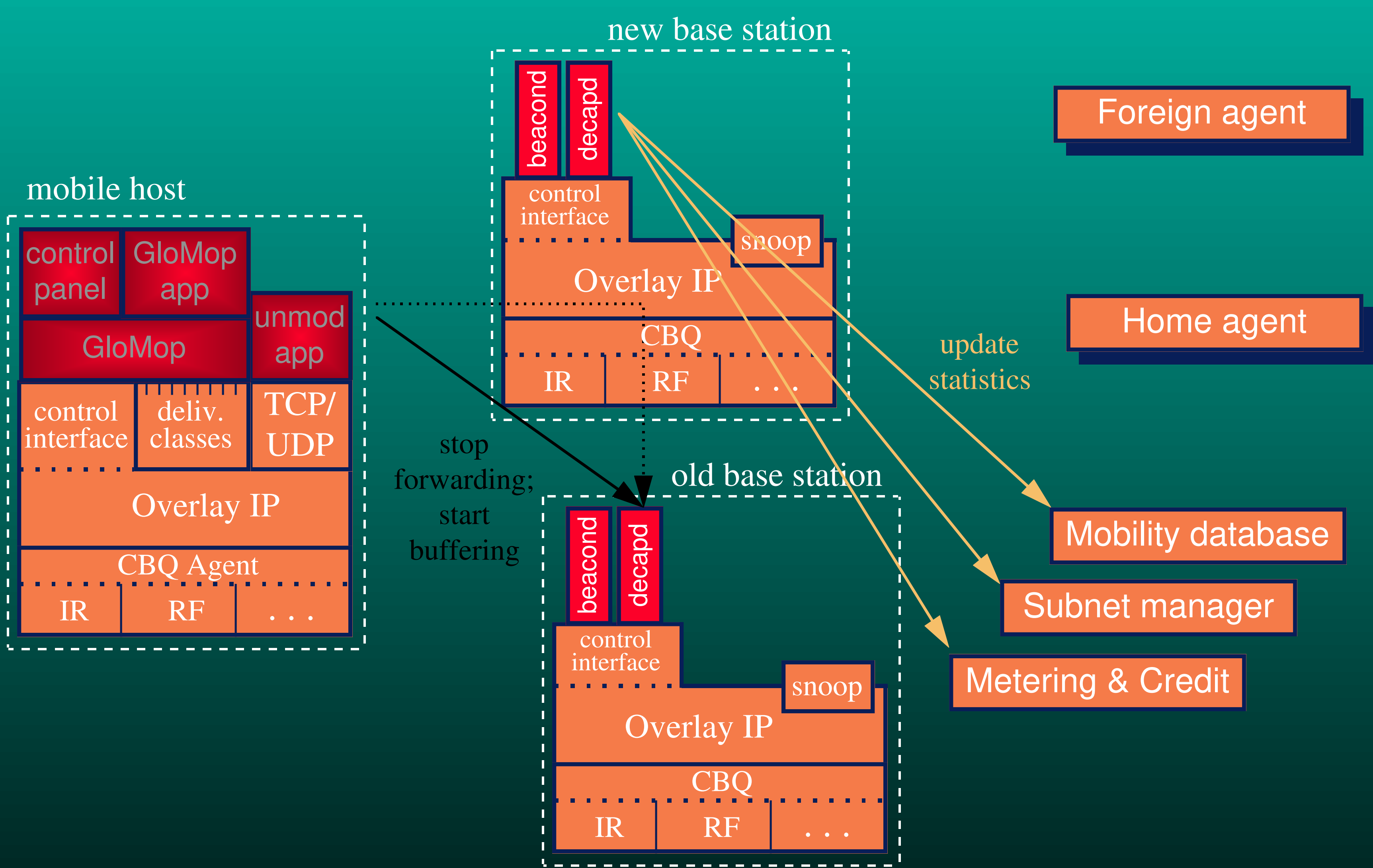

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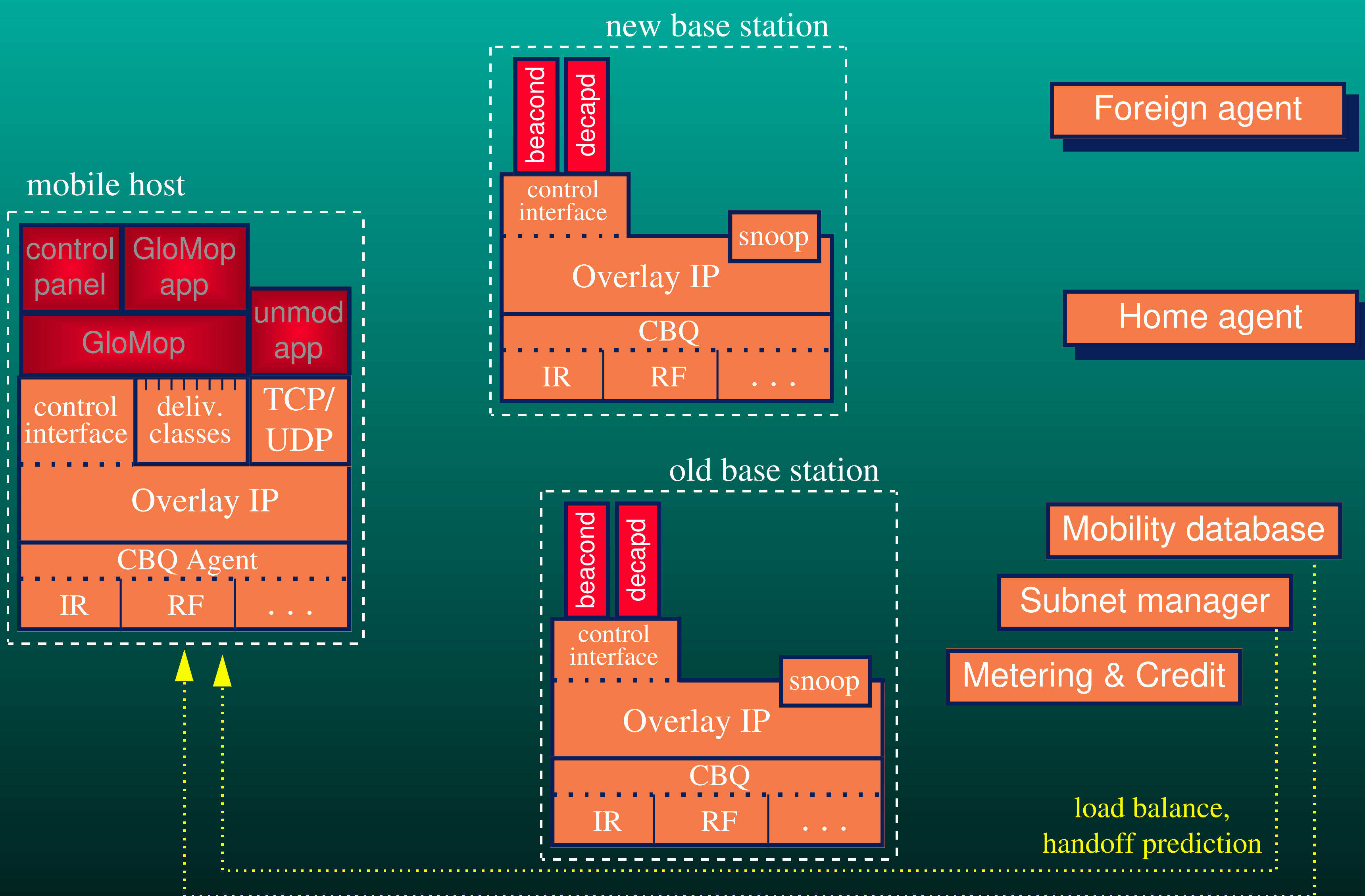
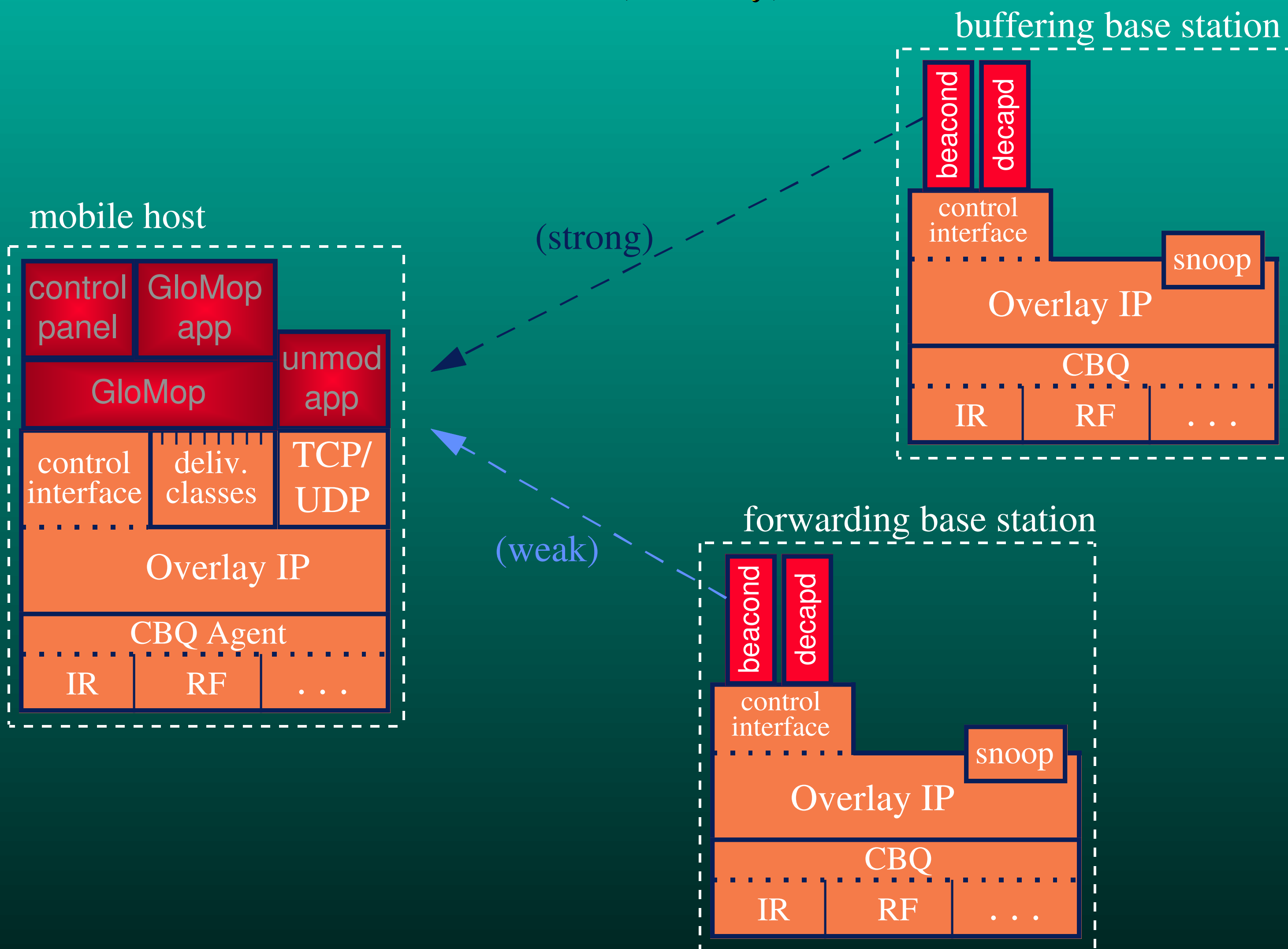
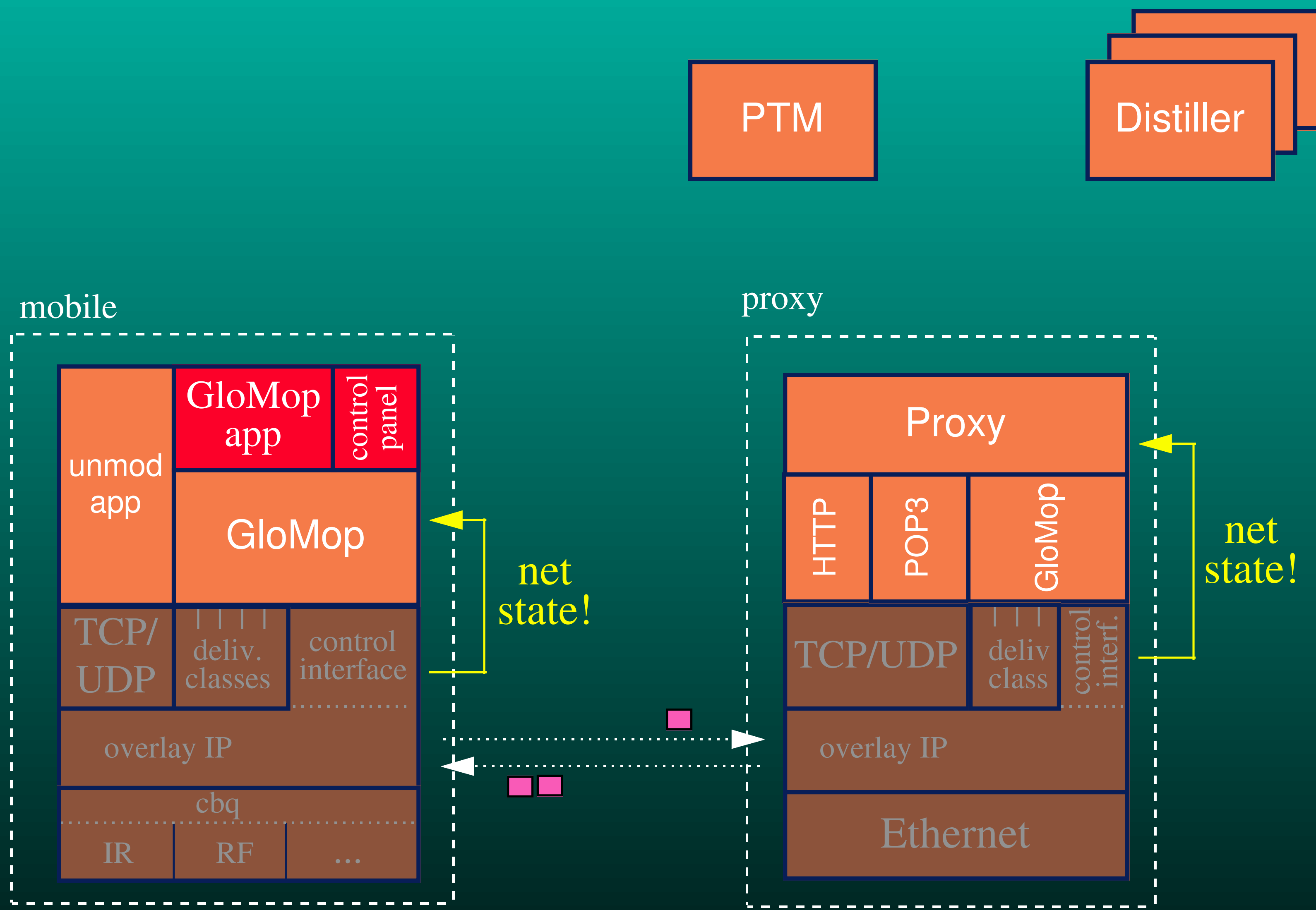


Handoff from WaveLAN to WaveLAN

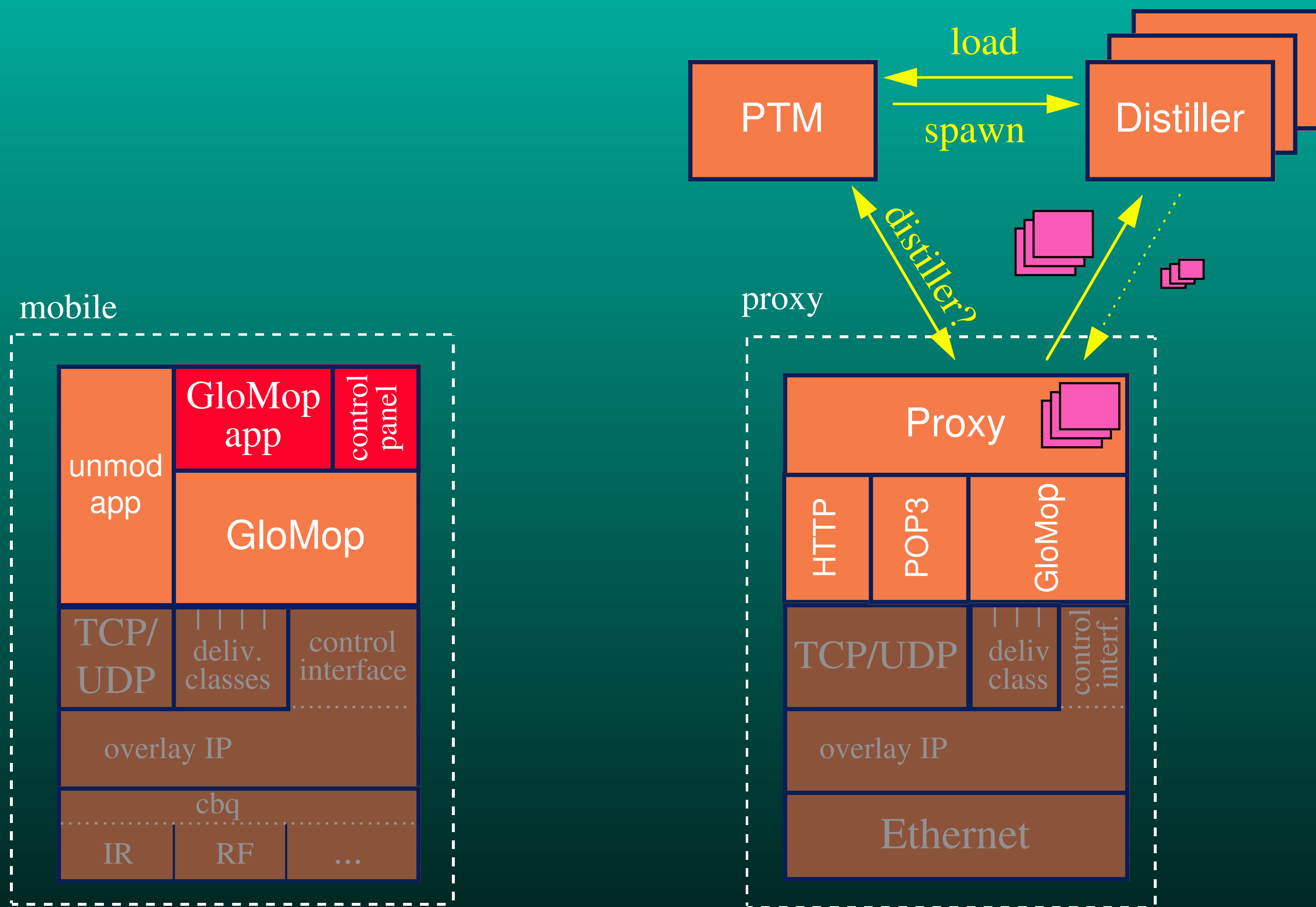
(mobility)



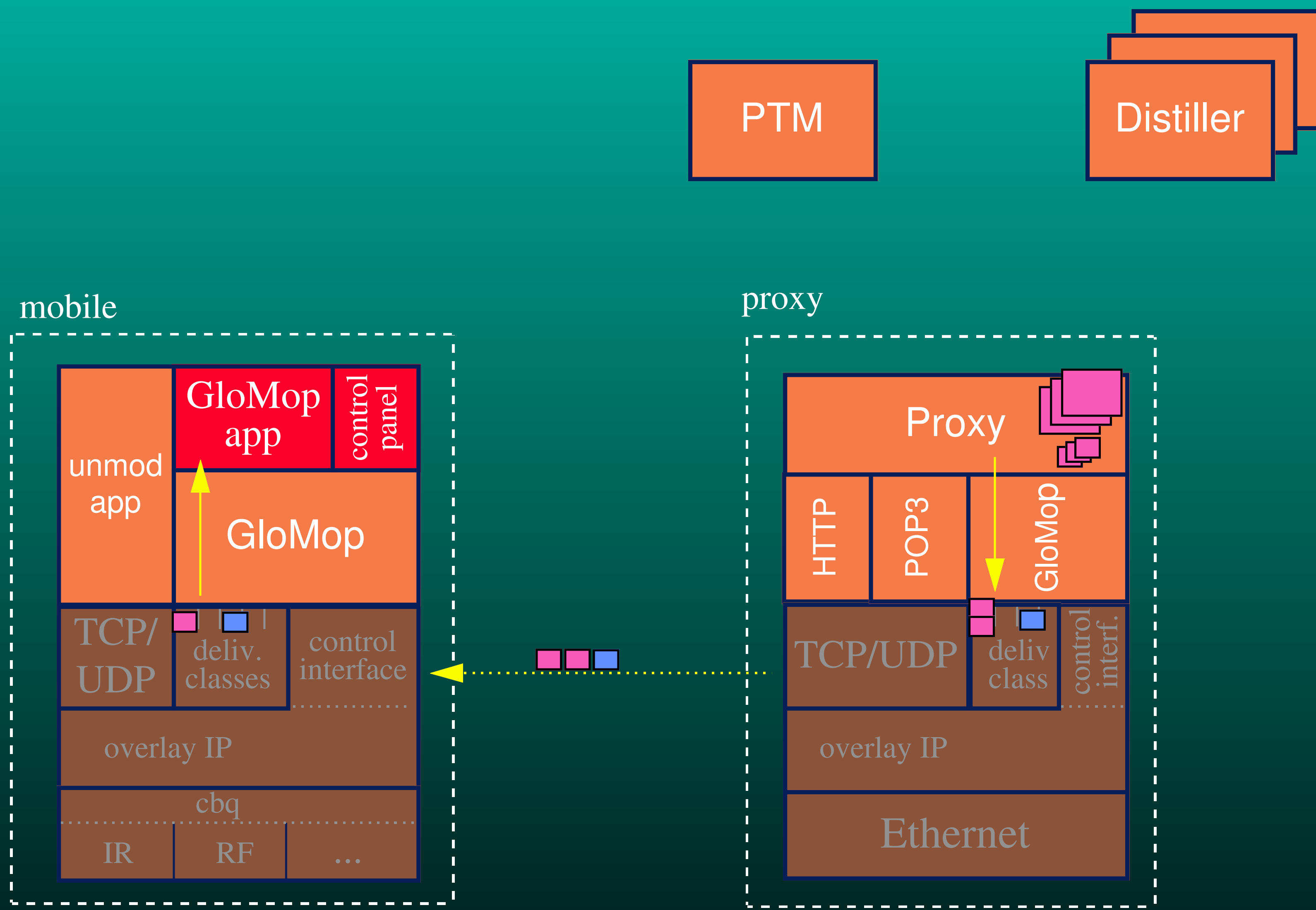
Dynamic Adaptation via NCM



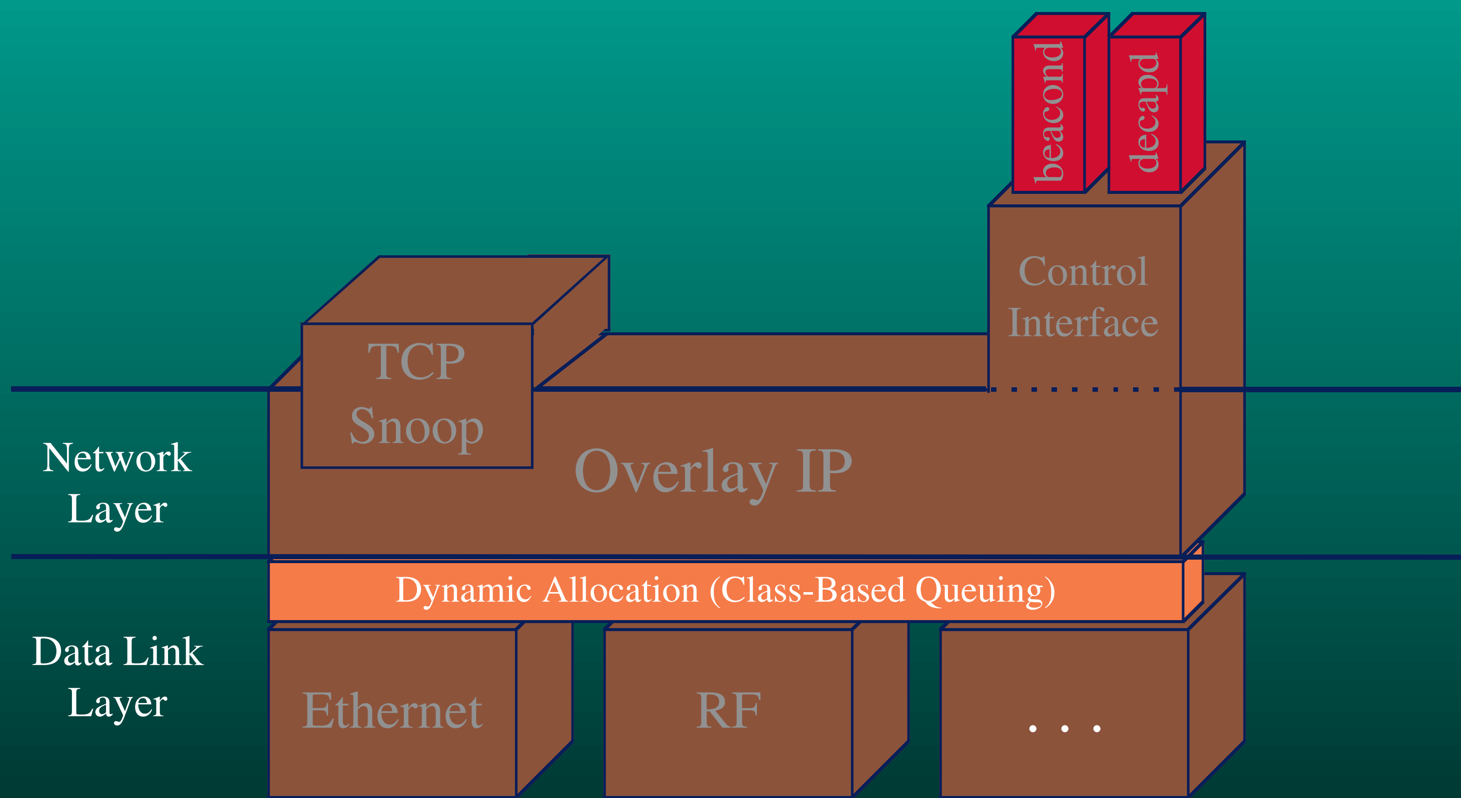
PTM Load Balancing



Delivery class abstractions

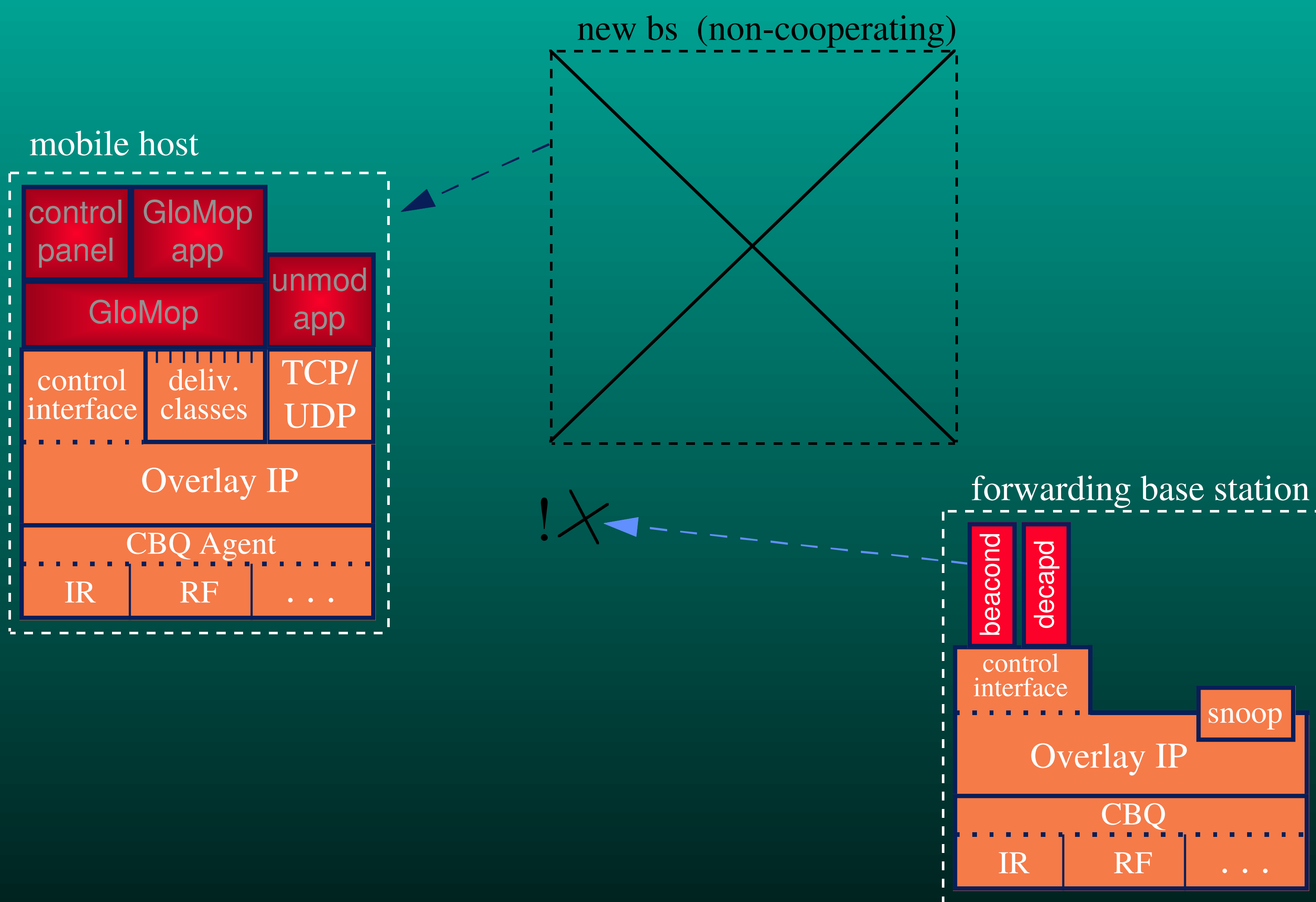


Dynamic Link Allocation

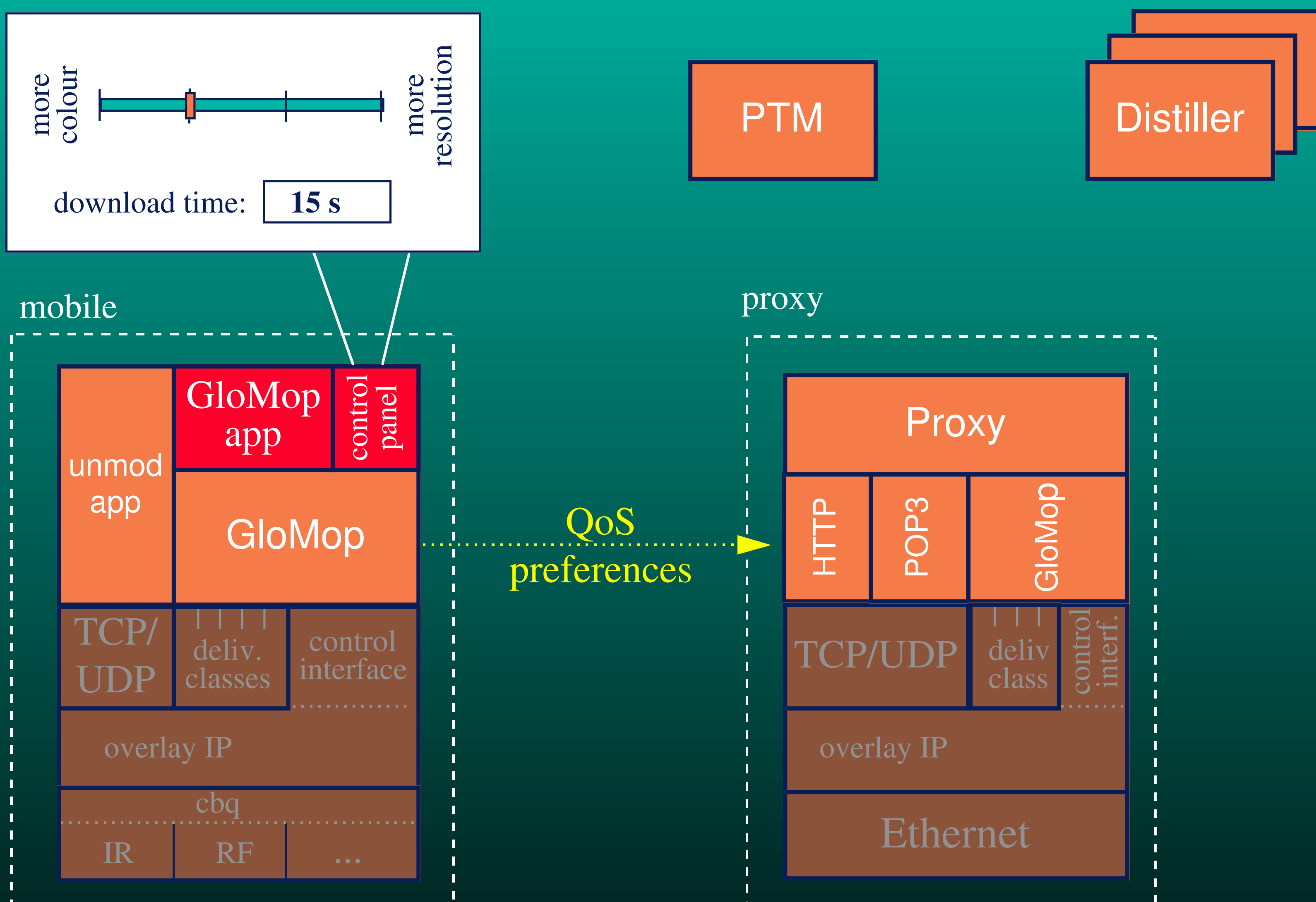


Handoff from WaveLAN to Metricom

(lost beacons)

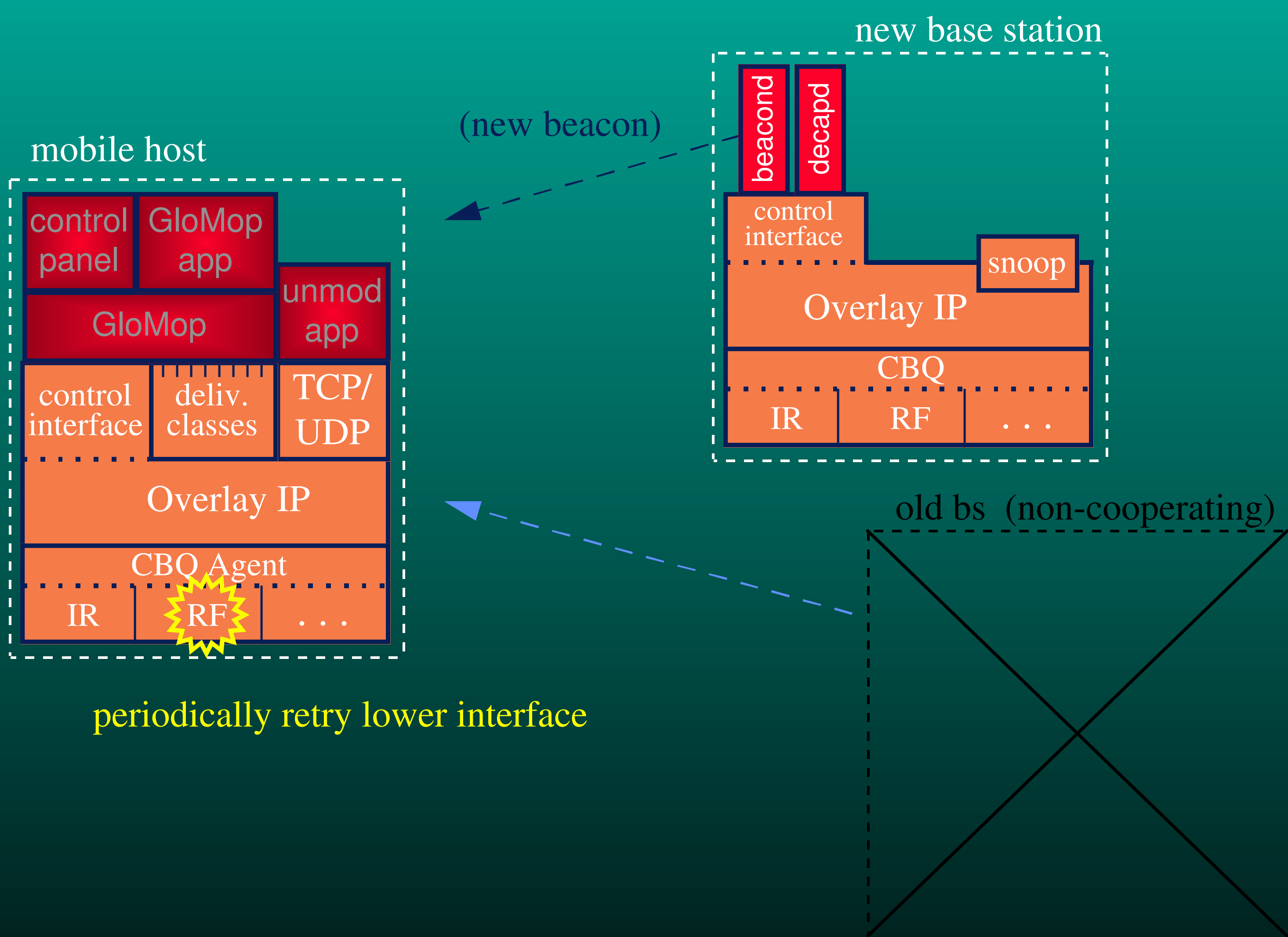


Flexible Refinement/QoS Mechanism



Handoff from Metricom to WaveLAN

(change of domain)



periodically retry lower interface

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Core Daedalus Architecture Summary

- Supports seamless roaming in heterogeneous and foreign environments
  - vertical and horizontal handoff support
- Custom Network Stack at MHs and (cooperating) BSs
  - unmodified corresponding hosts, home agents
  - compatibility with Mobile-IP
- Static assumptions about network characteristics
- Accepts handoff “hints” to handoff controller
- Some protocol-specific network optimization
  - TCP snoop

Extended Daedalus Architecture Summary

- Adds custom network stack at proxy host
  - delivery class abstraction for data-type specific transport
- Dynamic allocation at data link (hop by hop)
- Extensible, independent network services model
  - mechanisms facilitate localized policy decisions
- Dynamic measurement and notification of changes in network characteristics (via NCM)
- Network performance enhancements
  - low-latency handoff
  - hierarchical foreign agents
  - additional transport-layer optimizations

Core Proxy Architecture Summary

- Unmodified apps, application-specific protocols
  - proxy mechanism is either transparent to or already supported by the application
  - functionality and efficiency limited by the application’s protocol
- On-the-fly distillation and refinement possible
  - client and network adaptation, unmodified servers
  - proxy optimizations (prefetching, caching)
  - dynamic network adaptation is missing (no NCM)
- Loose coupling with Daedalus stack

Extended Proxy Architecture Summary

- Pluggable proxy architecture
  - support for both modified and unmodified apps
  - separation of load-balancing concerns into PTM
- GloMop application support layer
  - efficient custom protocol
  - explicit refinement and QoS mechanisms
- Authenticated proxied services
- Tight coupling with Daedalus stack
  - dynamic network adaptation via NCM
  - allow delivery policy through delivery classes

Some Open Issues

- Elements of the service architecture
  - complex element interaction and inter-dependency
  - the metering mechanism is not fully resolved
- Multiple simultaneous network interfaces
  - multiplexing of application data
  - undesirable for power-management
- Link-layer state on handoff
  - is state transfer necessary?
  - how to deliver data queued in base-station
  - different link-management policy in new network?
- Network connection monitor
  - stability and granularity of statistics

Some Open Issues (continued)

- Function migration
  - "Evil Twin" versus protocol filters at the proxy
  - can Rover-style migration coexist?
- Time-constant for proxy-adaptation
  - how quickly does it adapt, and to what granularity of network variation?
  - should the proxy receive adaptation hints?
- User interface issues
  - understanding and specifying constraints
  - data-type specific refinement controls
  - per-chunk, per-document, and per-session constraints