Inter Access Point Protocol

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Agenda

- Introduction
- Goals
- History
- Requirements
- Architecture
- Specifications
- Conclusion

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Introduction

- Wireless Networks introduce new concepts
  - Medium is unbounded, but range is limited.
  - End nodes can be mobile.
- IEEE 802.11 is developing a Wireless LAN standard.
  - Standard is in final stage, expected to go to Sponsor Ballot.
  - 802.11 defines MAC and PHY specifications, "Air Interface" only.
  - Provides basic primitives to support mobility.
- IEEE 802.11 extends its coverage beyond the range of its PHY through a Distribution System.
  - Distribution System connects multiple AP to form an ESS.
  - However, the Distribution System is not specified.
  - This represents an interoperability issue at the system level.

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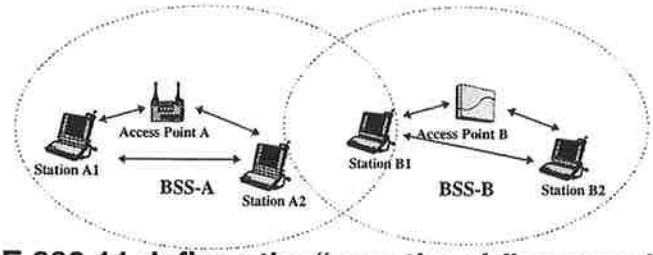
IEEE 802.11 architecture



- IEEE 802.11 defines the "over the air" protocol.

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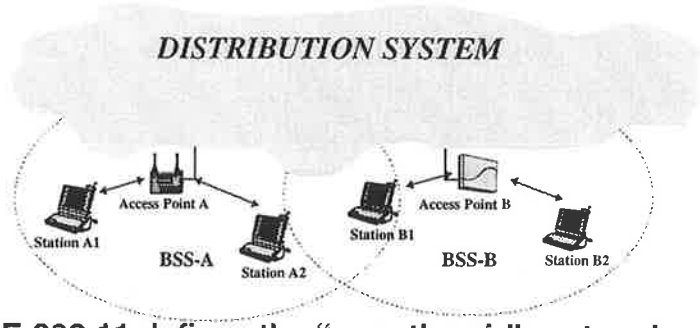
IEEE 802.11 architecture



- IEEE 802.11 defines the "over the air" protocol.
- Range extension through use of a Distribution System.

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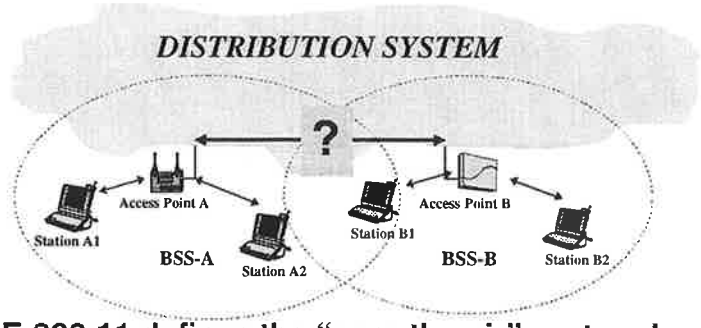
IEEE 802.11 architecture



- IEEE 802.11 defines the "over the air" protocol.
- Range extension through use of Distribution System.
- AP to AP protocol is not defined by 802.11.

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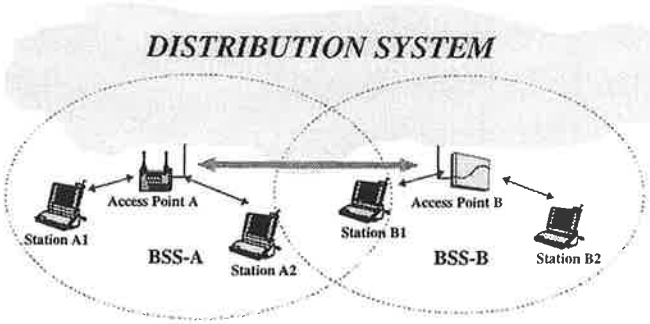
The Missing Link



- A standard protocol for Access Point communication.

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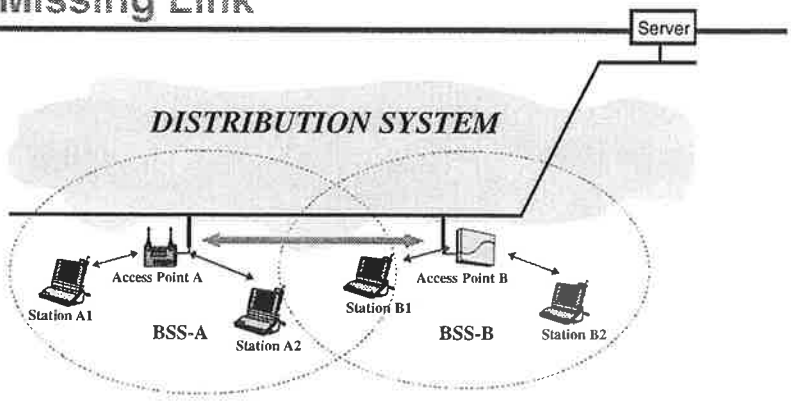
The Missing Link



- A standard protocol for Access Point communication.
- A particular Distribution System Medium.
  - based on existing LAN standards

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Goals of this initiative

- Specify the "missing link" for Wireless LAN systems interoperability.
  - to support mobility of end nodes
- Enable multivendor Distribution Systems.
  - based on existing network standards
  - by specifying IAPP, the protocol between Access Points
- Aironet , Digital Ocean and Lucent Technologies have developed an initial specification.
  - It is published as an "open voluntary standard".
  - To solicit feedback by interested parties

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History

- IEEE 802.11 started work in 1990.
  - Its PAR specifies support for range extension and mobility.
  - 802.11 decided early on not to specify the Distribution System.
    - » it is beyond IEEE 802 MAC level authority
    - » Distribution System requires Network and Transport layer functionality
  - 802.11 specifies the services the Distribution System must provide
- There were a number of attempts to specify interoperability functions on the Distribution System.
  - The term IAPP was introduced in IEEE P802.11-94/17.
  - IEEE P802.11-95/188 by Michael Fischer proposed a limited Distribution System by introduction of the MESS.
- Aironet, Digital Ocean and Lucent Technologies provide an initial specification of the IAPP.

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General IAPP requirements

- Build upon specified 802.11 functionality.
- Use existing networks to serve as the Distribution System Medium.
  - Existing 802 wired Networks
  - 802.11 Wireless LANs
- Support a wide range of Network transfer protocols.
  - Support MAC level Bridge based Data Link level implementations
  - Support Router based Network layer implementations
    - » Allow multi-segment IAPP
    - » Not intended to solve addressing issues for Network layer mobility.
- Allow for different network Management topologies.
- Provide mechanisms to allow APs to communicate with each other.
- The IAPP should be flexible and extendable.
  - allow proprietary extensions

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Architecture background

- The 802.11 architecture is designed to allow diverse Distribution System implementations:
  - The DS may be created from different technologies including but not limited to current 802.x wired LANs.
  - It is not constrained to either Data Link or Network layer.
  - Its addressing space can be separate from the addressing space used in the DS or integrated wired LAN.
- This IAPP initiative focuses on a set of solutions representing a typical case.
  - Distribution Systems based on existing 802.x wired LANs.
    - » The Distribution Medium (DM) can be an existing LAN with stations connected.
    - » With 802.11 and DM using the same MAC level address space.

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IAPP Architecture

- IAPP defines a communication mechanism between APs.
  - to allow for coordination between APs
  - to exchange channel or hop sequence information
- IAPP allows AP MAC Management entities to communicate.
  - to enable a station to disassociate from the "Old AP"
  - to redirect the Distribution System filtering functions
- Two transfer protocols will be implemented.
  - UDP/IP
    - » used whenever an IP address is present in the AP
  - 802.2 Sub-Network Access Protocol (SNAP)
    - » for simpler systems when no IP Address is present

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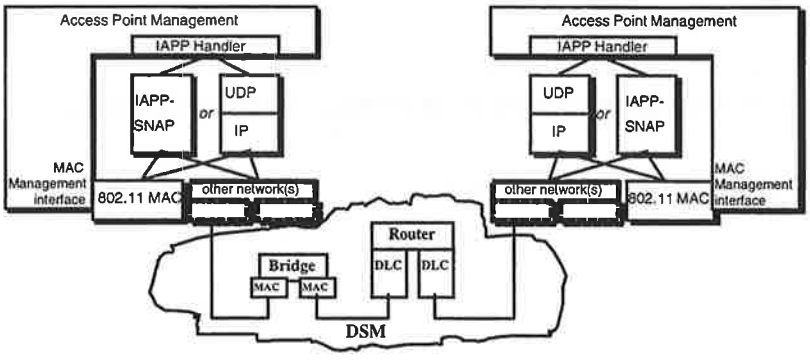
IAPP Architecture



- Distribution System Medium can be built from existing networks
  - including 802.11 wireless LANs

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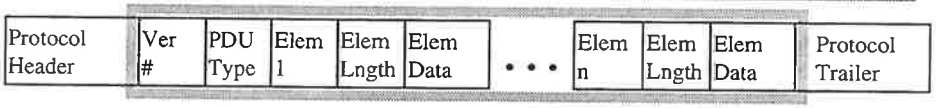
General IAPP Message Format



- **Protocol Header:** SNAP or UDP/IP protocol Header.
- **Ver#:** IAPP Version number.
- **PDU-Type:** Identifies Specific PDU.
- **n * PDU element:** PDU data element fields.
  Following 802.11 element format
  - **Element-ID:** Element identification
  - **Length:** Length of element data field in octets.
  - **Data:** Data of the element.

- **Messages can be specifically addressed to one AP, or group addressed to all APs.**

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Basic IAPP protocol functions

- **IAPP Announce Protocol**
  - **to facilitate AP awareness and coordination**
  - **to support the formation of Wireless Distribution Systems**

- **IAPP Handover Protocol**
  - **to extend the 802.11 Re-Association MAC management function across the distribution system**

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IAPP Announce Protocol

- IAPP Announce protocol:
  - Inform other APs and/or network management functions that a new AP has become active.
  - Inform other APs and/or network management functions of the continued operation of that AP.
  - Allow APs to communicate their configuration.
  - Allow for network Management function to provide AP coordination.
- Associated PDU Types:
  - » Announce.Request
  - » Announce.Response
- Supports centralized or distributed AP coordination, and allows autonomous operation in uncoordinated environments.
- Provides a means for Wireless APs to "Register" with other APs.
  - enables creation of a Wireless Distribution System

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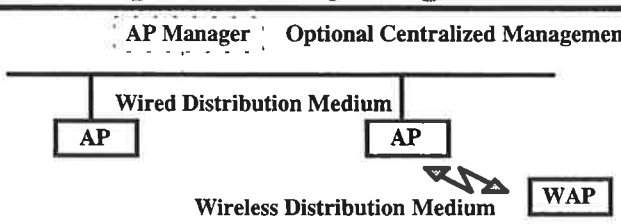
AP management topologies



- Topologies supported:
  - Uncoordinated APs
  - Centralized AP Management
  - Distributed AP Management
- Provides for "Management level AP awareness"
  - Needed to configure wireless Distribution Systems.
  - This is not covered by 802.11.

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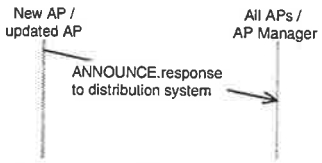
Uncoordinated APs

- New AP generates Announce.response.
  - sent as a general Broadcast
- Allows AP to identify itself and its operational status.



Uncoordinated AP

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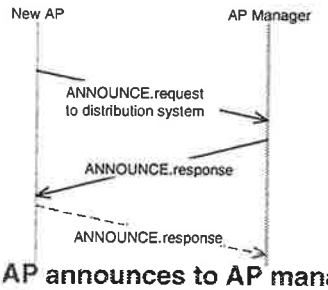
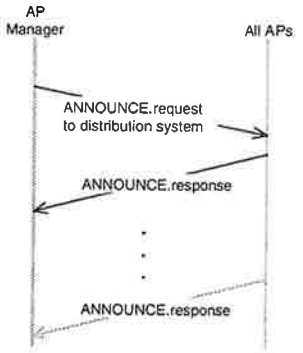
Centralized AP Management

- Announce.request generated by new AP.
  - AP manager will respond (with Master bit set).
- AP manager can query AP's by sending Announce.requests.
  - with "Response desired" enabled



New AP announces to AP manager



AP Manager query of all APs

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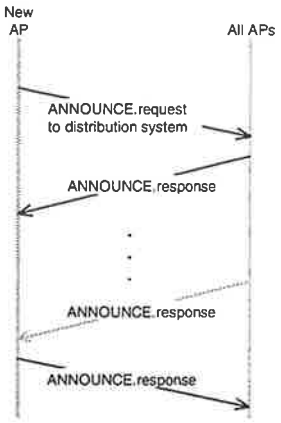
Distributed Control

- New AP generates Announce.request
  - with "Response desired" enabled.
- Other APs send Announce.response
- New AP generates Announce.response
  - Indicating its operational status.
- APs can generate Announce.response messages periodically as an "Alive indication".



Distributed Control

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IAPP Handover Protocol

- IAPP Handover Protocol:
  - Inform the "old AP" that a station has associated with a new AP.
    - » To release resources assigned to that station by the old AP.
    - » To allow optional frame forwarding of buffered frames,
    - » or discard them.
  - Update filter tables of intermediate MAC layer Bridges.
    - » By using the "Mobile Station Source address" as the SA of the handover request message.
- Associated PDU Types:
  - » Handover.Request
  - » Handover.Response.

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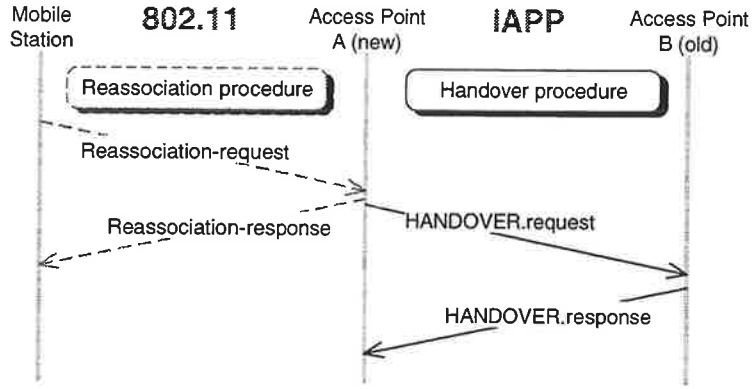
Handover procedure



- **Relationship between 802.11 reassociation and IAPP handover.**

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PDU Elements

• ESSID	as in 802.11
• BSSID	as in 802.11
• Old BSSID	as in 802.11
• MS-Address	Mobile Station address
• IAPP capability/Status	
• Announce interval	in Kusec
• Handover Timeout	in Kusec
• PHY type	identify 802.11 PHY
• Regulatory Domain	as in 802.11 MIB
• Channel	PHY dependent
• Beacon Interval	as in 802.11
• OUI Company identifier	Precedes block of proprietary elements.
– Proprietary elements	Following OUI Company ID only.

Element Usage

- Element use per PDU type:
  - fixed elements are specified
  - other elements are optional
- Proprietary elements are allowed.
  - receivers ignore elements they don't understand
- OUI Company ID precedes block of proprietary elements.
  - This prevents Element ID conflicts.
    - » (OUI, Element ID) tuple will be unique

Conclusion

- IAPP provides the "missing link" in Wireless networking.
  - interoperability between multiple vendor AP implementations
- IAPP is compatible with IEEE 802.11.
  - it builds upon the 802.11 functionality
- IAPP enables a multitude of AP management schemes.
  - with support across Bridges and Routers
- IAPP is scalable for the future.
  - element structure allows for migratable extensions
  - proprietary extensions are allowed

How to continue

- Short term
  - Comments on the IAPP are solicited from all interested parties.
  - Specification is maintained by Aironet and Lucent Technologies.
  - New versions are distributed via:
    - » IEEE Email reflector
    - » Web sites
  - Aironet, Digital Ocean and Lucent Technologies agree to implement IAPP in their 802.11 products
- Long term: Consensus of the meeting:
  - A lot of interest to move forward with this proposal.
  - Proposal to present it to 802.1 Technical plenary to see where it should belong.
    - » Do this in November, to prevent impact on 802.11 Sponsor ballot
    - » Would be very useful as informative annex to 802.11, but not now.