doc: IEEE P802.11-94/213A
Revised MAC Frame Formats

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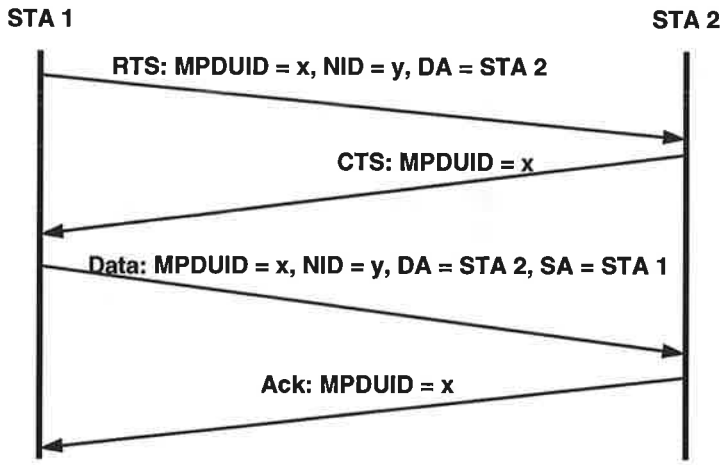
B2 Overall Operation

- There are two binary flags controlling the operation of a STA
  - Infrastructure
  - Acting_as_AP
- The combo of these bits defines a station's role in the network

Inf	AP	Role
1	0	STA in infrastructure
1	1	AP in infrastrucure
0	0	STA in ad-hoc
0	1	Nonsensical

How the B2 draft works



B2 Processing
Transmit RTS

Compute MPDUID
Form RTS from MPDUID, NID, final DA, Duration, & misc. bits
Transmit RTS

B2 Processing
Receive RTS

```
if (Infrastructure && Acting_as_AP && ToAP && NID == MyNID) { // AP
    receive RTS
    set NAV
    transmit CTS
}
else if (!Acting_as_AP && !ToAP && DA == MA) { // STA of some sort
    receive RTS
    ...
}
else {
    NAV = Duration
    ignore RTS
}
```

B2 Processing
Transmit CTS

Copy MPDUID and Duration from RTS into CTS
Transmit CTS

B2 Processing
Receive CTS

```
if (MPDUID == RTSMPDUID) {
    transmit data
}
else {
    NAV = Duration
    ignore CTS
}
```

B2 Processing
Transmit Data

```
if (Infrastructure && Acting_as_AP) { // AP
    NID = MyNID, DA = True DA, SA = True SA
    ToAP = 0
}
else if (Infrastructure && !Acting_as_AP) { // STA in Infra
    NID = MyNID, DA = True DA, SA = MA
    ToAP = 1
}
else { // STA in ad-hoc
    NID = MyNID, DA = True DA, SA = MA
    ToAP = 0
}
Transmit Data Frame
```

B2 Processing
Receive Data

```
if (Infrastructure && Acting_as_AP && ToAP && NID == MyNID) { //AP
    receive frame
    NAV = Duration
    transmit Ack
}
else if (!Acting_as_AP && !ToAP && DA == MA) { // STA
    receive frame
    ...
}
else {
    NAV = duration
    ignore data frame
}
```

B2 Processing
Transmit Ack

Copy Data frame MPDUID, Duration, and Frag# to the Ack

Transmit the Ack

B2 Processing Receive Ack

```
if (MPDUID == DataMPDUID) {
    transmission complete
    next fragment
}
else {
    NAV = Duration
    ignore Ack
}
```

MPDUID

- MPDUID = hash(NID, SA, Seq #)
- MPDUID is overloaded
  - Used to detect and eliminate duplicates
  - Matches RTS, CTS, Data, Ack together

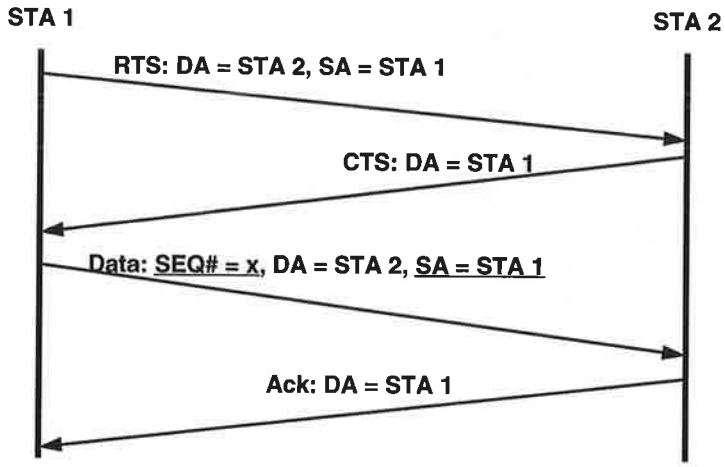
MPDUID Problems

- It's not very unique
  - Only two bytes
- Can cause non-duplicates to be rejected
  - If someone else hash's down to the same MPDU
- Can cause RTS/CTS/Data/Ack to be mismatched
  - Since frames are tied together using just MPDUID rather than the addresses of the source and destination, you could receive a CTS from someone else

MPDUID Fix

- Since you have a Seq # anyway, use it instead
- Perform duplicate detection using (SA, Seq #) pair
- Use directed RTS/CTS/Data/Ack to eliminate possibility of mismatching

MPDUID Fix Example



MPDUID Fix Benefits

- You get better filtering
- You get better matching of RTS/CTS/Data/Ack
- You don't have to compute a hash

NID

- NID = concat(1-bit Inf/AdH, 13-bit ESSID, 10-bit BSSID)
- NID is overloaded
  - Used by APs as an address match field
  - ESSID portion is used by STAs to identify APs as belonging to an administrative domain
  - Used to identify an ad-hoc BSS

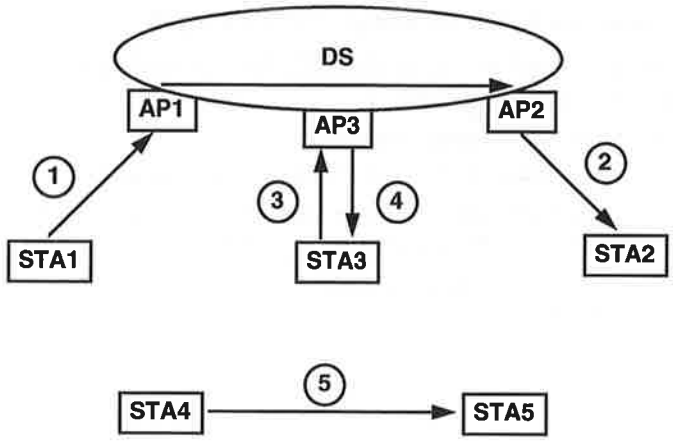
NID Problems

- It requires work to keep them unique
- Human must ensure that ESSID is unique for any overlapping ESSs
  - Difficult in multi-office buildings
  - It's only 13 bits, so there isn't much uniqueness
- Human must ensure that BSSID within ESSID is unique for all overlapping BSSs
  - Requires human to keep paperwork of which BSSIDs have been used and where they are

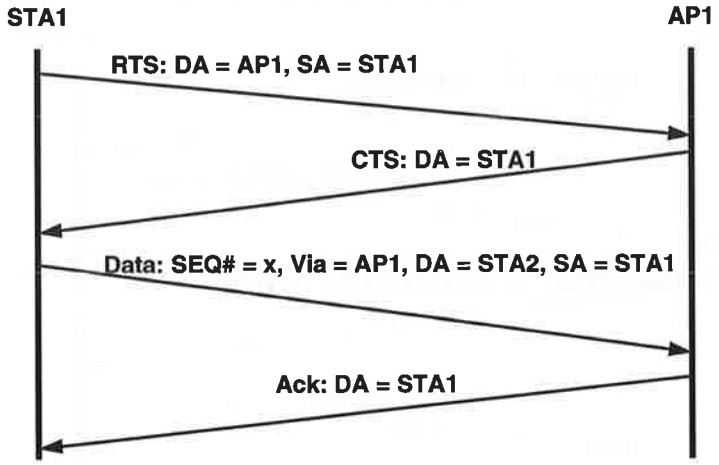
NID Fix

- Make NID = 48-bit address of AP
  - Now NID essentially is a BSSID
  - Ad-Hoc handled specially (later slide)
- Rename NID to "Via"
- Via amounts to the address of the AP a STA is associated with (MyAP)
- Leave ESSID only in Beacon/Probe Response frames
  - Since NID is now unique, ESSID is only needed to distinguish APs belonging to an administrative domain while looking for new APs to associate with
- Make ESSID a variable length string
  - No longer impacts header size

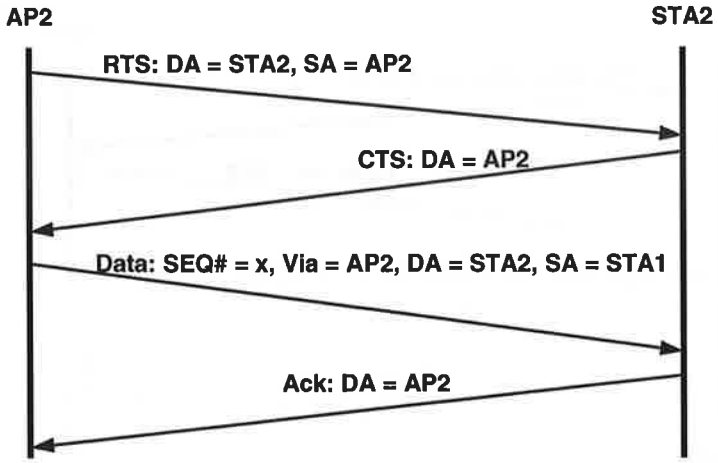
Example Cases



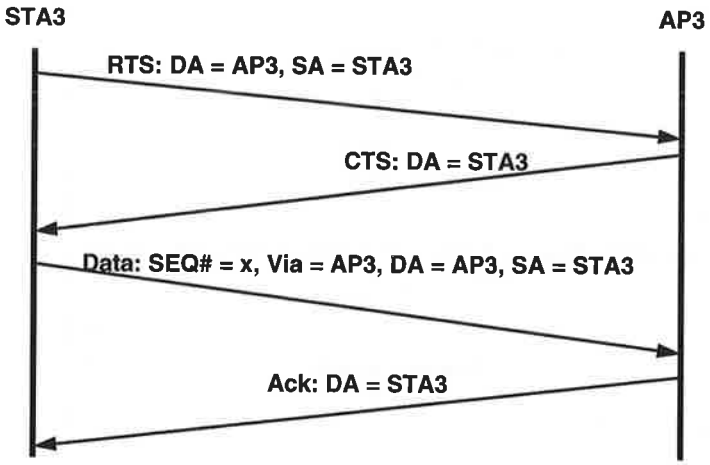
Case 1: From STA 1 to STA 2 enter DS through AP1



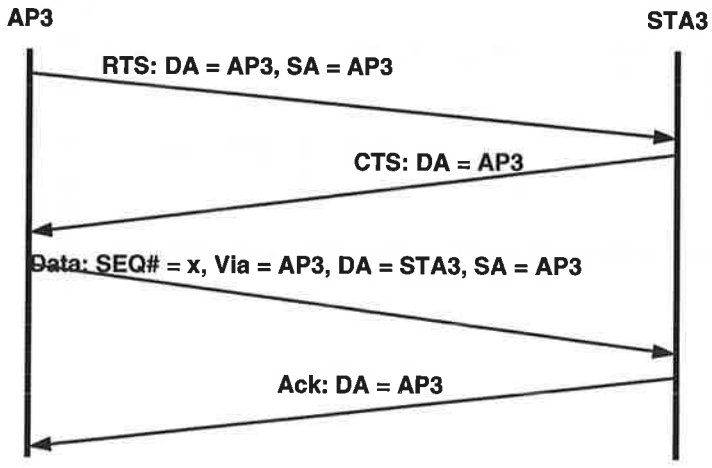
Case 2: From STA 1 to STA 2 exit DS through AP2



Case 3: Management frame from STA 3 to AP3



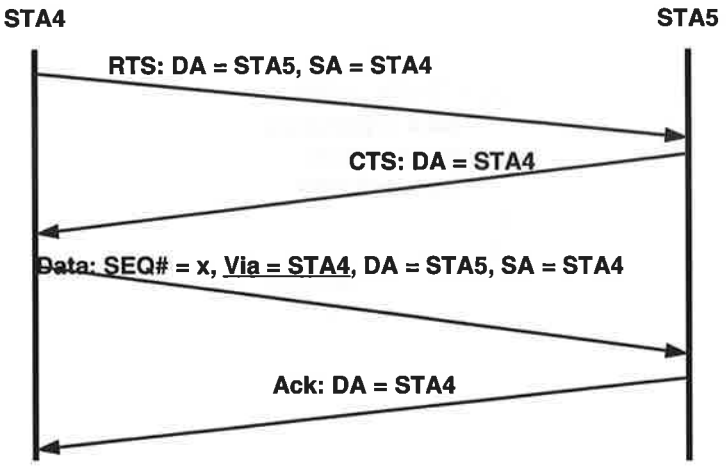
Case 4: Management frame from AP3 to STA3



Via and Ad-Hoc

- In Ad-Hoc BSSs, set the Via field to the originator of the frame

Case 5: Ad-hoc frame from STA 4 to STA 5



New Processing Transmit RTS

```
if (Infrastructure && !Acting_as_AP) { // Infra STA
    RTS DA = MyAP
}
else { // AP or Ad-hoc STA
    RTS DA = Final DA
}
Fill in SA=MA & Duration
Transmit RTS
```

New Processing Receive RTS

```
if (RTS DA == MA) {
    NAV = Duration
    receive RTS
    transmit CTS
}
else {
    NAV = Duration
    ignore RTS
}
```

New Processing Transmit CTS

Copy RTS SA to CTS DA
Copy RTS Duration to CTS Duration
Transmit CTS

New Processing Receive CTS

```
if (CTS DA == MA) {
    receive CTS
    transmit Data
}
else {
    NAV = Duration
    ignore CTS
}
```

New Processing Transmit Data

```
if (Infrastructure && Acting_as_AP) { // AP
    Via = MA, DA = True DA, SA = True SA
    ToAP = 0
}
else if (Infrastructure && !Acting_as_AP) { // Infra STA
    Via = MyAP, DA = True DA, SA = MA
    ToAP = 1
}
else { // Ad-hoc STA
    Via = MA, DA = True DA, SA = MA
    ToAP = 0
}
Fill in Duration, Frag#, etc.
Transmit Data
```

New Processing Receive Data

```
if (Acting_as_AP && ToAP && Via == MA) { // AP
    receive frame
    NAV = Duration
    transmit Ack
}
else if (!Acting_as_AP && !ToAP && DA == MA) { // STA
    receive frame
    ...
}
else {
    NAV = Duration
    ignore Data
}
```

New Processing Transmit Ack

```
if (Acting_as_AP) { // AP
    Ack DA = Data SA
}
else { // STA
    Ack DA = Via
}
Copy Duration, Frag#, etc.
Transmit Ack
```

New Processing Receive Ack

```
if (DA == MA) {
    transmission complete
    next fragment
}
else {
    NAV = Duration
    ignore Ack
}
```

Processing Complexity Summary

Action	Change (B2 to New)
Tx RTS	Much less (no MPDUID computation)
Rx RTS	Slightly less
Tx CTS	Same
Rx CTS	Same
Tx Data	Same
Rx Data	Same
Tx Ack	Slightly more
Rx Ack	Same
Overall	Less complex

Frame Fields Summary

Field:	FC	Via	DA	SA	Seq#	Frag	Dur	B2 Len	New Len
Size	2	6	6	6	1	1	2		
Frame									
RTS	x		x	x			x	16	16
CTS	x		x				x	7	10
Data	x	x	x	x	x	x	x*	23	24
Ack	x		x				x**	8	10

* Data frame duration is for next fragment
**Ack duration is duration of next fragment and is copied from Data frame duration

Via Fix Benefits

- Take advantage of the fact that all APs already have a unique identifier that is universally administered
- Network manager has virtually no administration to set up an AP
  - No longer needs to choose and administer a unique BSSID
- Better for "shrink-wrap" products

ESSID Details

- One role that NID filled was to identify APs belonging to an ESS via the ESSID portion of NID contained in Beacons and Probe Responses
- Do same thing but with larger, more descriptive field

ESSID Fix Benefits

- Since it's only in Beacon/Probe Responses, it doesn't have to be short
- It can be much more descriptive
  - E.G., "FooBar Corp. WLAN 1"
  - Helps diagnose problems
- Much less chance of collisions
- Better for "shrink-wrap" products

Frame Control Field