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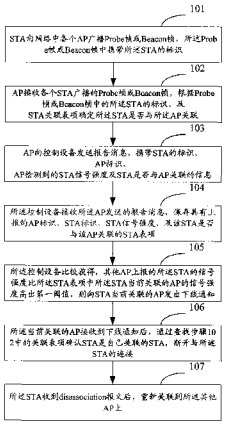
(54)发明名称

一种 WLAN 网络中 STA 漫游的方法及装置

(57)摘要

本发明公开了一种 WLAN 网络中 STA 漫游的方法，包括：所述控制设备接收所述 AP 发送的报告消息，所述报告消息中携带所述 AP 检测到的 STA 信号强度及所述 STA 是否与所述 AP 关联的信息；所述控制设备保存具有 STA 的信号强度及关联的 AP 的 STA 表项；在预设周期内，所述控制设备比较获得，其他 AP 上报的所述 STA 的信号强度比所述 STA 表项中所述 STA 当前关联的 AP 的信号强度高出第一阈值，则向所述 STA 当前关联的 AP 发出下线通知，使所述当前关联的 AP 断开与所述 STA 的连接，并使所述 STA 重新关联到所述其他 AP 上。本发明提高了 STA 漫游时的网络性能，和原有标准兼容，不需要客户端做任何改动。



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1. 一种 WLAN 网络中 STA 漫游的方法，应用于包括 STA、控制设备和至少两个接入点 AP 的系统中，其特征在于，所述方法包括以下步骤：

所述控制设备接收所述 AP 发送的报告消息，所述报告消息中携带上报的 AP 标识、STA 标识、STA 信号强度、及该 STA 是否与该 AP 关联；

所述控制设备将所述上报的 AP 标识、STA 标识、STA 信号强度、及该 STA 是否与该 AP 关联保存到 STA 表项；

在预设周期内，所述控制设备比较获得，其他 AP 上报的所述 STA 的信号强度比所述 STA 表项中所述 STA 当前关联的 AP 的信号强度高出第一阈值，则向所述 STA 当前关联的 AP 发出下线通知，使所述当前关联的 AP 断开与所述 STA 的连接，并使所述 STA 重新关联到所述其他 AP 上。

2. 如权利要求 1 所述的方法，其特征在于，所述控制设备接收所述 AP 发送的报告消息，之前还包括：

所述 AP 接收各个 STA 广播的 Probe 帧或 Beacon 帧，所述 Probe 帧或 Beacon 帧中携带所述 STA 的标识；

所述 AP 根据所述 STA 的标识与本地记录的 STA 关联表项确定所述 STA 是否与所述 AP 关联；

所述 AP 向所述控制设备发送报告消息，所述报告消息中携带上报的 AP 标识、STA 标识、所述 AP 检测到的 STA 信号强度及所述 STA 是否与所述 AP 关联的信息。

3. 如权利要求 2 所述的方法，其特征在于，所述 AP 向所述控制设备发送报告消息，具体包括：

所述 AP 收到某个 STA 的 Probe 帧或 Beacon 帧后，等待预设时间，计算所述预设时间内收到的关于所述 STA 的多个 Probe 帧或 Beacon 帧中的 STA 的信号强度平均值；

所述 AP 通过报告消息将所述 STA 的信号强度平均值及所述 STA 是否与所述 AP 关联的信息发送给所述控制设备。

4. 如权利要求 1 所述的方法，其特征在于，所述控制设备保存具有 STA 的信号强度及关联的 AP 的 STA 表项，具体包括：

所述控制设备收到报告消息后，判断是否没有其他 AP 报告所述 STA 的信号强度，如果没有，则创建所述 STA 表项；如果有，则将所述报告消息中的信息添加到所述 STA 表项中。

5. 如权利要求 1 所述的方法，其特征在于，所述使当前关联的 AP 断开与所述 STA 的连接，并使所述 STA 重新关联到所述其他 AP 上，具体包括：

所述 AP 判断所述 STA 是否正在和自己关联，如果是，则向所述 STA 发送断开连接报文；

所述 STA 接收到所述断开连接报文后，终止与所述当前关联 AP 的连接，向所述其他 AP 发送连接建立请求，以关联到所述其他 AP 上。

6. 如权利要求 5 所述的方法，其特征在于，所述断开连接报文中还携带原因值，用于指示切换原因。

7. 一种接入点，应用于包括 STA、控制设备和至少两个接入点 AP 的系统中，其特征在于，所述接入点包括：

收集模块，用于接收各个 STA 广播的 Probe 帧或 Beacon 帧，所述 Probe 帧或 Beacon 帧中携带所述 STA 的标识；

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上报模块，与所述收集模块连接，用于根据所述STA的标识与本地记录的STA关联表项确定所述STA是否与所述AP关联，并向所述控制设备发送报告消息，所述报告消息中携带上报的AP标识、STA标识、STA信号强度、及该STA是否与该AP关联的信息；

下线模块，用于收到下线通知时，判断所述STA是否正在和自己关联，如果是，则向所述STA发送断开连接报文，终止与所述STA的连接。

8. 如权利要求7所述的接入点，其特征在于，所述收集模块，具体用于收到某个STA的Probe帧或Beacon帧后，等待预设时间，计算所述预设时间内收到的关于所述STA的多个Probe帧或Beacon帧中的STA的信号强度平均值，通过报告消息将所述STA的信号强度平均值及所述STA是否与所述AP关联的信息发送给所述控制设备。

9. 一种控制设备，应用于包括STA、控制设备和至少两个接入点AP的系统中，其特征在于，所述控制设备包括：

接收模块，用于接收所述AP发送的报告消息，所述报告消息中携带上报的AP标识、STA标识、STA信号强度、及该STA是否与该AP关联的信息；

表项存储模块，与所述接收模块连接，用于保存具有上报的AP标识、STA标识、STA信号强度、及该STA是否与该AP关联的STA表项；

下线通知模块，与所述表项存储模块连接，用于在预设周期内，所述控制设备比较获得，其他AP上报的所述STA的信号强度比所述STA表项中所述STA当前关联的AP的信号强度高出第一阈值，则向所述STA当前关联的AP发出下线通知，使所述当前关联的AP断开与所述STA的连接，并使所述STA重新关联到所述其他AP上。

10. 如权利要求9所述的控制设备，其特征在于，所述表项存储模块，具体用于所述控制设备收到报告消息后，判断是否没有其他AP报告所述STA的信号强度，如果没有，则创建所述STA表项；如果有，则将所述报告消息中的信息添加到所述STA表项中。

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一种 WLAN 网络中 STA 漫游的方法及装置

技术领域

[0001] 本发明涉及通信技术领域，尤其涉及一种 WLAN 网络中 STA 漫游的方法及装置。

背景技术

[0002] WLAN(Wireless Local Access Network，无线局域网）提供了一种局域网的无线连接服务，WLAN 由于能够提供高速的无线数据接入，是目前 IT 行业比较热门的技术之一，已经广泛地应用于城市、公共场所覆盖，以及企业、楼宇、家庭等各种场所。

[0003] WLAN 提供了 ESS(Extended Service Set，扩展服务集）服务，在同一 ESS 覆盖范围内，STA(STAtion，无线客户端）能够关联到不同 AP(AccessPoint，无线接入点）上，通过 WLAN 获得网络服务，并能够无缝漫游。其中，同一 ESS 由多个 AP 提供相同的 SSID(Service Set Identifier，服务集标识），并形成连续覆盖区域，使得 STA 在覆盖范围内能够无缝进行越区切换。但在实际应用中发现，许多 STA 在漫游过程中效果不佳，不能及时切换到合适的 AP 上。

[0004] 在目前的 802.11 标准中，切换策略和切换行为完全是由 STA 决定，而标准也没有对这方面做出任何规定。实际使用中发现，一些 STA 采用了“盯住”策略，即当前关联的 AP 的信号强度没有降低到最低门限时不会切换到新的 AP 上。另一些 STA 能够比较 AP 间的信号强度，当发现某个 AP 的信号强度比当前关联的 AP 的信号强度大于某个阈值时，就会进行切换。由于 STA 通过周期性发送 Probe 或 Beacon 帧发现新 AP，为了减少扫描对应用性能的影响，STA 扫描 AP 的周期一般比较大，从而导致新的 AP 不能及时发现，或者各个 AP 的信号强度不能及时得到更新。

[0005] 在实际使用中发现，目前许多厂家的 STA 在漫游时不能及时切换到合适 的 AP 上，导致流量下降。通过比较 AP 间信号强度的 STA，STA 的默认切换阈值可能不可设，切换阈值过大，造成切换很慢；或者切换阈值可设，但使用 STA 的用户不会或不愿意修改，因此，不能顺利切换。

发明内容

[0006] 本发明提供了一种 WLAN 网络中 STA 漫游的方法及装置，以实现 STA 在漫游时及时切换到合适的 AP 上。

[0007] 本发明提供了一种 WLAN 网络中 STA 漫游的方法，应用于包括 STA、控制设备和至少两个接入点 AP 的系统中，所述方法包括以下步骤：

[0008] 所述控制设备接收所述 AP 发送的报告消息，所述报告消息中携带上报的 AP 标识、STA 标识、STA 信号强度、及该 STA 是否与该 AP 关联；

[0009] 所述控制设备将所述上报的 AP 标识、STA 标识、STA 信号强度、及该 STA 是否与该 AP 关联保存到的 STA 表项；

[0010] 在预设周期内，所述控制设备比较获得，其他 AP 上报的所述 STA 的信号强度比所述 STA 表项中所述 STA 当前关联的 AP 的信号强度高出第一阈值，则向所述 STA 当前关联的

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AP 发出下线通知，使所述当前关联的 AP 断开与所述 STA 的连接，并使所述 STA 重新关联到所述其他 AP 上。

[0011] 其中，所述控制设备接收所述 AP 发送的报告消息，之前还包括：

[0012] 所述 AP 接收各个 STA 广播的 Probe 帧或 Beacon 帧，所述 Probe 帧或 Beacon 帧中携带所述 STA 的标识和所述 STA 的信号强度；

[0013] 所述 AP 根据所述 STA 的标识与本地记录的 STA 关联表项确定所述 STA 是否与所述 AP 关联；

[0014] 所述 AP 向所述控制设备发送报告消息，所述报告消息中携带上报的 AP 标识、STA 标识、所述 AP 检测到的 STA 信号强度及所述 STA 是否与所述 AP 关联的信息。

[0015] 其中，所述 AP 向所述控制设备发送报告消息，具体包括：

[0016] 所述 AP 收到某个 STA 的 Probe 帧或 Beacon 帧后，等待预设时间，计算所述预设时间内收到的关于所述 STA 的多个 Probe 帧或 Beacon 帧中的 STA 的信号强度平均值；

[0017] 所述 AP 通过报告消息将所述 STA 的信号强度平均值及所述 STA 是否与所述 AP 关联的信息发送给所述控制设备。

[0018] 其中，所述控制设备保存具有 STA 的信号强度及关联的 AP 的 STA 表项，具体包括：

[0019] 所述控制设备收到报告消息后，判断是否没有其他 AP 报告所述 STA 的信号强度，如果没有，则创建所述 STA 表项；如果有，则将所述报告消息中的信息添加到所述 STA 表项中。

[0020] 其中，所述使当前关联的 AP 断开与所述 STA 的连接，并使所述 STA 重新关联到所述其他 AP 上，具体包括：

[0021] 所述 AP 判断所述 STA 是否正在和自己关联，如果是，则向所述 STA 发送断开连接报文；

[0022] 所述 STA 接收到所述断开连接报文后，终止与所述当前关联 AP 的连接，向所述其他 AP 发送连接建立请求，以关联到所述其他 AP 上。

[0023] 其中，所述断开连接报文中还携带原因值，用于指示切换原因。

[0024] 本发明还提供了一种接入点，应用于包括 STA、控制设备和至少两个接入点 AP 的系统中，所述接入点包括：

[0025] 收集模块，用于接收各个 STA 广播的 Probe 帧或 Beacon 帧，所述 Probe 帧或 Beacon 帧中携带所述 STA 的标识；

[0026] 上报模块，与所述收集模块连接，用于根据所述 STA 的标识与本地记录的 STA 关联表项确定所述 STA 是否与所述 AP 关联，并向所述控制设备发送报告消息，所述报告消息中携带上报的 AP 标识、STA 标识、STA 信号强度、及该 STA 是否与该 AP 关联；

[0027] 下线模块，用于收到下线通知时，判断所述 STA 是否正在和自己关联，如果是，则向所述 STA 发送断开连接报文，终止与所述 STA 的连接。

[0028] 其中，所述收集模块，具体用于收到某个 STA 的 Probe 帧或 Beacon 帧后，等待预设时间，计算所述预设时间内收到的关于所述 STA 的多个 Probe 帧或 Beacon 帧中的 STA 的信号强度平均值，通过报告消息将所述 STA 的信号强度平均值及所述 STA 是否与所述 AP 关联的信息发送给所述控制设备。

[0029] 本发明还提供了一种控制设备，应用于包括 STA、控制设备和至少两个接入点 AP

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的系统中，所述控制设备包括：

[0030] 接收模块，用于接收所述 AP 发送的报告消息，所述报告消息中携带上报的 AP 标识、STA 标识、STA 信号强度、及该 STA 是否与该 AP 关联；

[0031] 表项存储模块，与所述接收模块连接，用于保存具有上报的 AP 标识、STA 标识、STA 信号强度、及该 STA 是否与该 AP 关联的 STA 表项；

[0032] 下线通知模块，与所述表项存储模块连接，用于在预设周期内，所述控制设备比较获得，其他 AP 上报的所述 STA 的信号强度比所述 STA 表项中所述 STA 当前关联的 AP 的信号强度高出第一阈值，则向所述 STA 当前关联的 AP 发出下线通知，使所述当前关联的 AP 断开与所述 STA 的连接，并使所述 STA 重新关联到所述其他 AP 上。

[0033] 其中，所述表项存储模块，具体用于所述控制设备收到报告消息后，判断是否没有其他 AP 报告所述 STA 的信号强度，如果没有，则创建所述 STA 表项；如果有，则将所述报告消息中的信息添加到所述 STA 表项中。

[0034] 与现有技术相比，本发明具有以下优点：

[0035] 本发明中，AP 跟踪 STA 信号强度，在 STA 信号变弱时，强制 STA 下线，让 STA 切换新的 AP 上。因此，本发明通过 AP 推送方式，推动 STA 在漫游过程中及时切换，使 STA 在漫游过程中能够更及时地切换到新的 AP 上，提高了 STA 漫游时的网络性能，和原有标准兼容，不需要客户端做任何改动。

[0036] 附图说明

[0037] 图 1 是本发明中一种 WLAN 网络中 STA 漫游的方法流程图；

[0038] 图 2 是本发明中一种接入点结构图；

[0039] 图 3 是本发明中一种管理设备结构图。

[0040] 具体实施方式

[0041] 本发明的核心思路是：AP 监测 STA 信号强度，并将 STA 信号强度及是否与自己关联上报给 AC(Access Controller，无线接入控制器）或服务器，AC 或服务器根据各个 AP 报告的 STA 信号强度，判定 STA 应切换到新 AP 上而 STA 没有切换时，通知 AP 让 STA 下线，从而使得 STA 能够切换到新的 AP 上。

[0042] 本发明提供了一种 WLAN 网络中 STA 漫游的方法，应用于包括 STA、控制设备和至少两个接入点 AP 的系统中，本发明适用于 Fit AP 架构和 FAT AP 架构，在 Fit AP 架构中，控制设备为 AC，AC 可以旁挂于 BAS（宽带接入服务器）设备或串接于 AP 与 BAS 设备中间，AC 负责整个热点地区 AP 的管理，BAS 作为用户的认证点。当然，本发明也适用于 FATAP，需要一个具有 AC 功能的服务器，只需要在接入层添加 AP 设备即可，通过 ADSL(Asymmetrical Digital SubscriberLoop，非对称数字用户线路）或以太网专线接入到 BAS，再由 BAS 接入到城域网。无线用户一般采用 PPPoE(Point-to-Point Protocol over Ethernet，以太网上的点对点协议）或 WEB Portal 认证接入网络，BAS 作为无线用户的认证点。

[0043] 所述方法如图 1 所示，包括以下步骤：

[0044] 步骤 101，STA 向网络中各个 AP 广播 Probe 帧或 Beacon 帧，所述 Probe 帧或 Beacon 帧中携带所述 STA 的标识。

[0045] 其中，Beacon 帧由同步信道和 Beacon 信道共同构成，同步信道与 Beacon 信道分别在物理信道的 I 信道和 Q 信道上发送。同步信道由一系列同步突法帧构成，RTS 是接收

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周期 (Request To Send),进行 ACK/NACK 发送的 ANP 周期。在 RTS 周期内 STA 监听其他设备的 Beacon 发送请求消息,在 ANP 周期内,STA 广播其决定是否向 AP 发送 Beacon 信息及向哪个 AP 发送 Beacon 信息。

[0046] 步骤 102,AP 接收各个 STA 广播的 Probe 帧或 Beacon 帧,根据 Probe 帧或 Beacon 帧中的所述 STA 的标识与 AP 本地记录的 STA 关联表项确定所述 STA 是否与所述 AP 关联,该 STA 关联表项中记载与本 AP 关联的 STA 标识、本 AP 标识、该 STA 信号强度,其中,AP 标识可以为 IP 地址或 MAC 地址,STA 标识为 MAC 地址。另外,AP 接收各个 STA 广播的 Probe 帧或 Beacon 帧时,还要检测获取传输 Probe 帧或 Beacon 帧的无线信号的信号强度。

[0047] 步骤 103,AP 向所述控制设备发送报告消息,所述报告消息中携带所述 AP 检测到的 STA 信号强度及所述 STA 是否与所述 AP 关联的信息(即上报的 AP 标识、STA 标识、STA 信号强度、及该 STA 是否与该 AP 关联)。STA 在搜索周围 AP 时一般会在短时间内发出多个 probe 帧,AP 收到每个 probe 帧时会感知接收到的信号强度,为了避免瞬间的信号波动引起误判,可以通过平滑方式将多个 probe 帧的信号强度平均。具体包括:所述 AP 收到某个 STA 的 Probe 帧后,等待预设时间(例如 500 毫秒),如果收到关于该 STA 的更多 Probe 报文,计算所述预设时间内收到的关于所述 STA 的多个 Probe 报文中的 STA 的信号强度平均值,报告给所述控制设备。

[0048] 步骤 104,所述控制设备接收所述 AP 发送的报告消息,保存具有上报的 AP 标识、STA 标识、STA 信号强度、及该 STA 是否与该 AP 关联的 STA 表项,其中,STA 标识为 MAC(Media Access Control,介质访问控制)地址;上报的 AP 标识表示哪些 AP 上报了 STA 的信号强度;老化定时器等;控制设备接收到某个 AP 发送的报告消息后,判断是否没有其他 AP 报告所述 STA 的信号强度,如果没有,则创建所述 STA 表项;如果有,则将所述报告消息中的信息添加到所述 STA 表项中。

[0049] 步骤 105,为步骤 104 中的 STA 表项启动一个定时器,如 1 秒,在定时器到期时,所述控制设备比较获得,其他 AP 上报的所述 STA 的信号强度比所述 STA 表项中所述 STA 当前关联的 AP 的信号强度高出第一阈值(如 2db),则向所述 STA 当前关联的 AP 发出下线通知,同时删除对应表项。

[0050] 步骤 106,所述当前关联的 AP 接收到下线通知后,通过查找步骤 102 中的 STA 关联表项确认 STA 是自己关联的 STA,断开与所述 STA 的连接,向 STA 发出 disassociation 报文,其中 reason code 设置为 5(表示切换原因为强度变化),同时删除本 AP 上面关于该 STA 的记录;如果该 STA 没有和自己关联,不做任何操作。

[0051] 步骤 107,所述 STA 收到 disassociation 报文后,重新关联到所述其他 AP 上。具体包括:向所述其他 AP 发送资源请求,以关联到所述其他 AP 上。

[0052] STA 可以通过两种途径向其他 AP 发起资源请求 (Resource Request):一种是 STA 暂时断开当前的无线信道,通过其他的无线信道与其他 AP 进行通信;另一种是 STA 通过当前的 AP 转发 STA 的资源请求 (Resource Request) 与其他 AP 进行通信。

[0053] 无论哪种方式,STA 和其他 AP 之间都是通过 RRSAP(Resource RequestService Access Point) 模块进行资源配置的处理。STA 上的 RRSAP 产生资源请求消息,AP 上的 RRSAP 接收和处理来自 STA 的资源请求,并且响应 STA 的资源请求。STA 的 RRSAP 与当前 AP Broker function 进行资源请求与响应,STA 发送包括其他 AP 的资源请求消息,当前 AP

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的Broker function向其他AP转发资源请求，其他AP接收资源请求。Broker function可以实现资源请求消息的转发，限制STA发起的资源保留请求数或者能够同时保留资源的AP数。STA可以选择在切换之前在其他AP上保留资源，如果提前在其他AP上保留了资源，那么此资源在其他AP上的保存将持续一段时间，STA应该在此时间内完成切换过程。

[0054] 本发明提供了一种接入点，应用于包括STA、控制设备和至少两个接入点AP的系统中，如图2所示，所述接入点包括：

[0055] 收集模块210，用于接收各个STA广播的Probe帧或Beacon帧，所述Probe帧或Beacon帧中携带所述STA的标识；

[0056] 上报模块220，与收集模块210连接，用于根据所述STA的标识与本地记录的STA关联表项确定所述STA是否与所述AP关联，并向所述控制设备发送报告消息，所述报告消息中携带上报的AP标识、STA标识、STA信号强度、及该STA是否与该AP关联的信息；

[0057] 下线模块230，用于收到下线通知时，判断所述STA是否正在和自己关联，如果是，则向所述STA发送断开连接报文，终止与所述当前关联AP的连接。

[0058] 收集模块210，具体用于收到某个STA的Probe帧或Beacon帧后，等待 预设时间，计算所述预设时间内收到的关于所述STA的多个Probe帧或Beacon帧中的STA的信号强度平均值，通过报告消息将所述STA的信号强度平均值及所述STA是否与所述AP关联的信息发送给所述控制设备。

[0059] 本发明还提供了一种管理设备，应用于包括STA、控制设备和至少两个接入点AP的系统中，如图3所示，所述管理设备包括：

[0060] 接收模块310，用于接收所述AP发送的报告消息，上报的AP标识、STA标识、STA信号强度、及该STA是否与该AP关联的信息；

[0061] 表项存储模块320，与接收模块310连接，用于保存具有上报的AP标识、STA标识、STA信号强度、及该STA是否与该AP关联的STA表项；

[0062] 下线通知模块330，与表项存储模块320连接，用于在预设周期内，所述控制设备比较获得，其他AP上报的所述STA的信号强度比所述STA表项中所述STA当前关联的AP的信号强度高出第一阈值，则向所述STA当前关联的AP发出下线通知，使所述当前关联的AP断开与所述STA的连接，并使所述STA重新关联到所述其他AP上。

[0063] 表项存储模块320，具体用于所述控制设备收到报告消息后，判断是否没有其他AP报告所述STA的信号强度，如果没有，则创建所述STA表项；如果有，则将所述报告消息中的信息添加到所述STA表项中。

[0064] 本发明中，AP跟踪STA信号强度，在STA信号变弱时，强制STA下线，让STA切换新的AP上。因此，本发明通过AP推送方式，推动STA在漫游过程中及时切换，使STA在漫游过程中能够更及时地切换到新的AP上，提高了STA漫游时的网络性能，和原有标准兼容，不需要客户端做任何改动。

[0065] 通过以上的实施方式的描述，本领域的技术人员可以清楚地了解到本发明可以通过硬件实现，也可以借助软件加必要的通用硬件平台的方式来实现。基于这样的理解，本发明的技术方案可以以软件产品的形式体现出来，该软件产品可以存储在一个非易失性存储介质（可以是CD-ROM，U盘，移动硬盘等）中，包括若干指令用以使得一台计算机设备（可以是个人计算机，服务器，或者网络设备等）执行本发明各个实施例所述的方法。

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[0066] 本领域技术人员可以理解附图只是一个优选实施例的示意图，附图中的模块或流程并不一定是实施本发明所必须的。

[0067] 本领域技术人员可以理解实施例中的装置中的模块可以按照实施例描述进行分布于实施例的装置中，也可以进行相应变化位于不同于本实施例的一个或多个装置中。上述实施例的模块可以合并为一个模块，也可以进一步拆分成多个子模块。

[0068] 上述本发明序号仅仅为了描述，不代表实施例的优劣。

[0069] 以上公开的仅为本发明的几个具体实施例，但是，本发明并非局限于此，任何本领域的技术人员能思之的变化都应落入本发明的保护范围。

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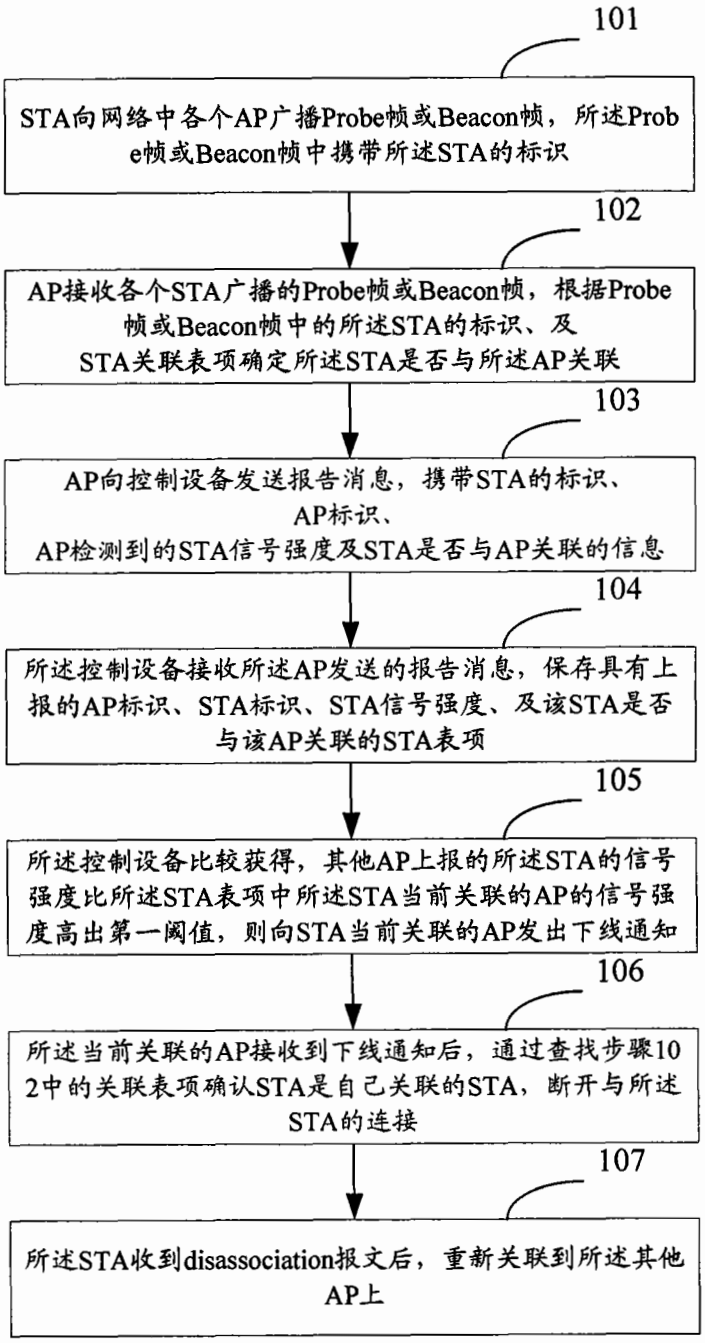

图 1

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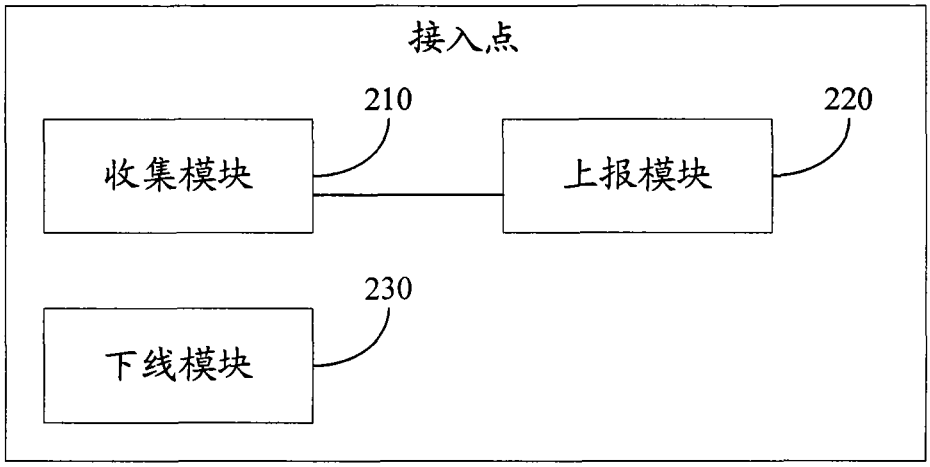

图 2

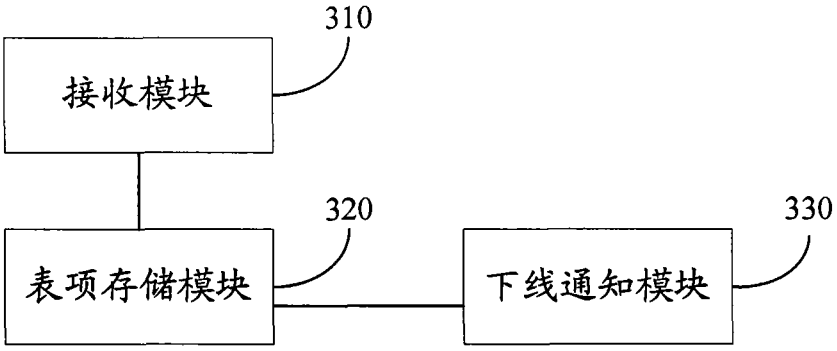

图 3

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CERTIFICATE OF TRANSLATION ACCURACY

I am a professional reviewer and coordinator specializing in translating Chinese, Japanese and Korean to English and vice versa.

I served as Chief Examiner of the certified court interpreter test for the State of California and as a contract translator and interpreter for various federal agencies through the U.S. Department of State of for more than a decade. I served as an instructor at the University of California at Berkeley and the Middlebury Institute of International Studies at Monterey.

I have more than 30 years of experience translating thousands of technical, legal, and business documents from Korean to English submitted to, among others, judicial authorities in Korea, various U.S. federal courts, the U.S. International Trade Commission (ITC), and the USPTO Patent Trial and Appeal Board (PTAB).

I certify that I translated the following document from Korean into the English language. I also certify that this is a true, correct, and complete translation of the corresponding source text to the best of my knowledge and ability.

I certify under penalty of perjury that the foregoing is true and correct.

Executed this 23th day of May 2023 in the Contra Costa County of the State of California.

By: _____

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Member, ATA

(19) China National Intellectual Property Administration

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H04W *84/12* (2009. 01)
H04W *88/08* (2009. 01)
H04W 88/18 (2009. 01)

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Examiner: Liu Juan

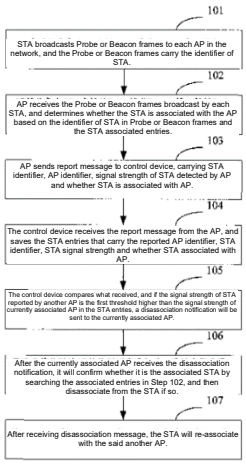
2 pages of Claims, 6 pages of Specification, 2 pages of Attached Drawings

(54) Title of the Invention

Method and apparatus for STA roaming in WLAN network

(57) Abstract

The present invention discloses a method for STA roaming in a WLAN network, comprising: receiving, by a control device, report messages sent by APs, wherein the report messages carry STA signal strength detected by the APs and information on whether STAs are associated with the APs; saving, by the control device, STA table entries having the STA signal strength and the associated APs; within a preset period, sending off-line notifications to the APs currently associated with the STAs if the control device compares and obtains that STA signal strength reported by other APs is higher than signal strength of the APs currently associated with the STAs in the STA table entries by a first threshold value, so that the currently associated APs are disconnected from the STAs, and the STAs are re-associated to the other APs. The present invention improves the network performance during STA roaming, is compatible with an original standard, and does not require any change from a client side.



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1. A method for STA roaming in a WLAN network, being applied to a system comprising STAs, a control device and at least two access point APs, characterized in that the method comprises the following steps:

receiving, by the control device, report messages sent by the APs, wherein the report messages carry reported AP identification, STA identification, STA signal strength, and whether the STAs are associated with the APs;

saving, by the control device, the reported AP identification, STA identification, STA signal strength, and whether the STAs are associated with the APs in STA table entries;

within a preset period, sending an off-line notification to the APs currently associated with the STAs if the control device compares and obtains that STA signal strength reported by other APs is higher than signal strength of the APs currently associated with the STAs in the STA table entries by a first threshold value, so that the currently associated APs are disconnected from the STAs, and the STAs are re-associated with the other APs.

2. The method according to Claim 1, characterized in that the control device receives the report messages sent by the APs, previously further comprising:

receiving, by the APs, Probe frames or Beacon frames broadcast by each STA, wherein the Probe frames or Beacon frames carry the STA identification;

determining, by the APs, whether the STAs are associated with the APs based on the STA identification and locally recorded STA association table entries;

sending, by the APs, report messages to the control device, wherein the report messages carry the reported AP identification, STA identification, STA signal strength detected by the APs and information on whether the STAs are associated with the APs.

3. The method according to Claim 2, characterized in that the APs send the report messages to the control device, specifically comprising:

after the APs receive Probe frames or Beacon frames of certain STAs, waiting for a preset time, and then calculating an average value of STA signal strength in a plurality of Probe frames or Beacon frames with respect to the STAs that is received within the preset time;

sending, by the APs, the average value of the STA signal strength and information on whether the STAs are associated with the APs to the control device through the report messages.

4. The method according to Claim 1, characterized in that the control device saves the STA signal strength and the STA table entries of the associated APs, specifically comprising:

after the control device receives the report messages, judging whether there are no other APs reporting the STA signal strength, creating the STA table entries if no; and adding information in the report messages to the STA table entries if yes.

5. The method according to Claim 1, characterized in that the currently associated APs are disconnected from the STAs, and the STAs are re-associated to the other APs, specifically comprising:

judging, by the APs, whether the STAs are associated with themselves, and sending disconnection messages to the STAs if yes;

after the STAs receive the disconnection messages, terminating connections with the currently associated APs, and sending connection establishment requests to the other APs to be associated to the other APs.

6. The method according to Claim 5, characterized in that the disconnection messages also carry a reason value, which is used to indicate a switch reason.

7. An access point applied to a system comprising STAs, a control device and at least two access point APs, characterized in that the access point comprises:

a collection module, which is used for receiving Probe frames or Beacon frames broadcast by each STA, wherein the Probe frames or Beacon frames carry STA identification;

a reporting module, which is connected to the collection module, and used for determining whether the STAs are associated with the APs based on the STA identification and locally recorded STA association table entries, and sending reporting messages to the control device,

wherein the reporting messages carry the reported AP identification, STA identification, STA signal strength, and information on whether the STAs are associated with the APs;

an off-line module, which is used for judging whether the STAs are associated with themselves when off-line notifications are received, and sending disconnection messages to the STAs to terminate connections with the STAs if yes.

8. The access point according to Claim 7, characterized in that the collection module is specifically used for waiting for a preset time and calculating an average value of the STA signal strength in a plurality of Probe frames or Beacon frames with respect to the STAs that are received within the preset time after the Probe frames or Beacon frames of the STAs are received, and sending the average value of the STA signal strength and the information on whether the STAs are associated with the APs to the control device through report messages.

9. A control device applied to a system comprising STAs, the control device, and at least two APs, characterized in that the control device comprises:

a receiving module, which is used for receiving report messages sent by the APs, wherein the report messages carry reported AP identification, STA identification, STA signal strength, and information on whether the STAs are associated with the APs;

a table entry storage module, which is connected to the receiving module and used for saving STA table entries having the reported AP identification, STA identification, STA signal strength, and whether the STAs are associated with the APs;

an off-line notification module, which is connected to the table entry storage module and used for, within a preset period, sending off-line notifications to the APs currently associated with the STAs if the control device compares and obtains that STA signal strength reported by other APs is higher than signal strength of the APs currently associated with the STAs in the STA table entries by a first threshold value, so that the currently associated APs are disconnected from the STAs, and the STAs are re-associated with the other APs.

10. The control device according to Claim 9, characterized in that the table entry storage module is specifically used for judging whether there are no other APs reporting the STA signal strength after the control device receives the report messages, creating the STA table entries if no; and adding information in the report messages to the STA table entries if yes.

METHOD AND APPARATUS FOR STA ROAMING IN WLAN

Technical Field

[0001] The present invention relates to the field of communication technologies, and in particular to a method and apparatus for STA roaming in a WLAN network.

Background Art

[0002] WLAN (Wireless Local Access Network) provides a wireless connection service for local access networks, WLAN is currently one of the more popular technologies in the IT industry due to the capacity of providing high-speed wireless data access, and has been widely applied to city and public place coverage as well as enterprises, buildings, homes and other places.

[0003] WLAN provides an ESS (Extended Service Set) service. within the same ESS coverage scope, STAs (STAtion) can be associated to different APs (Access Points), network services are obtained through WLAN, seamless roaming can be realized, wherein multiple APs provide the same SSID (Service Set Identification) for the same ESS, and a continuous coverage area is formed, so that the STAs can realize seamless cross-zone switching in the coverage area. However, it is found in practical application that many STAs do not work well in the roaming process and cannot be switched to the appropriate APs in time.

[0004] In the current 802.11 standard, switching policies and switching behaviors are entirely determined by the STAs, and the standard does not make any provisions for this aspect. It is found in actual use that some STAs adopt a "keep a close watch" policy, i.e., the currently associated APS could not be switched to new APs until the signal strength of the currently associated APs is reduced to the minimum threshold. Other STAs can compare the signal strength between APs, and conduct switching when the signal strength of certain APs is greater than the signal strength of the currently associated APs by a certain threshold value. Since the STAs discover the new APs by periodically sending Probe frames or Beacon frames, in order to reduce the impact of scanning on application performance, the period of the STAs scanning the APs is generally relatively large, the new APs cannot be found in time, or the signal strength of each AP cannot be updated in time.

[0005] It is found in actual use that the STAs of many manufacturers cannot be switched to the appropriate APs in time during roaming, resulting in traffic declining. By the STA comparing the signal strength between the APs, a default switching threshold value of the STAs may not be set, and a too large switching threshold value results in slow switching; or the switching threshold value can be set, but users using the STAs cannot or are not willing to modify it, so smooth switching cannot be realized.

Summary of the Invention

[0006] The present invention provides a method and apparatus for STA roaming in a WLAN network, so as to realize timely switching of STAs to appropriate APs during roaming.

[0007] The present invention provides a method for STA roaming in a WLAN network, which is applied to a system comprising STAs, a control device and at least two access point APs, and the method comprises the following steps:

[0008] receiving, by the control device, report messages sent by the APs, wherein the report messages carry reported AP identification, STA identification, STA signal strength, and whether the STAs are associated with the APs;

[0009] saving, by the control device, the reported AP identification, STA identification, STA signal strength, and whether the STAs are associated with the APs into STA table entries;

[0010] within a preset period, sending off-line notifications to the APs currently associated with the STAs if the control device compares and obtains that STA signal strength reported by other APs is higher than signal strength of the APs currently associated with the STAs in the STA table entries by a first threshold value, so that the currently associated APs are disconnected from the STAs, and the STAs are re-associated

with the other APs.

[0011] Wherein the control device receives the report messages sent by the APs, previously further comprising:

[0012] receiving, by the APs, Probe frames or Beacon frames broadcast by each STA, wherein the Probe frames or Beacon frames carry the STA identification;

[0013] determining, by the APs, whether the STAs are associated with the APs based on the STA identification and locally recorded STA association table entries;

[0014] sending, by the APs, the report messages to the control device, wherein the report messages carry the reported AP identification, STA identification, STA signal strength detected by the APs and information on whether the STAs are associated with the APs.

[0015] Wherein the APs send the report messages to the control device, specifically comprising:

[0016] after the APs receive the Probe frames or Beacon frames of certain STAs, waiting for a preset time, and then calculating an average value of the STA signal strength in a plurality of Probe frames or Beacon frames with respect to the STAs that are received within the preset time;

[0017] sending, by the APs, the average value of the STA signal strength and information on whether the STAs are associated with the APs to the control device through the report messages.

[0018] Wherein the control device saves the STA table entries having the STA signal strength and the associated APs, specifically comprising:

[0019] after the control device receives the report messages, judging whether there are no other APs reporting the STA signal strength, creating the STA table entries if no; and adding information in the report messages to the STA table entries if yes.

[0020] Wherein the currently associated APs are disconnected from the STAs, and the STAs are re-associated to the other APs, specifically comprising:

[0021] judging, by the APs, whether the STAs are associated with themselves, and sending disconnection messages to the STAs if yes;

[0022] after the STAs receive the disconnection messages, terminating connections with the currently associated APs, and sending connection establishment requests to the other APs to be associated to the other APs.

[0023] Wherein the disconnection messages also carry a reason value, which is used to indicate a switch reason.

[0024] The present invention also provides an access point applied to a system comprising STAs, a control device and at least two access point APs, and the access point comprises:

[0025] a collection module, which is used for receiving Probe frames or Beacon frames broadcast by each STA, wherein the Probe frames or Beacon frames carry STA identification;

[0026] a reporting module, which is connected to the collection module, and used for determining whether the STAs are associated with the APs based on the STA identification and locally recorded STA association table entries and sending reporting messages to the control device, wherein the reporting messages carry the reported AP identification, STA identification, STA signal strength, and information on whether the STAs are associated with the APs;

[0027] an off-line module, which is used for judging whether the STAs are associated with themselves when off-line notifications are received, and sending disconnection messages to the STAs to terminate connections to the STAs if yes.

[0028] Wherein the collection module is specifically used for waiting for a preset time and calculating an average value of the STA signal strength in a plurality of Probe frames or Beacon frames with respect to the STAs that are received within the preset time after the Probe frames or Beacon frames of the STAs are received, and sending the average value of the STA signal strength and the information on whether the STAs are associated with the APs to the control device through the report messages.

[0029] The present invention also provides a control device applied to a system comprising STAs, the

control device, and at least two APs, and the control device comprises:
[0030] a receiving module, which is used for receiving report messages sent by the APs, wherein the report messages carry reported AP identification, STA identification, STA signal strength, and information on whether the STA is associated with the APs;
[0031] a table entry storage module, which is connected to the receiving module, and used for saving STA table entries having the reported AP identification, STA identification, STA signal strength, and whether the STAs are associated with the APs;
[0032] an off-line notification module, which is connected to the table entry storage module, and used for, within a preset period, sending off-line notifications to the APs currently associated with the STAs if the control device compares and obtains that STA signal strength reported by other APs is higher than signal strength of the APs currently associated with the STAs in the STA table entries by a first threshold value, so that the currently associated APs are disconnected from the STAs, and the STAs are re-associated with the other APs.
[0033] Wherein the table entry storage module is specifically used for judging whether there are no other APs reporting the STA signal strength after the control device receives the report messages, creating the STA table entries if no; and adding information in the report messages to the STA table entries if yes.
[0034] Compared with the prior art, the present invention has the following advantages:
[0035] in the present invention, the APs track the STA signal strength, force the STAs offline when STA signals become weak, and allow the STAs to be switched to the new APs. Therefore, the present invention pushes the STAs to switch in time during roaming by means of an AP pushing manner, so that the STAs can be switched to the new APs in a more timely manner during roaming, which improves the network performance of the STAs during roaming, is compatible with an original standard, and does not require any change from a client side.
[0036] Descriptions of the Attached Drawings
[0037] FIG. 1 is a flowchart of a method for STA roaming in a WLAN network in the present invention;
[0038] FIG. 2 is a structure chart of an access point in the present invention;
[0039] FIG. 3 is a structure chart of a management device in the present invention.
[0040] Embodiments
[0041] The core idea of the present invention is that APs monitor STA signal strength and report the STA signal strength and whether STAs are associated with themselves to an AC (Access Controller) or server, and the AC or server notifies the APs to make the STAs offline when judging that the STAs should be switched to the new APs based on the STA signal strength reported by each AP and the STAs are not switched, so that the STAs can be switched to the new APs.
[0042] The present invention provides a method for STA roaming in a WLAN network, which is applied to a system comprising STAs, a control device, and at least two access point APs. The present invention is applicable to a Fit AP architecture and a FAT AP architecture. In the Fit AP architecture, the control device is the AC, the AC can be side-mounted to a BAS (Broadband Access Server) device or serially connected between the APs and the BAS device, the AC is responsible for the management of the APs in a whole hotspot area, and BASs act as authentication points for users. Of course, the present invention is also applicable to FATAP, which needs a server with an AC function, only an AP device needs to be added in an access layer, and access to the BASs is realized through an ADSL (Asymmetrical Digital Subserial Loop) or Ethernet private line, and then access to a metropolitan area network is realized through the BASs. The wireless users generally adopt PPPoE (Point-to-Point Protocol over Ethernet) or WEB Portal authentication to access the network, and the BASs act as the authentication points for the wireless users.
[0043] As shown in FIG. 1, the method comprises the following steps:
[0044] Step 101, broadcasting, by STAs, Probe frames or Beacon frames to each AP in a network, wherein the Probe frames or Beacon frames carry STA identification.
[0045] Wherein the Beacon frames are jointly composed of synchronous channels and Beacon channels,

and the synchronous channels and the Beacon channels are transmitted on I-channels and Q-channels of physical channels, respectively. The synchronous channels are composed of a series of synchronous burst frames, RTS is a receiving cycle (Request To Send) and an ANP cycle to perform ACK/ NACK transmission. During the RTS cycle, the STAs monitor Beacon send request messages from other devices, and during the ANP cycle, the STAs broadcast their decisions on whether to send Beacon messages to the APs and which AP to send the Beacon messages to.

[0046] Step 102, receiving, by the APs, the Probe frames or Beacon frames broadcast by each STA, and determining whether the STAs are associated with the APs based on the STA identification in the Probe frames or Beacon frames and STA association table entries recorded locally by the APs, wherein the STA identification associated with the APs, the AP identification, and the STA signal strength are documented in the STA association table entries, wherein the AP identification may be an IP address or an MAC address, and the STA identification is an MAC address. In addition, when the APs receive the Probe frames or Beacon frames broadcasted by each STA, the signal strength of wireless signals of transmitting the Probe frames or Beacon frames also need to be detected and obtained.

[0047] Step 103, sending, by the APs, the report messages to the control device, wherein the report messages carry the STA signal strength detected by the APs and information on whether the STAs are associated with the APs (i.e., the reported AP identification, STA identification, STA signal strength, and whether the STAs are associated with the APs). The STAs usually send out multiple probe frames in a short period of time when searching surrounding APs. When the APs receive each probe frame, they will perceive the received signal strength. In order to avoid misjudgment caused by instantaneous signal fluctuations, the signal strength of multiple probe frames can be averaged by a smoothing manner. In particular, it comprises the following steps: after the APs receive the Probe frames of certain STAs, waiting for a preset time (for example, 500 ms), calculating an average value of the STA signal strength in the multiple Probe messages with respect to the STA that are received within the preset time if more Probe messages about the STAs are received, and reporting to the control device.

[0048] Step 104, receiving, by the control device, the report messages sent by the APs, saving the STA table entries having the reported AP identification, STA identification, STA signal strength, and whether the STAs are associated with the APs, wherein the STA identification is the MAC (Media Access Control) address, wherein the reported AP identification indicates which APs reported the STA signal strength, and an aging timer, etc.; and after the control device receives the report messages sent by the certain AP, judging whether there are no other APs reporting the STA signal strength, creating the STA table entries if not, and adding information in the report messages to the STA table entries if yes.

[0049] Step 105, initiating a timer for the STA table entries in Step 104, such as for 1 second, at the expiration of the timer, sending off-line notifications to the APs currently associated with the STAs and deleting the corresponding table entries at the same time if the control device compares and obtains that STA signal strength reported by other APs is higher than signal strength of the APs currently associated with the STAs in the STA table entries by a first threshold value (such as 2 db).

[0050] Step 106, after the currently associated APs receive the off-line notifications, confirming that the STAs are the STAs associated with themselves by looking up the STA association table entries in Step 102, disconnecting from the STAs, sending disassociation messages to the STAs, wherein a reason code is set to 5 (indicating that the switching reason is strength changes), and at the same time, records of the STA on such AP are deleted; and if the STA is not associated with themselves, no action is taken.

[0051] Step 107, after the STA receives the disassociation messages, re-associate to the other APs, specifically comprises: sending a resource request to the other APs to be associated to the other APs.

[0052] The STAs can initiate resource requests (Resource Request) to the other APs in two ways: one is that the STAs temporarily disconnect the current wireless channels and communicate with the other APs through other wireless channels; the other is that the STAs forward resource requests (Resource Request) of the STAs through the current APs to communicate with the other APs.

[0053] Either way, resource allocation between the STAs and the other APs is handled through RRSAP (Resource Request Service Access Point) module. The RRSAP on the STA generates the resource request message, and the RRSAP on the AP receives and processes the resource request from the STAs, and responds to the resource request from the STAs. The RRSAP of STA makes resource request and response with the Broker function of the current AP, and the STA sends resource request messages including other APs, the Broker function of the current APs forwards the resource requests to other APs, and the other APs receive the resource requests. The Broker function can forward the resource request messages and limit a number of resource retention requests initiated by the STAs or a number of APs that can simultaneously retain resources. The STAs can choose to retain the resources on the other APs before switching. If the resources are retained on the other APs in advance, saving of such resources on the other APs will last for a period of time, and the STA should complete a switching process within such time.

[0054] The present invention provides an access point applied to a system comprising STAs, a control device, and at least two access point APs, as shown in FIG. 2, the access point comprises:

[0055] a collection module 210, which is used for receiving Probe frames or Beacon frames broadcast by each STA, wherein the Probe frames or Beacon frames carry the STA identification;

[0056] a reporting module 220, which is connected to the collection module 210 and used for determining whether the STAs are associated with the APs based on the STA identification and locally recorded STA association table entries, and sending reporting messages to the control device, wherein the reporting messages carry the reported AP identification, STA identification, STA signal strength, and information on whether the STAs are associated with the APs;

[0057] an off-line module, which is used for judging whether the STAs are associated with themselves when off-line notifications are received, and sending disconnection messages to the STAs to terminate connections to the STAs if yes.

[0058] The collection module 210 is specifically used for waiting for a preset time and calculating an average value of the STA signal strength in a plurality of Probe frames or Beacon frames with respect to the STAs that are received within the preset time after the Probe frames or Beacon frames of the STAs are received, and sending the average value of the STA signal strength and the information on whether the STAs are associated with the APs to the control device through report messages.

[0059] The present invention further provides a management device applied to a system comprising STAs, a control device, and at least two access point APs, as shown in FIG. 3, the management device comprises:

[0060] a receiving module 310, which is used for receiving report messages sent by the APs, wherein the report messages carry the reported AP identification, STA identification, STA signal strength, and information on whether the STA is associated with the APs;

[0061] a table entry storage module 320, which is connected to the receiving module 310 and used for saving STA table entries having the reported AP identification, STA identification, STA signal strength, and whether the STAs are associated with the APs;

[0062] an off-line notification module 320, which is connected to the table entry storage module and used for, within a preset period, sending off-line notifications to the APs currently associated with the STAs if the control device compares and obtains that STA signal strength reported by other APs is higher than signal strength of the APs currently associated with the STAs in the STA table entries by a first threshold value, so that the currently associated APs are disconnected from the STAs, and the STAs are re-associated with the other APs.

[0063] The table entry storage module 320 is specifically used for judging whether there are no other APs reporting the STA signal strength after the control device receives the report messages, creating the STA table entries if no; and adding information in the report messages to the STA table entries if yes.

[0064] In the present invention, the APs track the STA signal strength, force the STAs offline when STA signals become weak, and allow the STAs to be switched to the new APs. Therefore, the present invention pushes the STAs to switch in time during roaming by means of an AP pushing manner, so that the STAs

can be switched to the new APs in a more timely manner during roaming, which improves the network performance of the STAs during roaming, is compatible with an original standard, and does not require any change from a client side

[0065] By the above description of the embodiments, it will be clear to those skilled in the art that the present invention can be implemented by means of hardware or by means of software plus necessary common hardware platforms. Based on this understanding, the technical scheme of the present invention can be manifested in the form of a software product, the software product can be stored in a non-volatile storage medium (may be a CD-ROM, U disk, mobile hard disk, etc.), which comprises several instructions to make one computer equipment (may be a personal computer, server, or network device, etc.) perform the methods described in various embodiments of the present invention.

[0066] It will be understood by those skilled in the art that the attached drawings are only schematic diagrams of one preferred embodiment and that modules or processes in the attached drawings are not necessarily necessary to implement the present invention.

[0067] Those skilled in the art can understand that the modules in the appliances of the embodiments can be distributed among the appliances of the embodiments as described in the embodiments, or can be varied accordingly to be located in one or more appliances different from the embodiments. The modules of the above embodiments may be combined into a single module or may be further split into multiple sub-modules.

[0068] The above serial numbers of the present invention are for descriptive purposes only and do not represent the advantages or disadvantages of the embodiments.

[0069] The above disclosed are only several specific embodiments of the present invention, however, the present invention is not limited to this, and any variations that can be contemplated by those skilled in the art shall fall within the scope of protection of the present invention.

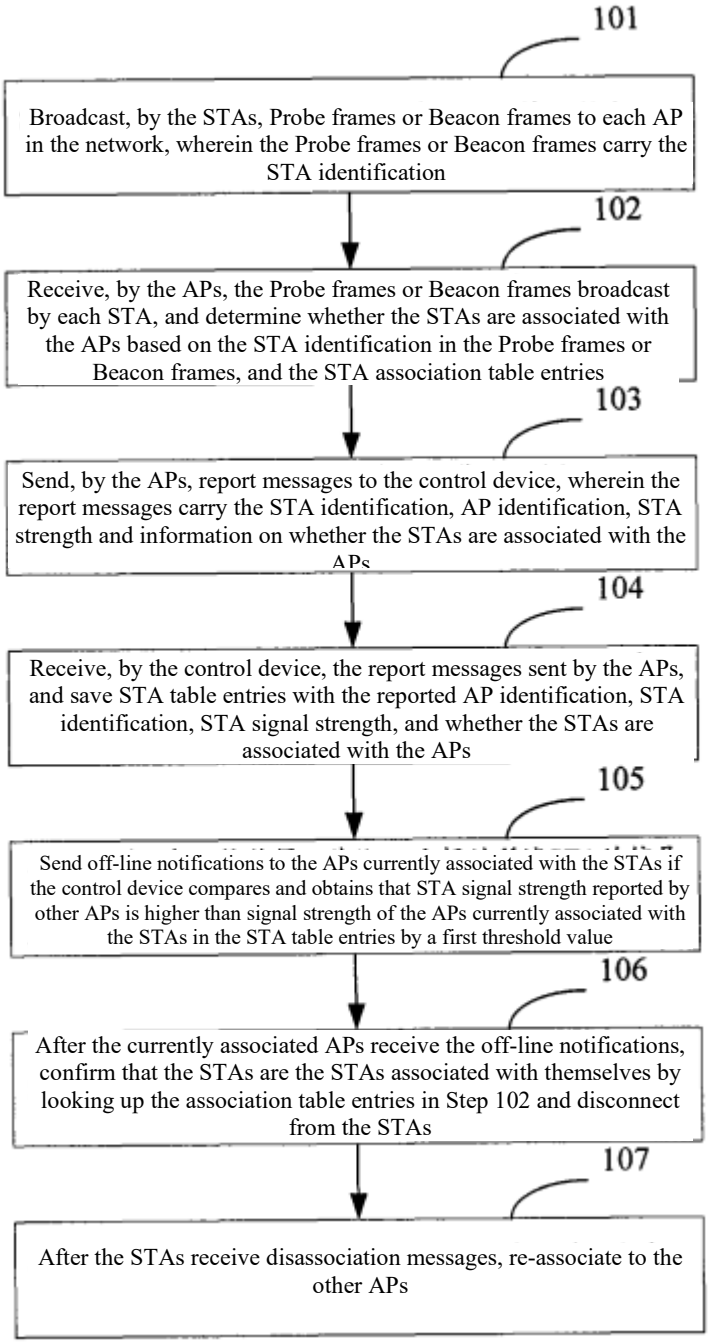
101
Broadcast, by the STAs, Probe frames or Beacon frames to each AP in the network, wherein the Probe frames or Beacon frames carry the STA identification
102
Receive, by the APs, the Probe frames or Beacon frames broadcast by each STA, and determine whether the STAs are associated with the APs based on the STA identification in the Probe frames or Beacon frames, and the STA association table entries
103
Send, by the APs, report messages to the control device, wherein the report messages carry the STA identification, AP identification, STA strength and information on whether the STAs are associated with the APs
104
Receive, by the control device, the report messages sent by the APs, and save STA table entries with the reported AP identification, STA identification, STA signal strength, and whether the STAs are associated with the APs
105
Send off-line notifications to the APs currently associated with the STAs if the control device compares and obtains that STA signal strength reported by other APs is higher than signal strength of the APs currently associated with the STAs in the STA table entries by a first threshold value
106
After the currently associated APs receive the off-line notifications, confirm that the STAs are the STAs associated with themselves by looking up the association table entries in Step 102 and disconnect from the STAs
107
After the STAs receive disassociation messages, re-associate to the other APs

FIG. 1

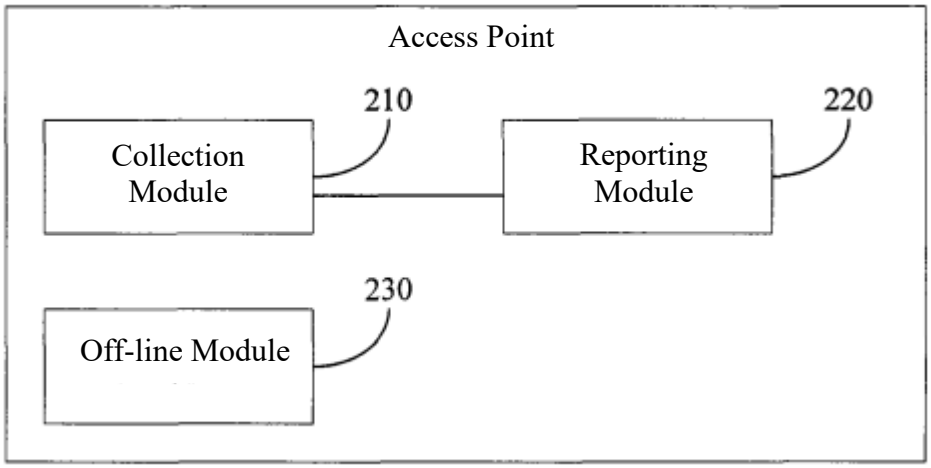
Access Point
210
220
Collection Module
Reporting Module
230
Off-line Module

FIG. 2

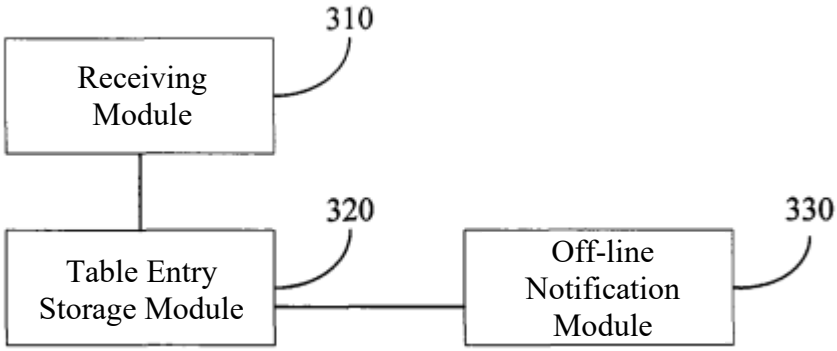
310
Receiving Module
320
330
Table Entry Storage Module
Off-line Notification Module

FIG. 3