Vocabulary and Proposed Working Definitions.

Document 802.11/91-
Dave Bagby
1 March 1991

Introduction:

During the January 802.11 meeting I presented a paper containing proposed working definitions for various portions of a wireless network architecture. Other papers were presented which used different terms for similar concepts. The differing mapping of terms and concepts contributed to increased confusion during several discussions.

As a result, I volunteered (or was volunteered, I am still not sure of the dynamics of what happened...) to write a paper to establish a common vocabulary, so that we might communicate more effectively. During the course of the week, I noticed that the expected scope of my paper tended to grow.

Several people offered to send me vocabulary documents from their firms. Fortunately, (or alas, depending on your viewpoint) none of those arrived in my mail. I've had a very busy couple of months and probably couldn't have processed the additional information anyway.

I decided to concentrate on sorting out the various concepts discussed during the January meeting, attempt to place them into perspective, and see if some modified working definitions could be derived which would accommodate all (or at least most) of the various ideas. I have approached the task with my engineering hat on - looking for a set of useful working definitions to build upon.

This paper represents my humble attempt at this task.

Within this paper several phrases are common. I have taken the liberty of using abbreviations for these phrases. The abbreviations used are:

BSA: Basic Service Area
AP: Access Point
APC: Access Point Coverage
DSM: Distribution System Media
DS: Distribution System
ESA: Extended Service Area
NOS: Network Operating System

The BSA Controversy:

Of the definitions I presented in January, most were straight forward and did not generate great deals of controversy, with one

very notable exception. The definition for BSA stirred up more conversation that I anticipated.

During the discussions, I noted that several differing concepts were being pushed. The proponents of the concepts all wanted their views adopted as defined capabilities of a BSA network.

I have attempted to identify the various concepts which were discussed in January. There are fairly large emotional attachments to the phrase "Basic Service Area" (BSA).

It would be productive for us to divorce ourselves from the preconceived ideas we have when hearing the term BSA. To avoid the emotional trap of the BSA label, I have avoided it's attachment to any particular model through most of this paper. If it helps, use the term "duck" (or any other you like) instead of BSA when thinking about architectures.

To make progress we need to concentrate on ideas over the names of ideas.

I have assumed that the reader was present during the January meeting. I give enough of the concepts to identify them, but I make no attempt to recount the discussions which occurred during the January meeting.

For those readers who may have only recently become involved in 802.11, welcome. Hang in here with us, the picture gets clearer with time...

Concepts:

First I want to summarize the various concepts I have identified while discussing the definition of BSA.

The Hub or Head End:

(I use "Hub" to refer to both, it's shorter...)

One of the areas of controversy results from a mixture of assumptions.

Some folks believe that a wireless network can only operate correctly (in their view) if the network is controlled by a central point (to coordinate who can talk when, etc.). This is primarily a software protocol / state machine issue.

Some think that this coordination is best accomplished by having control logic reside in a central piece of hardware. These folks favor topologies which include a physical "Hub" of some type.

This group is motivated by an attraction to protocols which take a deterministic, time slotted approach to network access.

To this group, a BSA must include a "Hub" (otherwise the network wouldn't work).

There are two concepts here:

1) The desire for a time slotted access protocol.

2) The required presence of a physical Hub for two stations to communicate.

The logical protocol service (percieved as a required part of the network) is a "traffic cop" function. The assumption is that this requires a piece of hardware, often called a Hub.

There is no reason that the "traffic cop" function could not be performed by one station or more stations within a BSA network.

The issue is dependent on the access protocol chosen. If the protocol chosen requires only one controller, stations could arbitrate among themselves to decide which one becomes the "traffic cop" .

The Ad Hoc / transient network model:

Another group of people believe that an important usage pattern is the "Ad Hoc" network. These people want to be able to arrive somewhere (maybe an IEEE meeting?) with their portable computer and be able to communicate with any other station containing an 802.11 LAN adaptor.

To these folks the requirement for a third piece of hardware (a Hub) is unacceptable. They are concerned over who will bring the Hub to the meeting. They point out that the requirement to carry a Hub around in case you encounter another Wireless LAN capable computer user is inconvenient and impracticable. They are also unwilling to have their ability to communicate depend on the presence of an infrastructure wherever they are.

BSA vs. ESA approaches:

One group of people think of BSA as meaning "a single cell of coverage". They further think of a single cell of coverage as the basic building block which is used to make an ESA network. Put several BSAs together and you have an ESA...

There is a certain attractive simplicity to this approach. It fits naturally with those who believe that a Hub is necessary. Some think of an Access Point as identical to a Hub.

As our work progresses we may be able to achieve implementation advantages by combining similar logical concepts. It is unwise to make this leap during the definition stage of our work. We will

be better able to evaluate alternatives (on their merits) if we keep different concepts logically separated.

The questions mixed together are:

1) What do we call the area within which two stations can communicate?

2) What do we call a cell of coverage which is part of a multicellular system?

3) What object generates / anchors / creates a cell?

Some people think that "Hub" and "Access Point" are different terms for identical objects. Others think that a Hub and Access Point perform different functions.

The difference in viewpoint was not always recognized by the various groups during discussion. This difference showed up particularly when discussing different network usage models.

Mixed modes of communication:

Another source of architectural confusion comes from the intermixing of assumptions regarding communication paths. I heard at least four different assumptions being used at various times.

Consider the path a message travels which is intended to originate from station A and get to station B;

Case 1:
From A directly to B.

Case 2:
From A to Hub, then to B.

Case 3:
From A directly to B, with a Hub controlling when A will talk and B will listen.

Case 4:
From A to an AP, and then to B.

Case 5:
From A to an AP, thru a Distribution System, to another AP, then to B.

I also heard combinations discussed where the message went direct from A to B when possible, but used a Hub or AP when the direct path wasn't possible (I never did hear how the system decides if the direct path is possible or not).

All of these cases are results of different assumptions about network operation. There was also a tendency to confuse BSA and ESA type networks.

Repeater operation:

Some people wanted to use repeaters as a way to get range extension. For these folks a message path might be from A, via C, to B. They further think that this is a function which should be part of the definition of BSA.

The logic is that because only station adaptors are being used, there is no Distribution System present. Therefore, a set of stations acting as repeaters must be a BSA network.

This approach assumes physical and logical functions are identical. In defining an architecture, we need to be aware that not all logical functions are physically packaged separately.

Repeaters logically constitute a Distribution System; they provide range extension by using a wireless Distribution System Media. The DS just happens to be implemented in a distributed fashion, in the same packaging as the station adaptors.

Network Usage Models:

I heard three network usage models discussed during the January meeting. They were:

1) Ad Hoc network, transitory in time and space.

The proponents of this model are interested in portable computing and the ability to link machines together on the spur of the moment.

They are opposed to the requirement for a third piece of hardware to enable two stations to communicate. The objections were to the physically separate component, not to the time slotted protocols. The melding of the two concepts generated opposition to the time slotted protocols that may not have been intended.

As pointed out previously, the logical "traffic cop" portion of the issue can be separated from the physical implementation issue. Either a deterministic, slotted protocol or a statistical protocol could be used to implement this usage model.

2) Single cell, fixed geographical location.

This usage model was generally described as a single cell of coverage centered about a traditional network server. Since most network servers are hard to move, the coverage area tends to be in a fixed location.

The model derives naturally from the software architectures of current centralized network operating systems (ex: Novell). There was some controversy as to wether this was a BSA network or a degenerate ESA network of only one cell.

The proponents of this model point out that to make commercially viable products, they need to be able to support this situation (since Novell currently has the largest NOS market share).

A wireless LAN adaptor inside a server can be viewed as a peer station adaptor, a logical and / or physical Hub, or a repeater. The software protocol used is independent of this model.

The categorization (BSA vs ESA) of this model is not as important as the support for operation with current NOSs.

3) Multi cell, overlapping coverage area, ESA network.

This usage model was the most easily accepted by all. Members seem to agree that to get arbitrary geographical coverage, we will need some type of Distribution System in addition to the station adaptors.

Most committee members think of a DS as a set of APs interconnected together with wire. The intelligence of the DS can be either distributed or centralized. Our working definitions should also be flexible enough to include DSs that utilize wired or wireless media for their interconnections.

Controversy arose because of the use of terms by different people for different concepts. We need to separate the logical concepts of ESA cells and BSA cells. If they converge during implementation, fine, but there are conceptual differences.

Our terminology should not invite us to fall prey to ignoring the differences. It is important to realize that the PAR puts forward two different types of networks: the BSA and the ESA. In all our discussions we should remain aware of which one is being discussed.

Some Analysis:

Many differing viewpoints were expressed. Part of the committee's task is to create a solution(s) which accommodates the requirements of the committee members. The first step is to create working definitions which will accommodate various product desires.

Let's see if we can untangle this situation some...

Two terms in the PAR require additional definition; BSA and ESA.

The PAR states:

1) DS: "... a distribution system designed to provide range extensibility will be defined as part of this standard."

2) BSA: "... in which each station can communicate with any other station in the BSA."

3) ESA: "... in which each station can communicate with any other station via the defined and managed Distribution System."

In a BSA ***stations communicate with other stations***. One way to phrase this is:

BSA = Station Set + X

What is X in this equation? Are any components other than stations required or desired?

In an ESA ***stations communicate with stations via a DS***. The equation for this is:

ESA = Station Set + DS

Consider the following logic:

A BSA and ESA network are not identical. The PAR states that a ESA network has a DS and a BSA network does not.

Therefore; X not = DS.

Let's investigate further into what X may be.

Let's consider the most elemental wireless network situation. One station alone is a very uninteresting network. Few (if any of us) would settle for two stations as an upper limit. Yet, two stations is the obvious minimum requirement for network communication.

A minimal network must enable two stations to communicate.

Applying the time honored KISS principal says that the simplest way for two stations to communicate is directly. The addition of any other component increases complexity.

The controversy in January was over the requirement for "direct" communication between stations. There were three objections raised.

Let's examine the objections:

Problem 1:
How would this apply to an ESA network since most people have accepted the concept of an Access Point?

The concern is that if messages pass from station A, thru one or two APs, and then to station B, the requirement for direct communication from A to B is violated.

This perception is a result of the intermixing of the logical functions of BSA and ESA cells.

The "direct" language was used only for the BSA definition.

We already know (from the PAR) that additional infrastructure is required for an ESA network (i.e. the DS). Stations are not required to communicate directly when operating within an ESA. In fact the PAR says they communicate via the DS.

In a BSA network there is no DS and therefore no conflict is presented by the "direct" wording.

Problem 2:
The "direct" requirement would disallow the use of a Hub architecture.

The first sub-issue is that a "traffic cop" function is perceived as necessary to network operation. The coordination of when station traffic is generated *does not imply* that the traffic *passes through* a Hub.

As pointed out earlier, the possible adoption of a protocol which requires a "traffic cop" function, does not necessitate a dedicated physical Hub module. In fact the requirement for a dedicated Hub component for a BSA is strongly objected to by many.

The second sub-issue is that some want all traffic to pass through a Hub or Access Point.

It is important not to confuse Hub and AP. An AP is part of a DS, which only exists as part of an ESA network. The argument does not apply to BSA networks.

If traffic always passes through a Hub, the Hub is likely providing a range extension function.

Range extension is the defined purpose of a DS and is part of an ESA network. It is contradictory to have a Hub as part of a BSA for purposes of range extension. Again the argument does not apply to a BSA network.

If the Hub is not providing range extension, the presence of a physical Hub is of no positive benefit to the architecture (since it's traffic cop function does not require an additional physical component).

The logical conclusion is that a BSA does not contain a physical Hub component (though a BSA network may contain the "traffic cop" functionality).

Problem 3:
The desire to allow stations to act as repeaters to achieve extended range.

The entire purpose of using stations as repeaters is to provide range extension. This is a type of DS. It's presence changes the scope of the conversation from a BSA network to an ESA network. It is not an argument which applies to a BSA network.

Conclusion:

The conclusion is that X is, in fact, Null. This says that a BSA network is a collection of Stations. With only stations in a BSA, the *only* way they can communicate is directly, from station to station. Our two equation have now become:

BSA = Station Set.
ESA = Station Set + DS.

Different sets of stations are different physical networks.

Note that BSA and ESA networks may occupy the same physical space. Within a room, some people may be using a DS to access an infrastructure at the same time that two other people use an Ad Hoc BSA to exchange information.

All the usage models and functionality desires expressed in January can be met by the adoption of a small set of appropriate working definitions.

After sorting through the assumptions and emotional content of January's discussions, we see that, given the context of a BSA network, the objections to the word "direct" are misplaced.

Because of the emotional attachment to the term BSA, I hesitate to attempt a definition. However, we are obligated by our PAR to provide further definition for a BSA.

Please set any emotional perceptions aside (as I grab the BSA tiger by the tail) and consider the following set of working definitions. The proposed set provides the minimal necessary definitions of the components of BSA and ESA networks.

After a great deal of discussion, I believe that the offered definitions really do satisfy all the functional requirements presented by 802.11 members in January.

Several people pointed out that a wireless network is inherently three dimensional in nature. I have modified the definitions to

use language that oriented toward three dimensional thinking. This leads to the use of "volume" in place of "area".

The PAR refers to areas. For consistency I have left the terms BSA and ESA as is (instead of BSV and ESV). While not as technically correct, it is probably more descriptive to initial readers of the standard.

Working Definitions:

Starting with the simplest wireless network component:

Definition 1 (Station):
A station is any computer which contains an implementation of an 802.11 MAC and PHY.

Proceeding to the most elemental wireless network:

Definition 2 (Basic Service Area):
A Basic Service Area (BSA) is that volume within which each station can directly communicate with any other station within the BSA.

And addressing the ESA network components:

Definition 3 (Access Point):
Access point (AP) is the term used for a fixed radiation point provided by a Distribution System.

Definition 4 (Access Point Coverage area):
An Access Point Coverage area (APC) is that volume within which a station can directly communicate with the Access Point.

Definition 5 (Distribution System Media):
The Distribution System Media (DSM) is the media used by a Distribution System to interconnect access points.

Definition 6 (Distribution System):
A Distribution System (DS) is defined to be that system, which links a set of Access Points together, in such a way that stations within APCs, can communicate.

Definition 7 (Extended Service Area):
An Extended Service Area (ESA) is the sum of the APCs provided by a Distribution System's Access Points.