[0049] Antenna unit **18** may include a smart antenna array **28** including a plurality of antenna elements **30**. Antenna unit **18** may also include a sector antenna **31** operable to transmit and/or receive signals throughout a sector. In some embodiments, sector antenna **31** is comprised of one or more antenna elements similar to antenna elements **30** in smart antenna array **28**. In the embodiment shown in FIG. **1**, antenna unit **18** is located on an antenna tower **22**. However, antenna unit **18** may be otherwise located, for example on a building. Preferably, signals directed to and from antenna unit **18** are generally unobstructed near antenna unit **18**, or in other words, antenna elements **30** can "see" a large area.

[0050] Traditional sector antennas used in cellular communication systems transmit radio signals in a wide beam to a relatively wide area, or sector, since the location of mobile stations is unknown to the system. Such systems pollute the electromagnetic environment by transmitting signals in unnecessary directions. In contrast, smart antenna system **14** divides the wide beam into a plurality of narrow beams. For example, in the embodiment shown in FIG. **1**, smart antenna system **14** divides a wide beam **32** covering an approximate 120 degree range into seven narrow beams **34**. This is accomplished by manipulating the phase of the signals received by antenna elements **30** of smart antenna array **28**. In some embodiments, narrow beams **34** are formed using a beamforming network, sometimes referred to as a BFN. In contrast, sector antenna **31** transmits and receives signals throughout the sector through wide beam **32**, bypassing the beamforming network. Signals may be communicated between antenna unit **18** and a particular mobile station **15** via a narrow beam **34** or via wide beam **32** (using sector antenna **31**), depending on various parameters.

[0051] Antenna unit **18** may be coupled to smart antenna apparatus **16** by one or more radio signal wires **40** operable to communicate radio signals between antenna unit **18** and smart antenna apparatus **16**. For example, antenna unit **18** may be coupled to smart antenna apparatus **16** by a plurality of radio signal wires **40**, each corresponding to a narrow beam **34**. Similarly, smart antenna apparatus **16** may be coupled to base station transceiver **24** by one or more radio signal wires **42** operable to communicate radio signals between smart antenna apparatus **16** and base station transceiver **24**. Radio signal wires **40** and **42** may include any wire media suitable for communicating radio frequency signals. For example, in one embodiment, radio signal wires **40** and **42** are radio frequency (RF) cables.

[0052] When a mobile station **15** transmits uplink signals, the uplink signals may be received along any number of narrow beams **34** due to multi-path or other interference phenomena, and/or due to overlapping areas covered by adjacent narrow beams **34**. The uplink signals received via each narrow beam **34** are communicated to smart antenna apparatus **16** via radio signal wires **40**. In one embodiment, one or more separate radio signal wires **40** are provided to communicate the signals received via each narrow beam **34**.

[0053] Smart antenna apparatus **16** processes uplink signals received along each narrow beam **34** and/or other input signals or data to select the best narrow beam **34** and to allow uplink signals received via that narrow beam **34** to be communicated to base station transceiver **24** via radio signal wires **42**. For example, smart antenna apparatus **16** may select the best narrow beam **34** based on one or more inputs or parameters. One input may include signaling information received by signaling information monitoring system **106** (described below in connection with FIG. **2**). Other example inputs or parameters include signal strength, signal quality, relevant power, and signal history of signals received from one or more mobile stations **15**. After smart antenna apparatus **16** communicates the uplink signals received via the selected narrow beam **34** to base station transceiver **24**, the uplink signals may be processed and/or further communicated by base station system **12**. It should be noted that the term "narrow beam" as used in this document applies both to the physical beams through which antenna unit **18** transmits and receives signals (as indicated using reference numeral **34** in FIG. **1**) as well as the signals received via each of the physical beams.

[0054] When downlink signals are to be transmitted from base station system **12** to mobile station **15**, the downlink signals are communicated from base station transceiver **24** to smart antenna apparatus **16** via radio signal wires **42**. Smart antenna apparatus **16** may select a best narrow beam **34** through which to send the downlink signals. Like the beam selection for uplink signals discussed above, the beam selection for the downlink signals may be based on one or more inputs or parameters, including signaling information received by signaling information monitoring system **106**. Other example inputs or parameters include signal strength, signal quality, and signal history of signals received from one or more mobile stations **15**.

[0055] Smart antenna apparatus **16** may switch from one narrow beam **34** to another narrow beam **34** accordingly. For example, when mobile station **15** moves to a new location, smart antenna system **14** may switch from one narrow beam **34** to another narrow beam **34** for receiving uplink signals from and/or transmitting downlink signals to mobile station **15**. In this manner, smart antenna system **14** may locate and track mobile stations **15** as they move within wide beam **32**, and transmit signals to and receive signals from each mobile stations **15** via one or more appropriate narrow beams **34**. At a particular point in time, the narrow beam **34** selected as the best beam for communicating uplink signals received from mobile station **15** to base station transceiver **24** may be the same as, or different from, the narrow beam **34** selected as the best beam for communicating downlink signals to mobile station **15**. This may provide an advantage in situations in which the best beam for receiving uplink signals from a mobile station is not the same as the best beam for transmitting signals to that mobile station. This may be likely, for example, in high-interference environments, such as dense or urban environments.

[0056] Base station system **12** may communicate with mobile stations **15** within a range of frequencies, which may be divided into a number of frequency bands. According to some wireless communication standards, the available bandwidth is divided into a number of frequency bands, which may each be referred to simply as a frequency. In some standards, each uplink frequency (in other words, a frequency used for uplink communications) may be associated with a corresponding downlink frequency, such that pairs of frequencies are available. For example, in a P/E/R-GSM 900 environment, each frequency (both uplink and downlink) has a bandwidth of 200 kHz, and each uplink frequency band is offset from its corresponding downlink frequency band by 45 MHz. Typically, due to limitations of signal