DOWNLOAD PDF CDMA DISTRIBUTED ANTENNA SYSTEM FOR INDOOR WIRELESS COMMUNICATIONS

Chapter 1 : DAS and BDA Antennas by MP Antenna

Abstract: This paper introduces an architecture and gives preliminary analysis of an indoor wireless CDMA communication system using a distributed antenna. The architecture is suitable to an environment affected by a large degree of shadowing.

Base station subsystem â€" the base stations and their controllers Network and Switching Subsystem â€" the part of the network most similar to a fixed network, sometimes just called the "core network" GPRS Core Network â€" the optional part which allows packet-based Internet connections Operations support system OSS â€" network maintenance Base station subsystem[edit] GSM cell site antennas in the Deutsches Museum , Munich , Germany GSM is a cellular network , which means that cell phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM networkâ€" macro , micro , pico , femto , and umbrella cells. The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average rooftop level. Micro cells are cells whose antenna height is under average rooftop level; they are typically used in urban areas. Picocells are small cells whose coverage diameter is a few dozen meters; they are mainly used indoors. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells. Cell horizontal radius varies depending on antenna height, antenna gain, and propagation conditions from a couple of hundred meters to several tens of kilometres. There are also several implementations of the concept of an extended cell, [18] where the cell radius could be double or even more, depending on the antenna system, the type of terrain, and the timing advance. Indoor coverage is also supported by GSM and may be achieved by using an indoor picocell base station, or an indoor repeater with distributed indoor antennas fed through power splitters, to deliver the radio signals from an antenna outdoors to the separate indoor distributed antenna system. These are typically deployed when significant call capacity is needed indoors, like in shopping centers or airports. However, this is not a prerequisite, since indoor coverage is also provided by in-building penetration of the radio signals from any nearby cell. GSM carrier frequencies[edit] Main article: Regardless of the frequency selected by an operator, it is divided into timeslots for individual phones. This allows eight full-rate or sixteen half-rate speech channels per radio frequency. These eight radio timeslots or burst periods are grouped into a TDMA frame. Half-rate channels use alternate frames in the same timeslot. The channel data rate for all 8 channels is Voice codecs[edit] GSM has used a variety of voice codecs to squeeze 3. Originally, two codecs, named after the types of data channel they were allocated, were used, called Half Rate 6. These used a system based on linear predictive coding LPC. In addition to being efficient with bitrate s, these codecs also made it easier to identify more important parts of the audio, allowing the air interface layer to prioritize and better protect these parts of the signal. Finally, with the development of UMTS , EFR was refactored into a variable-rate codec called AMR-Narrowband , which is high quality and robust against interference when used on full-rate channels, or less robust but still relatively high quality when used in good radio conditions on half-rate channel. This allows the user to retain his or her information after switching handsets. Alternatively, the user can change operators while retaining the handset simply by changing the SIM. SIM lock Sometimes mobile network operators restrict handsets that they sell for use with their own network. This is called locking and is implemented by a software feature of the phone. A subscriber may usually contact the provider to remove the lock for a fee, utilize private services to remove the lock, or use software and websites to unlock the handset themselves. It is possible to hack past a phone locked by a network operator. It has considered the user authentication using a pre-shared key and challenge-response , and over-the-air encryption. However, GSM is vulnerable to different types of attack, each of them aimed at a different part of the network. The security model therefore offers confidentiality and authentication, but limited authorization capabilities, and no non-repudiation. GSM uses several cryptographic algorithms for security. Serious weaknesses have been

found in both algorithms: Since different efforts have been made in order to crack the A5 encryption algorithms. The most commonly deployed GPRS ciphers were publicly broken in They also noted that some carriers do not encrypt the data i.

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Chapter 2 : Optical Telecom|Distributed Antenna Systems|DAS Design|DAS Installation

This paper introduces an architecture and gives preliminary analysis of an indoor wireless CDMA communication system using a distributed antenna.

Sousa - Sun City, South Africa , " The objective of this study is to utilize antennas in novel ways so as to achieve performance benefits at the system level in future wireless networks. Despite possessing many appealing features, CDMA distributed antenna DA systems suffer from low capacity per antenna element AE as a result of the multiple access interference MAI accumulated in the common feeder. In this study, the limiting case of one AE per sector is investigated. Sousa - in Proc. Commun , " In this study the relationship between the number of antenna elements in a CDMA distributed antenna DA system and the yielding reverse link SIR is investigated by taking power control dynamic range into account. In environments hostile to propagation, perfect power control may not be realized with In environments hostile to propagation, perfect power control may not be realized with a central antenna CA , because this would require an impractically high dynamic range. This situation may yield a significant decrease in capacity. In such environments, the DA system is an ideal solution, since as the number of antenna elements increases, the dynamic range of the power control decreases. However, in a single-cell system once there are a sufficient number of antenna elements to implement perfect power control within a reasonable dynamic range, there is no need for additional antenna elements. Antenna interconnection strategies for personal communication systems by Halim Yanikomeroglu, Elvino S. Areas Commun , " Abstract â€" Microcellular and distributed antenna systems are two promising candidates for implementing personal communication systems. In this paper, antenna interconnection strategies for these systems are studied in order to determine cost-efficient as well as robust and flexible architectures in In this paper, antenna interconnection strategies for these systems are studied in order to determine cost-efficient as well as robust and flexible architectures in hexagonal layouts. To this end, some results from minimal networks theory are used, in particular, those dealing with the problem of Steiner trees. The significant reduction in conduit and cable lengths that the Steiner minimal tree SMT architecture provides over the star type, especially in large networks, is demonstrated. It is further shown that the SMT architecture also provides more flexibility and robustness compared to the star type. The suboptimal, but easy-to-construct, minimal spanning tree MST architecture is given as well, and it is compared to the SMT and star types. In a DA cell, many simple antenna elements are coupled to a common feeder. The same signal is transmitted from and received by all of the antenna elements which are distributed throughout the cell In this paper we consider different antenna sub-systems for integrated wireless access networks IWAN. The appropriate antenna sub-system is dependent on the modulation scheme used. In this paper we consider a CDMA scheme along with various antenna sub-systems such as a distributed antenna, an antenna sub-system which we refer to as a sectorized distributed antenna, and a distributed antenna utilizing sub-carrier multiplexing. These concepts lead to a network architecture consisting of network switches, radio controllers, base stations, and the various antenna subsystems. Show Context Citation Context We refer to the last two as distributed antennas. The objective in choosing a type of antenna is to minimize radiation to unwanted areas to minimize interference, to use the smallest number of eleme The Steiner minimal tree SMT architecture is proposed for the wired-network infrastructure of wireless access networks. It is demonstrated that the wireless access networks having star or bus logical topologies can be realized within the proposed optimal SMT conduit structure. The SMT architecture results in a significant reduction in conduit length compared to the conventional star type, besides it provides more flexibility and robustness. For the systems which have logical bus topologies with centralized complexity, such as the distributed antenna DA systems, the SMT architecture is optimal in both cable and conduit lengths. In a wireless access network, there are two main cost factors: In a DA system, since the same signal is transmitted from and received by all the antenna elements, the system has a logical bus topology with a very low level of complexity at the antenna elements Coordinated port selection and beam

steering optimization in a multi-cell distributed antenna system using semidefinite relaxation by Talha Ahmad, Ramy H. Wireless Commun , " Abstractâ€”In this paper, we consider coordinated downlink transmission in a cellular system wherein each base station BS has multiple geographically dispersed antenna ports. Each port uses a fixed transmit power and the goal of the BSs is to collectively determine the subset of ports and the corres Each port uses a fixed transmit power and the goal of the BSs is to collectively determine the subset of ports and the corresponding beam steering coefficients that maximize the minimum signalto-interference-plus-noise ratio observed by the user terminals. This problem is NP-hard. To circumvent this difficulty, a twostage polynomial-complexity technique that relies on semidefinite relaxation and Gaussian randomization is developed. It is shown that, for the considered scenarios, the port state vectors and beam steering coefficients generated by the proposed technique yield a performance comparable to that yielded by exhaustive search, but with a significantly less computational complexity. It is also shown that the proposed technique results in significant power savings when compared with other transmission strategies proposed in the literature. Index Termsâ€”Distributed antenna systems, remote radio heads, multi-cell coordination, port selection, beam steering optimization, semidefinite relaxation, Gaussian randomization. We propose a new macro-selection strategy to improve the conventional macrodiversity selection We propose a new macro-selection strategy to improve the conventional macrodiversity selection technique. Furthermore, the issue of macrodiversity maximal ratio combining in non-CDMA microcellular networks is investigated as a natural extension of the soft handover of the already established CDMA cellular systems. The proposed schemes have performance advantage over the conventional macrodiversity method at a modest extra processing. Some of these examples are typical scenarios fitting into the indoor microcellular systems, see for example [12, pp. In such environments the number of deployed access ports will be large; Abstract â€” We investigate microdiversity-augmented macrodiversity techniques in wireless communication networks. The setup consists of K widely separated access ports each carrying N antennas. The conventional selection macrodiversity Scheme I and two proposed methods Scheme II and Scheme III for port selection are investigated and their performance are compared. Scheme II utilizes the advancement in distributed antennas and radio-on-fiber technologies whereas Scheme III utilizes these technologies in a way similar to the soft handover of CDMA systems. Analytical performance expressions for the probability of error and outage probability for Scheme I are developed. Simulations are used to investigate Scheme II and Scheme III and it is observed that these latter schemes exhibit performance superiority over the conventional macrodiversity selection method. The power savings obtained using the proposed architecture and new selection schemes could be used either for coverage extension or to increase capacity in wireless networks. Interference management is utmost important in CDMA systems, since any reduction in inter-ference translates into a direct increase in capacity. The main objective of this thesis is to utilize antennas in novel ways so as to achieve performance bene ts at the system level through spatial interferenc The main objective of this thesis is to utilize antennas in novel ways so as to achieve performance bene ts at the system level through spatial interference management. To this end, we study CDMA multi-antenna wireless access networks where the transmission and reception are through multiple antennas distributed in the service area , and compare the performance of such networks with that of the conventional types where there is only one central antenna CA , which is the base station antenna. Although the capacity of a DA system may be considerably higher than that which employs Show Context Citation Context Also, it is interesting to note that, depending on the inter-AE distance, the required delays for path resolution may naturally be introduced as a result of the propagation delay in the cable. Eng , " In the name of your Lord Who has created all that exists â€” created man from a clot. He has taught man that which he did not know. However, the conventional DASs do not inherently mitigate inter-cell interference. In this thesis, coordinated multi-point transmission schemes are developed for interference mitigation in the downlink of a cellular DAS. The thesis is comprised of two parts. In the first part, two precoding schemes are developed, which enable coordinated transmission from multiple distributed antenna ports in a cellular DAS with a total power constraint. The goal is to serve multiple Show Context

Citation Context Early works on the integration of DASs in cellular networks appeared in [11]â€”[14], and these were primarily focussed on code division multiple access CDMA based systems. In addition to incorporat

Chapter 3 : Seamless Cellular In-Building Cellular Repeater Solutions

To this end, we study CDMA multi-antenna wireless access networks (where the transmission and reception are through multiple antennas distributed in the service area), and compare the performance of such networks with that of the conventional types where there is only one central antenna (CA), which is the base station antenna.

A microcellular arrangement is defined in which a base station communicates user information signals using CDMA communication signals with subscriber terminals. A distributed antenna system is utilized in the system to provide multipath signals which facilitate signal diversity for enhanced system performance. Description This is a continuation of application Ser. Field of the Invention The present invention relates to wireless PBX and wireless local loop telephone systems. More specifically, the present invention relates to a novel and improved microcellular telephone system and distributed antenna system therefor so as to facilitate indoor communications using spread spectrum communication signals. Description of the Related Art The use of code division multiple access CDMA modulation techniques is one of several techniques for facilitating communications in which a large number of system users are present. However the spread spectrum modulation technique of CDMA has significant advantages over these modulation techniques for multiple access communication systems. In the just mentioned patent, a multiple access technique is disclosed where a large number of mobile telephone system users each having a transceiver communicate through satellite repeaters or terrestrial base stations also referred to as cell-sites stations, cell-sites or for short, cells using code division multiple access CDMA spread spectrum communication signals. In using CDMA communications, the frequency spectrum can be reused multiple times thus permitting an increase in system user capacity. The use of CDMA results in a much higher spectral efficiency than can be achieved using other multiple access techniques. The terrestrial channel experiences signal fading that is characterized by Rayleigh fading. The Rayleigh fading characteristic in the terrestrial channel signal is caused by the signal being reflected from many different features of the physical environment. As a result, a signal arrives at a mobile unit receiver from many directions with different transmission delays. At the UHF frequency bands usually employed for mobile radio communications, including those of cellular mobile telephone systems, significant phase differences in signals traveling on different paths may occur. The possibility for destructive summation of the signals may result, with on occasion deep fades occurring. Terrestrial channel fading is a very strong function of the physical position of the mobile unit. A small change in position of the mobile unit changes the physical delays of all the signal propagation paths, which further results in a different phase for each path. Thus, the motion of the mobile unit through the environment can result in a quite rapid fading process. For example, in the MHz cellular radio frequency band, this fading can typically be as fast as one fade per second per mile per hour of vehicle speed. Fading this severe can be extremely disruptive to signals in the terrestrial channel resulting in poor communication quality. Additional transmitter power can be used to overcome the problem of fading. However, such power increases effect both the user, in excessive power consumption, and the system by increased interference. The terrestrial channel poses special problems to any communication system particularly with respect to multipath signals. The use of CDMA techniques permit the special problems of the terrestrial channel to be overcome by mitigating the adverse effect of multipath, e. In a CDMA cellular telephone system, the same wide band frequency channel can be used for communication in all cells. The CDMA waveform properties that provide processing gain are also used to discriminate between signals that occupy the same frequency band. Furthermore the high speed pseudonoise PN modulation allows many different propagation paths to be separated, provided the difference in path delays exceed the PN chip duration, i. If a PN chip rate of approximately 1 MHz is employed in a CDMA system, the full spread spectrum processing gain, equal to the ratio of the spread bandwidth to system data rate, can be employed to discriminate against paths that differ by more than one microsecond in path delay from each other. A one microsecond path delay differential corresponds to differential path distance of approximately 1, feet. The

urban environment typically provides differential path delays in excess of one microsecond, and up to microseconds are reported in some areas. In narrow band modulation systems such as the analog FM modulation employed by conventional telephone systems, the existence of multiple paths results in severe multipath fading. With wide band CDMA modulation, however, the different paths may be discriminated against in the demodulation process. This discrimination greatly reduces the severity of multipath fading. Multipath fading is not totally eliminated in using CDMA discrimination techniques because there will occasionally exist paths with delayed differentials of less than the PN chip duration for the particular system. Signals having path delays on this order cannot be discriminated against in the demodulator, resulting in some degree of fading. It is therefore desirable in the CDMA cellular telephone system that some form of diversity be provided which would permit a system to reduce fading. Diversity is one approach for mitigating the deleterious effects of fading. Three major types of diversity exist: Time diversity can best be obtained by the use of repetition, time interleaving, and error detection and correction coding which is a form of repetition. The present invention employes each of these techniques as a form of time diversity. CDMA by its inherent nature of being a wideband signal offers a form of frequency diversity by spreading the signal energy over a wide bandwidth. Therefore, frequency selective fading affects only a small part of the CDMA signal bandwidth. Space or path diversity is obtained by providing multiple signal paths through simultaneous links from a mobile user through two or more cell-sites. Furthermore, path diversity may be obtained by exploiting the multipath environment through spread spectrum processing by allowing a signal arriving with different propagation delays to be received and processed separately. Examples of path diversity are illustrated in copending U. The deleterious effects of fading can be further controlled to a certain extent in a CDMA system by controlling transmitter power. A system for cell-site and mobile unit power control is disclosed in copending U. Accordingly, disclosed therein is the use of a pilot carrier signal as a coherent phase reference for the satellite-to-mobile link and the cell-to-mobile link. In the terrestrial cellular environment, however, the severity of multipath fading, with the resulting phase disruption of the channel, precludes usage of coherent demodulation technique for the mobile-to-cell link. The present invention provides a means for overcoming the adverse effects of multipath in the mobile-in-cell link by using noncoherent modulation and demodulation techniques. The cross-correlation between different PN sequences and the autocorrelation of a PN sequence for all time shifts other than zero both have a zero average value which allows the different user signals to be discriminated upon reception. However, such PN signals are not orthogonal. Although the cross-correlations average to zero, for a short time interval such as an information bit time the cross-correlation follows a binomial distribution. As such, the signals interfere with each other much the same as if they were wide bandwidth Gaussian noise at the same power spectral density. Thus the other user signals, or mutual interference noise, ultimately limits the achievable capacity. If two or more paths are available with greater than one microsecond differential path delay, two or more PN receivers can be employed to separately receive these signals. Since these signals will typically exhibit independence in multipath fading, i. Therefore a loss in performance only occurs when both receivers experience fades at the same time. Hence, one aspect of the present invention is the provision of two or more PN receivers in combination with a diversity combiner. In order to exploit the existence of multipath signals, to overcome fading, it is necessary to utilize a waveform that permits path diversity combining operations to be performed. A method and system for constructing PN sequences that provide orthogonality between the users so that mutual interference will be reduced is disclosed in copending U. Using these techniques in reducing mutual interference allowing higher system user capacity and better link performance. With orthogonal PN codes, the cross-correlation is zero over a predetermined time interval, resulting in no interference between the orthogonal codes, provided only that the code time frames are time aligned with each other. In the cell-to-mobile link, pilot, sync, paging and voice channels are defined. Information communicated on the cell-to-mobile link channels are, in general, encoded, interleaved, bi-phase shift key BPSK modulated with orthogonal covering of each BPSK symbol along with quadrature phase shift key QPSK spreading of the covered symbols. In the mobile-to-cell link, access and voice channels

are defined. Information communicated on the mobile-to-cell link channels are, in general, encoded, interleaved, orthogonal signalling along with QPSK spreading. Using orthogonal PN sequences does in fact reduce mutual interference, thereby permitting greater user capacity, in addition to supporting path diversity so as to overcome fading. The above mentioned patent and patent applications disclose a novel multiple access technique wherein a large number of mobile telephone system users communicate through satellite repeaters or terrestrial base stations using code division multiple access spread spectrum modulation that allows the spectrum to be reused multiple times. The resulting system design has a much higher spectral efficiency than can be achieved using previous multiple access techniques. In cellular telephone systems, a large geographic area is provided with mobile telephone service by installing a number of cell-sites situated so as to provide coverage of the entire geographic area. If service demand exceeds the capacity that can be provided by a set of cell-sites that just provides coverage, the cells are subdivided into smaller cells. This process has been carried out to the extent that some major metropolitan areas have nearly cell-sites. The technique described in U. In a further development of the cellular telephone idea, it is desired to provide a number of very small cells, called microcells, which would provide coverage of a very limited geographic area. Usually, it is considered that such areas are limited to a single floor of an office building and the mobile telephone service can be viewed as a cordless telephone system that may or may not be compatible with the mobile cellular telephone system. The rationale for providing such a service is similar to the reasoning for use of Private Branch Exchange PBX systems in business offices. Such systems provide for low cost phone service for a large number of calls between phones within the business while providing simplified dialing for internal phone numbers. A few lines are also provided to connect the PBX system to the public telephone system, allowing calls to be made and received between phones in the PBX system and telephones located elsewhere. It is desirable for the microcell system to provide a similar level of service but with the added feature of cordless operation anywhere within the service area of the PBX. In applications such as the wireless PBX or Wireless local loop telephone systems path delays are much shorter in duration than in cellular mobile systems. In buildings and other indoor environments where PBX systems are used it is necessary to provide a form of diversity which will enable discrimination between CDMA signals. The primary problem solved by the disclosed invention is the provision of a simple antenna system that provides high capacity, simple installation, good coverage and excellent performance. Another problem is to achieve the above limited coverage while maintaining compatibility with the mobile cellular system and while taking a negligible amount of capacity away from the mobile system. This is achieved in the disclosed invention by combining the capacity properties of CDMA with a new distributed antenna design that confines the radiation to a very limited and carefully controlled area. The implementation of spread spectrum communication techniques, particularly CDMA techniques, in a PBX environment therefore provides features which vastly enhance system reliability and capacity over other communication system techniques. CDMA techniques as previously mentioned further enable problems such as fading and interference to be readily overcome. Accordingly, CDMA techniques further promote greater frequency reuse, thus enabling a substantial increase in the number of system users. In this concept, a set of simple antennas are fed by a common signal with only time delay processing to distinguish signals. The transmit output of the cell transmitter is fed down a coaxial cable to a string of radiators. The radiators are connected to the cable using power splitters. The resulting signals, amplified as necessary, are fed to the antennas. The salient features of this antenna concept are: In the distributed antenna processing, each antenna taps into the distribution cable somewhat like a cable TV system. Broadband gain is provided as needed at the antennas or at the cable taps. Note that the cable system will usually consist of two cables, one for transmit signals and one for receive signals. In many cases, the necessary delay will be provided naturally by the distribution cable and no additional delay elements will be necessary. When additional delay is necessary, it will usually prove simplest to coil up a length of coaxial cable. A very important feature of this architecture is that no signal specific processing is necessary.

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Chapter 4 : Distributed Antenna Systems (DAS): The Definitive Guide []

A distributed antenna system (DAS) is a shared-infrastructure or neutral host model for expanding a wireless network footprint such as WiFi, GSM, CDMA/1x-EVDO, UMTS, and LTE by adding coverage and capacity in hard to reach areas.

Kamel Tourki Huawei France , October Ian Marsland and Prof. Halim Yanikomeroglu, September Ramy Gohary and Prof. Halim Yanikomeroglu, June Halim Yanikomeroglu, December Halim Yanikomeroglu and Prof. Ramy Gohary, December Halim Yanikomeroglu and Dr. Sebastian Szyszkowicz, July Sebastian Szyszkowicz, December Sebastian Szyszkowicz and Prof. Ramy Gohary, and Prof. Ramy Gohary, January Ramy Gohary, September Halim Yanikomeroglu, May Marc St-Hilaire, September Halim Yanikomeroglu, August Richard Yu, September Halim Yanikomeroglu, July Shalini Periyalwar and Prof. Halim Yanikomeroglu, January Halim Yanikomeroglu Carleton, Ottawa, Canada. Szyszkowicz, Interference in Cellular Networks: Shalini Periyalwar, Carleton University, January Falconer, Carleton University, January Halim Yanikomeroglu, Carleton University, December Samy Mahmoud, Carleton University, May Halim Yanikomeroglu, Carleton University, January Halim Yanikomeroglu, Carleton University, September Falconer, Carleton University, July Falconer, Carleton University, Sousa, University of Toronto,

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Chapter 5 : Distributed Antenna System Training Noida, Delhi: Nex-G Skills

With the distributed antenna system (DAS) becoming a strategic, first-line network element, DAS must meet rapidly evolving wireless network requirements in a cost-effective, scalable, and future-ready manner.

Sousa - Sun City, South Africa , " The objective of this study is to utilize antennas in novel ways so as to achieve performance benefits at the system level in future wireless networks. Despite possessing many appealing features, CDMA distributed antenna DA systems suffer from low capacity per antenna element AE as a result of the multiple access interference MAI accumulated in the common feeder. In this study, the limiting case of one AE per sector is investigated. Show Context Citation Context It is shown in that study that the DA is an ideal antenna type for systems employing CDMA modulation, in the sense that by employing DA, power control PC may be maintained perfectly in such system Sousa, Senior Member " Abstractâ€”In a multiantenna system, there is a potential antenna gain against interference, in addition to the diversity gain achieved against fading. It is well known that in order to attain most of the diversity gain against fading , the antenna elements should be placed apart with a distance man Rao , " We compare the performance of two multiple antenna systems to be used in quality of service QoS supported indoor wireless networks. While a conventional array antenna system AAS has collocated, closely spaced antenna elements, a distributed antenna system DAS has largely spaced antennas over t While a conventional array antenna system AAS has collocated, closely spaced antenna elements, a distributed antenna system DAS has largely spaced antennas over the entire area of radio coverage. To support multimedia applications requiring high bandwidth and on time delivery, we propose a set of highly spectrum efficient radio resource management algorithms. We focus on the optimization of downlink since many kinds of Internet traffic show the downlink dominance in their traffic asymmetry. To maximize the downlink throughput, we present a new transmit beamforming algorithm which can be equally applied to both DAS and AAS. The beamforming algorithm is integrated with a link scheduling algorithm that exploits the space division multiplexing SDM capability of multiple antenna systems to meet the QoS requirements of all terminals. In this paper, we consider a more advanced utilization of a DAS. We apply different complex weights to different antennas. The allocation of downlink power magnitude and the phase angles are deter The CDMA sectorized distributed antenna SDA is a novel antenna architecture which yields an increase in the reverse link capacity, in the order of the number of antenna elements used [1]. In an SDA system, a power control algorithm that balances the SIR should be considered, since the conventional power-balanced power control algorithm results in considerable disparities among the SIR levels of different users. However, SIR-balancing for the SDA system is more complicated than that for the conventional central antenna systems due to macrodiversity. In SBMPC, the set of equations to be solved are nonlinear due to diversity which makes the solutions for SIR-balancing algorithms, given in the literature, inapplicable. Therefore, we propose an iterative We consider a flat fading Interference management is utmost important in CDMA systems, since any reduction in inter-ference translates into a direct increase in capacity. The main objective of this thesis is to utilize antennas in novel ways so as to achieve performance bene ts at the system level through spatial interferenc The main objective of this thesis is to utilize antennas in novel ways so as to achieve performance bene ts at the system level through spatial interference management. To this end, we study CDMA multi-antenna wireless access networks where the transmission and reception are through multiple antennas distributed in the service area , and compare the performance of such networks with that of the conventional types where there is only one central antenna CA , which is the base station antenna.

Chapter 6 : DAS Training â€“ Distributed Antenna System | Wireless Mobi Technologies

wireless companies are providing indoor and outdoor wireless coverage using passive distribution, active distribution, hybrid solutions, repeaters and small cells [9]. Telecommunication Properties Inc. has deployed an LTE-DAS system at the Medical Branch of.

Each node of the antenna comprises more than one antenna. Each antenna at a common node provides a path having a different delay to the base station. Description This is a continuation of application Ser. Field of the Invention The present application is related to U. The present invention relates to communication systems, particularly indoor communication systems including cellular telephones, personal communication services PCS , wireless private branch exchange PBX and wireless local loop telephone systems. More specifically, the present invention relates to a novel and improved distributed antenna system for microcellular communication systems to facilitate indoor communications using spread spectrum signals. Description of the Related Art The use of code division multiple access CDMA modulation techniques is one of several techniques for facilitating communications in which a large number of system users are present. Other multiple access communication system techniques, such as frequency hopping spread spectrum, time division multiple access TDMA , frequency division multiple access FDMA and amplitude modulation schemes such as amplitude companded single sideband ACSSB are known in the art. However the spread spectrum modulation technique of CDMA has significant advantages over these modulation techniques for multiple access communication systems. In the just mentioned patent, a multiple access technique is disclosed where a large number of mobile telephone system users each having a transceiver communicate through satellite repeaters or terrestrial base stations also referred to as cell-sites stations, cell-sites, or for short, cells using code division multiple access CDMA spread spectrum communication signals. In using CDMA communications, the frequency spectrum can be reused multiple times thus permitting an increase in system user capacity. The use of CDMA results in a much higher spectral efficiency than can be achieved using other multiple access techniques. The terrestrial channel experiences signal fading that is characterized by Rayleigh fading. The Rayleigh fading characteristic in the terrestrial channel signal is caused by the signal being reflected from many different features of the physical environment. As a result, a signal arrives at a mobile unit receiver from many directions with different transmission delays. At the UHF frequency bands usually employed for mobile radio communications, including those of cellular mobile telephone systems, significant phase differences in signals traveling on different paths may occur. The possibility for destructive summation of the signals may result, with on occasion deep fades occurring. Terrestrial channel fading is a very strong function of the physical position of the mobile unit. A small change in position of the mobile unit changes the physical delays of all the signal propagation paths, which further results in a different phase for each path. Thus, the motion of the mobile unit through the environment can result in a quite rapid fading process. For example, in the MHz cellular radio frequency band, this fading can typically be as fast as one fade per second per mile per hour of vehicle speed. Fading this severe can be extremely disruptive to signals in the terrestrial channel resulting in poor communication quality. Additional transmitter power can be used to overcome the problem of fading. However, such power increases effect both the user by excessive power consumption, and the system by increased interference. The terrestrial channel poses special problems to any communication system particularly with respect to multipath signals. The use of CDMA techniques permit the special problems of the terrestrial channel to be overcome by mitigating the adverse effect of multipath, e. In a CDMA communication system, the same wideband frequency channel can be used for communication by all base stations. Typically a FDMA scheme is used where one frequency band is used for communications from the base stations to the remote or mobile stations forward link and another for communications from the remote or mobile stations to the base stations reverse link. The CDMA waveform properties that provide processing gain are also used to discriminate between signals that occupy the same frequency band. Furthermore the high speed pseudonoise

PN modulation allows many different propagation paths to be separated, provided the difference in path delays exceed the PN chip duration, i. If a PN chip rate of approximately 1 MHz is employed in a CDMA system, the full spread spectrum processing gain, equal to the ratio of the spread bandwidth to system data rate, can be employed to discriminate against paths that differ by more than one microsecond in path delay from each other. A one microsecond path delay differential corresponds to differential path distance of approximately 1, feet. The urban environment typically provides differential path delays in excess of one microsecond, and up to microseconds are reported in some areas. In narrow band modulation systems such as the analog FM modulation employed by conventional telephone systems, the existence of multiple paths results in severe multipath fading. With wideband CDMA modulation, however, the different paths may be discriminated against in the demodulation process. This discrimination greatly reduces the severity of multipath fading. Multipath fading is not totally eliminated in using CDMA discrimination techniques because there occasionally exists paths with delayed differentials of less than the PN chip duration for the particular system. Signals having path delays on this order cannot be discriminated against in the demodulator, resulting in some degree of fading. It is therefore desirable in such communication systems that some form of diversity be provided which would permit a system to reduce fading. Diversity is one approach for mitigating the deleterious effects of fading. Three major types of diversity exist: Time diversity can best be obtained by the use of repetition, time interleaving, and error detection and correction coding which is a form of repetition. The present invention employs each of these techniques as a form of time diversity. CDMA by its inherent nature of being a wideband signal offers a form of frequency diversity by spreading the signal energy over a wide bandwidth. Therefore, frequency selective fading affects only a small part of the CDMA signal bandwidth. Space or path diversity is obtained by providing multiple signal paths through simultaneous links from a mobile user through two or more base stations. Furthermore, path diversity may be obtained by exploiting the multipath environment through spread spectrum processing by allowing a signal arriving with different propagation delays to be received and processed separately. Examples of path diversity are illustrated in U. The deleterious effects of fading can be further controlled to a certain extent in a CDMA system by controlling transmitter power. A fade which decreases the power received by the base station from the mobile unit can be compensated for by increasing the power transmitted by the mobile station. The power control function operates in accordance with a time constant. Depending on the time constant of the power control loop and the length of time of a fade, the system may compensate for the fade by increasing the transmit power of the mobile unit. A system for base station and mobile unit power control is disclosed in U. If two or more paths are available with differential path delay greater than one chip duration two or more PN receivers can be employed to separately receive these signals at a single base station or mobile unit. Since these signals typically exhibit independence in multipath fading, i. Therefore a loss in performance only occurs when both receivers experience fades at the same time. Hence, one aspect of the present invention is the provision of two or more PN receivers in combination with a diversity combiner. In order to exploit the existence of multipath signals, to overcome fading, it is necessary to utilize a waveform that permits path diversity combining operations to be performed. A method and system for constructing PN sequences that provide orthogonality between the users so that mutual interference is reduced is disclosed in U. Using these techniques to reduce mutual interference allows higher system user capacity and better link performance. With orthogonal PN codes, the cross-correlation is zero over a predetermined time interval, resulting in no interference between the orthogonal codes, provided only that the code time frames are time aligned with each other. The above mentioned patents and patent applications disclose a novel multiple access technique wherein a large number of mobile unit telephone system users communicate through satellite repeaters or terrestrial base stations using code division multiple access spread spectrum modulation that allows the spectrum to be used multiple times. The resulting system design has a much higher spectral efficiency than can be achieved using previous multiple access techniques. In cellular telephone systems, a large geographic area is provided with mobile telephone service by installing a number of base stations, each positioned to cover a cell, and the set of cells

situated so as to provide coverage of the entire geographic area. If service demand exceeds the capacity that can be provided by a set of base stations providing coverage over a certain area, the cells are subdivided into smaller cells and more base stations are added. This process has been carried out to the extent that some major metropolitan areas have nearly base stations. In a further development of the cellular telephone idea, it is desired to provide a number of very small cells, called microcells, which would provide coverage of a very limited geographic area. Usually, it is considered that such areas are limited to a single floor of an office building and the mobile telephone service can be viewed as a cordless telephone system that may or may not be compatible with the mobile cellular telephone system. The rationale for providing such a service is similar to the reasoning for use of Private Branch Exchange PBX systems in business offices. Such systems provide for low cost phone service for a large number of calls between phones within the business while providing simplified dialing for internal phone numbers. A few lines are also provided to connect the PBX system to the public telephone system, allowing calls to be made and received between telephones in the PBX system and telephones located elsewhere. It is desirable for the microcell system to provide a similar level of service but with the added feature of cordless operation anywhere within the service area of the PBX. In the indoor communication system environment, path delays are typically much shorter in duration than experienced in the outdoor communication system environment. In buildings and other indoor environments where indoor communication systems are used, it is necessary to provide a form of diversity which enables discrimination between multipath signals. The primary problem solved by the disclosed invention is the provision of a simple antenna system that provides high capacity, simple installation, good coverage and excellent performance. Another problem solved by the present invention is that it achieves the above coverage while maintaining compatibility with the mobile cellular system and while taking a negligible amount of capacity away from the mobile system. This is achieved in the disclosed invention by combining the capacity properties of CDMA with a new distributed antenna design that confines the radiation to a very limited and carefully controlled area. The implementation of spread spectrum communication techniques, particularly CDMA techniques, in an indoor environment provides features which vastly enhance system reliability and capacity over other communication systems. CDMA techniques as previously mentioned further enable problems such as fading and interference to be readily overcome. Accordingly, CDMA techniques further promote greater frequency reuse, thus enabling a substantial increase in the number of system users. In this concept, two sets of antennas are fed by a common signal with only time delay processing to distinguish signals. The transmit output of the base station is fed to a string of antenna elements, for example with a coaxial cable. The antenna elements connect to the cable using power splitters. The resulting signals, amplified and frequency converted as necessary, are fed to the antennas. The salient features of this distributed antenna concept are as follows: In the present invention, two sets of antenna cables are positioned in parallel thus creating a series of nodes comprised of two antenna elements. Signals transmitted from antennas of different antenna elements at a common node are provided different delay paths between the base station and the antenna. The antenna elements may comprise down conversion circuitry thus reducing the cabling path loss between the antenna elements and the base station and allowing the use of readily available SAW devices as delay elements. Another advantage is that little site specific engineering is required for installation. Normally, antenna placement is determined only by physical constraints, together with the requirement that every location desiring service must be covered by a set of two antennas. There is no concern for the overlapping of antenna patterns. In fact, overlapping coverage is desirable in that it provides diversity operation to all terminals in the overlap area. Overlap is, however, not required. The advantages of the distributed antenna concept are clear when considering the inherent simplicity of the base station equipment required to support indoor communications of the type such as cellular telephone, PCS, wireless PBX, wireless local loop or wireless home extension telephone. Details of the single set of antennas are disclosed in U. However a system employing a single set of antennas can experience service quality reductions that can be alleviated by a dual set of antennas. A CDMA system, to achieve high capacity, uses a strict power control mechanism. Each

mobile unit transmits enough power to communicate with the antenna with the lowest path loss to the mobile unit. Communications with all other antennas thus have less than optimal energy.

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Chapter 7 : Dr. Halim Yanikomeroglu

Distributed antennas (DA) have been proposed for providing coverage and increasing the capacity of indoor wireless communication systems by using multiple antenna elements (access points) [1]-[4.

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A code division multiple access (CDMA) communication system in which cellular techniques are utilized in a wireless Private Branch Exchange (PBX) environment. A microcellular arrangement is defined in which a base station communicates user information signals using CDMA communication signals with subscriber terminals.