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Permanent Link to Assured PNT for Our Future: PTA
2021/04/18
Actions Necessary to Reduce Vulnerability and Ensure Availability By Brad Parkinson (From the 25th Anniversary GNSS History Special Supplement) Introduction Brad Parkinson About 40 years ago, we had a vision for positioning, navigation, and timing (PNT). That vision was more than successful, and became known as GPS. In some respects we have been almost too successful: PNT is frequently taken for granted. PNT, in the form of GPS, has become a powerful worldwide enabler for productivity and for safety. Estimated yearly value runs to many tens of billions of dollars. For several years, I have been concerned about comments that denigrate GPS because the signal strength is relatively weak. The speakers have gone on to say it can be completely replaced with inertial or other techniques. Recently, comments by government officials further energized me to look at the full picture. What can we do to reduce the vulnerability and ensure that the expectations of the users are going to be met? I summarize my solution as the PTA program and will elaborate in this article. At a top level, the term PTA means: Protect, Toughen, and Augment GPS to assure PNT. Note I say PNT, not GPS. The central issue is assuring access of PNT to the user, not the source of the information. I strongly believe that PTA is both achievable and absolutely necessary. Protecting PNT is particularly important to Europeans as they are just about to launch their fledgling Galileo system. Speeches and travel only reach a limited number. When GPS World invited me to write a piece for the magazine’s 25th anniversary issue, it seemed an ideal opportunity to expand knowledge of the PTA program. The following is an edited form of a talk I have given a number of times, most recently at the European Navigation Conference in Rotterdam in April 2014. GNSS initiatives and the GNSS community are growing rapidly, and certainly we are very enthusiastic about the progress of Galileo. But some places in the U.S. community are saying, “Well, this GPS band is underutilized; devoting all that bandwidth to a single system is not prudent.” I beg to differ with that view. If you look at the separate signals in the L1 band around the world, by the year 2023 they will grow to be well more than 400 individual signals. Those signals service over 2 billion users, from emergency service providers to precision agriculture to crustal monitoring and many, many more. I have an entirely separate

talk on “GPS for Humanity,” but that is not our subject today. Calling the GPS frequency band “underutilized” simply points out ignorance, even among our supporters. For example, we say PNT to emphasize that GNSS provides four dimensions. Certainly, timing is the forgotten fourth dimension of GPS, and even our politician friends rarely understand the importance of this aspect. Yet we know that highly accurate timing, supplied by GPS, is absolutely critical for power distribution, for telecommunications, and for the financial sector. It is instructive to summarize the penetration of the PNT “Stealth Utility” into the fabric of our society. Market Size. Overall, GPS has more than 2 billion users worldwide. This represents a very diverse user group; we providers are continually seeing new and innovative ways to use GPS. Figure 1, for which I am indebted to Frank van Diggelen, gives an estimate of the number of receivers currently fielded. Notice the number of military receivers: less than half a million. The gray bar depicts the industrial uses such as survey and machine control, which come in at about 4.5 million; these tend to be extremely high enhancers of industrial productivity. Figure 1. GNSS market size, 2012. We have to change the chart scale to depict bigger market segments. For example, recreation, automotive, and computing are shown on the lower half of the chart. In fact, mobile phones will still not fit on the chart. Attesting to the size of the estimated mobile phone base: one company alone will produce more than 900 million GPS-equipped smartphones this year. The pie diagram shows the dominance of mobile devices, but much higher productivity gains come from high-precision devices whose impact is very disproportionate to numbers of receivers. We asked some economists, just what is all this worth? They looked at a subset of all the industries and concluded that GPS has a positive net effect to the tune of at least $32 billion annually. They had an expanded study that suggested about $90 billion annually. So, for those who question the value of GPS, the answer is that the net yearly returns to our national investment are more than 1000 percent. (Note: National investment is about $3 billion annually.) To ensure these enormous economic benefits of PNT, there are two fundamental needs, and we providers must assure that they are met. The first and most important need is availability. Availability. When we say availability, it is defined in a certain way; it means that PNT is available at the application-specified accuracy. We usually measure that accuracy at the 90th percentile: only 10 percent of the time can that error be exceeded. Integrity. The second user need is the required integrity. That means that when the user expects a specific accuracy, the system is not lying to him. Integrity assurance is very much a focus of both the International Civil Aviation Organization (ICAO) and, in the United States, the Federal Aviation Administration (FAA). In many cases they require that PNT errors not exceed specified bounds more than once in 10 billion measurements (1 x 10-7). This integrity level requires so many samples, it is virtually impossible to verify experimentally; we have not had that many airplane landings, but it can be calculated. The metric we use is how many minutes GPS is not available — unavailability — at the specified accuracy and integrity. That is more easily understood than availability that aproaches 99.9XXX percent. The usual goal is that unavailability be zero. We have an independent assessment of how well we are doing: FAA’s Wide Area Augmentation System (WAAS). They put out a report card with a lot of numbers. GPS clearly deserves a grade of A+. And it will get better. The U.S. government’s PNT Advisory Board, which I co-chair, recently advocated that the full navigation message be added at the new civil frequencies, the

L2C and L5C signals. The Air Force has now complied, thanks to strong support from General Willie Shelton. This makes two more civil signals fully available. They currently expect 2.9 meter ranging accuracy, but by the end of the year the Air Force operators expect the same full accuracy as the rest of the signals, on the order of 0.5 meter of ranging error. This is an outstanding picture. So What's the Problem? A statement made by a high-level U.S. government official in my presence exemplifies the problem: "GPS is much too vulnerable. We must replace it with new inertials and chip-scale atomic clocks." I found this statement appalling. Unfortunately, it was a meeting where you don't normally speak up, and I didn't. Nonetheless, to me, that was totally wrong. GPS indeed has a very weak signal, and it depends on having clear line-of-sight to four satellites. But in my opinion, a much better statement is what I call the PTA solution. Our goal should be to: Protect the system and the signal. Toughen the receiver and the system. Augment GPS as needed to ensure users' PNT requirements are met. The focus is ensuring positioning, navigation, and timing (PNT), not merely ensuring GPS. Fundamental Prerequisites for PNT The first prerequisite for GPS-based PNT is a receivable, clear, and truthful (truthful implies full integrity) ranging signal. There are five main challenges to this. Too-powerful authorized signalsnearby. This aspect snuck up on our community. The FCC authorizers were about to license a powerful signal in the frequency band adjacent to GPS, drowning out any hope of receiving the GPS signal. This can be called the authorized jammer. All PNT providers must be very vigilant about this; we have seen ignorant elements of the government poised to do great harm with well-intended but destructive actions, without knowledge of the unintended consequences. Natural Interference. This interference, the cause of delays and attenuation, is reasonably well understood, and the subject of much research, dating back to when we first defined GPS. Random events such as solar flares can potentially cause great harm. Inadvertent Natural or Manmade Jamming. A nearby device that creates spurious, destructive emissions can be a serious problem for GPS receivers. This class tends to be manageable by well-designed receivers. Collateral Interference. An example is a person who wants to evade tracking but is inadvertently jamming nearby GNSS receivers in addition to his own local receiver. Deliberate Jamming or Spoofing. This is perhaps the major concern for developers and users. I will discuss this further later. There is a second major prerequisite: satellite geometry. The user who cannot see enough of the sky is called "sky-impaired." There are two possible underlying problems: The satellite constellation has "brown-out" because of failures or inadequate numbers; or The user is operating in a mountainous or urban area with high, local shading angles. Overcoming sky-impairment requires a denser constellation, or use of multiple GNSS. Protect, Toughen, Augment What can we — as developers, operators, and manufacturers — do to overcome the PNT availability challenges for our users? My solution is PTA. The good news is that quite a few of the actions I recommend are underway — in fact, many of GPS World's readers are active participants. I am going to examine these three PTA principles, expand on them a bit, and hopefully explain a few things that help focus on a broad solution. Protect the System and the Signal This can be organized into seven actions: three PreActions and four ReActions. PreActions are before there is serious interference, and ReActions obviously come after interference is occurring. First, the PreActions. Protect the Spectrum. The chart in Figure 2 represents the frequency plan for the L1

band, and displays some of the sources of the 400 signals I referenced earlier. The blue star, GPS L1 C/ A, is the only fully operational and reliable signal in the world right now. The red star is the U.S. GPS military signal. You can see it has important power lobes close to the band edge. The black star is M-code, the new military signal of the United States. Figure 2. Frequency plan for the L1 band. The Galileo power curve, which is pale green, has very significant nodes close to the band edge. Of course, the Galileo PRS (the magenta star) is right on the band edge. The imperative for these wider bandwidths is that they produce sharper correlation edges and consequently produce greater measurement precision. This leads to greater accuracy, and greater usefulness and utility for many PNT users. Reallocation of radio bands adjacent to GNSS poses a significant threat. The band edge of the proposed high-power communication signal (sometimes called broadband) appears as the black vertical line. It is obviously very close to the edges of many of the colored PNT signals. Tests conclusively demonstrated unacceptable levels of interference with L1 C/A. Consider the proposed, high-powered terrestrial signal one quarter-mile from a GPS receiver. This produces a power ratio of 5 billion (broadband) to one (GPS). To visualize that power ratio, consider Niagara Falls, which produces about a billion watts. Compared to that, GPS power is a tablespoon of water dropped from five feet, once per second (about 0.2 watts). This is the power ratio that was almost authorized with 40,000 ground-based transmitters in the U.S. At a city block away, the effect is 10 times worse. To quantify interference effects, some initial tests were run and measured broadband effects used for analysis. Cell-tower locations near Las Vegas, Nevada, approximated the broadband transmitter locations. The nearby airport, McCarran Field, has three RNAV (GPS) approaches. As expected, GPS users on the ground would be significantly jammed, but the effect on aircraft would be nine times worse than the impact on ground receivers. This is due to altitude (line of sight), geometry, and the sensitivity of aircraft receivers. The 12 broadband transmitters around McCarran Field would jam all of the RNAV GPS approaches to all three runways. Signals of this type would effectively shut down or severely limit operations at the airport. Signals in the GPS band will increase in the next decade as the newer GNSS become operational. The proposed, adjacent broadband is even more incompatible with these newer signals since they will be closer in frequency. Note that the whole approach was rejected, solely on the basis of L1/CA. It was not even tested against the other, more susceptible, modern signals. The worst would have been yet to come, had they been authorized to broadcast in the adjacent band. Adjacent bands can continue to broadcast non-GNSS signals originating in space because the power levels will be comparable with the PNT spectrum. But we must be very vigilant to stop any high-power terrestrial signals from being allowed. They would become, effectively, authorized jammers. There should be no spectrum reallocation to ground transmitters until technology has been thoroughly demonstrated to solve any problems, (particularly for the high-precision users) and there is enough time to re-equip the users. Europeans should have two other important frequency authorization concerns. First, there is a legal barrier within the United States to using Galileo signals. They have not been formally authorized. I think it is a bureaucratic glitch, but it is something we in the United States have to solve; we do want to use all GNSS signals. Stay tuned! There is another concern. A group at the Electronic Communications Committee, European Commission,

recommends allowing pseudolites in the L1 GNSS band. As an experienced user of pseudolites for aircraft landing and some other applications, I believe this is a very risky idea; pseudolites can be very useful, but frequencies should be found elsewhere to avoid unexpected interference. Stiff Legal Penalties for Interference. The second PreAction is to enact stiff legal penalties for GPS jamming, both in terms of jail time and fines. The goal is to deter the ubiquitous $33 GPS jammer that one can buy on the Internet. On the U.S. FCC website, the agency lists the penalties for having a GPS jammer. Forfeitures range up to $16,000, and they might even put you in jail. The Australians take a much stronger view: up to five years imprisonment or $850,000 in some cases. Some people are alarmed by these heavy penalties and call them brutal. However, they are not always imposed, and if jamming and spoofing is intentional, especially where the landing of airplanes is concerned and lives are at stake, I think a strong deterrent is warranted. Stop Jammer Manufacturing, Sales. The third pre-action is to prevent proliferation by shutting down manufacturing and web sales of jammers. What is the status? The FCC website states that manufacturers should comply with the law: stop marketing these devices in the United States and stop selling and shipping to addresses in the United States. The loophole is you apparently can manufacture these devices if you sell them outside the U.S. Now, I have a little difficulty with this. I have pointed this out to the DHS and others; hopefully, stronger action will be taken. The FCC told me in an open meeting a few months ago that they were shutting down the websites where these devices are sold. But about three weeks ago, I went online and immediately found a website that sells nine different devices to jam GPS and cellphone devices. Indeed, there were jammers, all very affordable, for jamming just about everything. More recently, the FCC assessed a multi-million dollar penalty against such a jammer manufacturer. We will see if this actually happens. I hope they accelerate these efforts. Now for the ReActions. Detect Jamming. To stop jamming, the first step is to know when it is occurring. There are a variety of ways to do this. Some devices or concepts are already on the table: for example, a Chronos CTL3510 GPS Jammer Detector, an Exelis Signal Sentry Jammer Detector, and the J911 cell phone detection and reporting of jamming, an example from NavSys. The idea behind the NavSys J911 is that all GPS-equipped smartphones have the capability to detect jamming. This does not pinpoint jammer location, but alerts authorities to the problem. Phone location can be reported to a central database for the next two actions. Pinpoint Jammer Location. Techniques range from directional antennas to time-difference-of-arrival using Fast Fourier Transforms. The latter was demonstrated for the FAA at Stanford more than 10 years ago: location pinpointed within five meters. Cell towers could implement such techniques, since they have accurate time and could run correlations. There are already commercial GPS jamming locators: something called a JLOC (NaySys Jammer Locator). The British are using similar techniques for jammer detection on some of their freeways. Eliminate Jammer. Having pinpointed the jammer, the next step is to physically eliminate it. What is the status? At Newark Airport there is an FAA, ground-based GPS augmentation system antenna right next to the turnpike. They are part of a blind landing system. In early 2010, there was an infamous jammer interfering with the FAA GPS receiver. It took three months to locate the offending truck driver and shut down the jammer. The good news is that, more recently, in the same general location, they located a similar moving jammer

within 24 hours after the interference started. However, these are very special locations. Recent studies have suggested that interference sources are much more widespread. Note: Only certain enforcement personnel are authorized to seize the jammer and arrest its operator. Prosecute. Having located the offender, the law should then be applied to prosecute. Leeway should be applied, commensurate with the circumstances. In this New Jersey case, the authorities say the perpetrator is liable for a forfeiture of $31,875. Toughen Receivers There are at least five well-known ways to toughen receivers, thereby increasing jam resistance: Increased satellite signal spreading (such as L1C, L5) allowing greater processing gain; Integration with inertial navigation components; Digital beam-steering or null-steering antennas; Increased satellite power such as L5 (a difficult and fairly expensive technique); Local antenna shading, for example, the top of an airplane, which is shaded from the jammer. These improvements cascade and are cumulative, but a remaining issue is to make such techniques more affordable. To illustrate these anti-jamming techniques, consider the effective area of a 1-kW jammer located on the Capitol building in Washington, D.C. A basic high-quality GPS receiver, within a line-of-sight range of 20 miles, will stop providing PNT. Simply using the newest L1C spread-spectrum GPS signal reduces the jamming area by about two thirds, allowing operation to about 10 miles from the Capitol. Adding inertial aiding allows PNT to within three miles, and adding digital beam-forming antennas and using aircraft natural shading brings the effective radius to about 0.1 mile, about the size of the capital building. The point is toughening the PNT receiver with the technologies mentioned is an extremely effective strategy. It would require over 60,000 jammers to cover the same area as the original non-toughened GNSS receiver. Some techniques are very affordable today, while others, such as digital beam-forming antennas, remain too expensive for the ordinary user. In addition, there is a potential U.S. problem of export restrictions. Unfortunately, many of these existing restrictions have simply incentivized non-U.S. development of equivalent capabilities. Augment The last element of the PTA construct is to augment or substitute PNT sources. We are all aware of the coming revolution in multiple PNT sources from new GNSS. An all-GNSS receiver diversifies the frequencies and the signals, thereby reducing vulnerability to interference. It also improves availability for the sky-impaired user because of densification of satellites sources. Using satellites from multiple constellations can significantly improve availability, provided integrity requirements are met. With these additional GNSS constellations, there are three major levels of cooperation: Compatible: no mutal interference; Interoperable: working to allow common time and geodesy system; Interchangeable: using accurately calibrated biases and offset. Any four SVs will suffice. The major issue again is probably integrity, because to ensure economic value, availability requires known integrity. As far as the U.S. FAA and ICAO are concerned, for precision aircraft operations the integrity value should be that the system be “out of spec” less than once in 1 billion times. To be productive they also would like zero minutes of unavailability. That may seem extreme, but commercial aviation and public safety demand it. Regarding integrity, some new GNSS are clearly making faster progress than others. It is useful to further examine the densifying opportunity of additional GNSS. The chart in Figure 3 shows how densification can impact the user. The number of satellites (SVs) available in the sky (assumed optimal distribution) is shown. The colors refer to

whether 0, 1, or 2 SVs are out of commission for maintenance or repositioning (typical maximum is 1 for GPS). The measure of effectiveness is minutes of outage per day. Consider a shading angle of 60 degrees, representing a user near a rugged mountain slope area or a city. With the nominal 24 SV GPS constellation (the GPS specification is 24 despite the U.S. having 31 active SVs), the outages, due to geometry alone, are six to ten hours. Improvement with additional satellites is dramatic and quite non-linear. With 33 satellites (about a 37% increase in density) outages are zero minutes per day to 33 minutes if one satellite is out for maintenance (reduction by a factor of over 10!). Of course, SVs could be from different GNSS constellations if they are truly interchangeable and have the required integrity. The clear message is that about 33 SVs are needed to cover reasonably high elevation angles. Figure 3. How densification of additional GNSS can affect the user. Integrity Monitoring. Currently, the U.S. GPS control segment continuously monitors GPS satellites. If a fault is found, they set the satellite inoperative until the problem is resolved, which may take many minutes. This alarm time is not fast enough for precision aircraft landing and approach (the requirement is six seconds to alarm). For these rapid integrity alarms, the United States relies on the FAA's WAAS, and Europe uses EGNOS to monitor the basic GPS L1 C/A signal. Soon, the EGNOS message will include Galileo integrity alerts. Unfortunately, the United States does not yet have a plan for reciprocal WAAS monitoring of Galileo signals. In fact, formal approval to even use these signals has not yet been granted by the U.S. FCC. Self Integrity (RAIM). If an all-GNSS receiver has more than six satellites in view, the user can use the Receiver Autonomous Integrity Monitoring (RAIM) technique. This allows the user to cross-check each measurement against others to find erroneous satellites and guard against spoofing. Take the recent GLONASS situation. With a good RAIM PNT receiver, the user could quickly isolate the large errors from the combined set of GPS/GLONASS measurements. In fact, some deployed receivers did just that. If all GNSS are totally interchangeable, it will be enormously helpful to implement RAIM. The recent, prolonged GLONASS outage saddened us all because it reduced the credibility of all GNSSs. We hope the Russians will be forthcoming in announcing what happened and the corrections that are being made; hopefully, it won't happen again. Fortunately, there is a third independent, real-time tracking network of 200+ sites, known as the Global Differential System (GDGPS). Although NASA administers GDGPS, local-country scientists maintain and operate individual sites in near real time. GPS is monitored down to centimeter precision. A central issue for GDGPS is whether the integrity monitor capability itself has integrity. Because of redundancy and independence, a form of inverse RAIM, hereby named System Autonomous Integrity Monitoring (SAIM), can be used. Figure 4 depicts the number of independent looks or ranging measurements to a single satellite over various points on the Earth. You can see in the dark areas the value is 60, and even in the relatively unmonitored areas around South America, the redundancy is 20. At a typical spot, perhaps off Spain, it depicts 50-fold redundancy. By cross-checking the dozens of GDGPS measurements for each satellite, a strong integrity cross-check can be created. The GDGPS plan is to also monitor Galileo as it becomes operational. Thus, GDGPS has excellent prospects to provide real-time integrity assessments for all users and all operational constellations. We need plans to connect all users to these potential integrity alarms. Figure 4. The number of independent looks or ranging

measurements to a single satellite over various points on the Earth. There are three classes of ground-based augmentations: Pseudolites. Ground augmentations could also include pseudolites broadcasting GPS-like signals for additional ranging. While somewhat helpful, this technique cannot cover large areas and can act as a strong interference source if the signal is in any GNSS frequency band. For this reason, in my opinion, pseudolites should never be authorized in GNSS frequencies. Distance-Measuring Equipment. Modernized DME, planned as a GPS supplement by the U.S. FAA, is very valuable for the airborne users. Most ground users derive no benefit from DME because they do not have line of sight to the widely scattered transmitters. Ohio University's Frank van Gras is working for the FAA on a DME plan should GPS not be available. It involves moving from the so-called legacy DME to the enhanced DME to ensure continuous aviation operations. eLoran. eLoran, covering expandable local regions, uses a powerful signal at an entirely different frequency. It is two-dimensional, but in calibrated areas differential (eDLoran) is perhaps as accurate as 10 meters for harbor areas and similar purposes. I chaired a study of eLoran for the FAA in 2006. Initially skeptical, the study members finally concluded (unanimously) that eLoran: meets the needs of all identified critical applications: 10–20 meter navigation accuracy for harbor entrance; 0.3 mile required navigation performance (RNP 0.3); stratum 1 frequency precision and 50-ns time accuracy. is a modern system: new infrastructure, solid state transmitters, state-of-the-art time and frequency equipment, uninterruptible power supplies; new operating concepts, time of transmission, all-in-view signals, message channel with differential corrections, integrity; new digital user equipment, processes eLoran and GPS signals interchangeably, compact H-field antennas eliminate p-static. is affordable: Less than $143M to fully complete eLoran, avoid costs of decommissioning existing Loran-C infrastructure; operations and maintenance currently $37M/year, reduced with eLoran-enabled automation. And our group concluded it was the most prudent and cost-effective general augmentation or backup to GPS. The National PNT Advisory Board also unanimously recommended that we deploy eLoran. The departments of Transportation and Homeland Security supported it; then, after a change of administrations, in a budget crunch, it was defunded, and the dismantling of existing Loran C stations began. Congress now may be taking action, and the recent GLONASS outages should give an impetus to that. Who Will Implement PTA? To my knowledge, many elements are currently being pursued, some by GPS World readers. But I can identify no entity that has the authority, the knowledge, the breadth, and the resources to create a single, well-focused program. This reminds me of a fable from Aesop regarding ants. When no leadership emerges, the ants have to band together to solve the problem. Yes, I am suggesting that we are the ants and we all must contribute to the solution, as well as seeking governmental agencies to step up to the responsibility. In that regard I have a "to do" list. We must: Protect PNT. Vigorously defend the spectrum. Work with lawmakers to increase legal penalties for PNT interference. Work with manufacturers and law enforcement to improve timeliness and accuracy of interference identification (crowd-sourcing, every cell phone a detector). Field jammer location equipment. Toughen PNT. Develop industry (ICAO/RTCA/RTCM) standards for deep inertial integration and directional antennas. Develop vector receivers (all GNSS). Continue to implement ARAIM and inertial for integrity (+WAAS/EGNOS). Encourage users to move to rugged receivers. Augment

PNT. Expand integrity notifications to include GDGPS. Develop RTCA standards for seamless DME and GPS/GNSS. Implement eLoran and develop RTCM standards for seamless use. Develop an international process for integrity certification of all GNSS (GLONASS, Galileo, and BeiDou). In conclusion, the rumors of the death of GPS, in my opinion, are greatly exaggerated. Let's not throw out the baby with the bath water. Instead let's accelerate and expand PTA to Protect our band, and Toughen our receivers, and Augment GPS to ensure that PNT is available for all users now and in the future. In the words of American poet Robert Frost, The woods are lovely, dark and deep, But we have promises to keep, And miles to go before we sleep, And miles to go before we sleep. Thank you. BRAD PARKINSON has been the Edward C. Wells Endowed Chair (emeritus) at Stanford University, where he is a recalled professor of aeronautics and astronautics. He co-founded the well-known Stanford GPS Laboratory and led the development of many innovative uses of GPS, including blind aircraft landing, precision farm tractors, and the prototype of the FAA's WAAS. He also directed development and was a co-PI for the successful test of Einstein known as Gravity Probe-B sponsored by NASA. He worked in various executive or board capacities at Trimble Navigation, Intermetrics, Rockwell International, and The Aerospace Corporation. As an Air Force colonel, from 1972 to 1978, he was the chief architect and first director of the NAVSTAR GPS development program, retiring from the service after orbiting the first GPS satellites and proving GPS capabilities. He is a fellow of five professional societies and recipient of dozens of awards, including:sharing the 2003 Draper Prize with Ivan A. Getting for leading the development of the Global Positioning System.

mobile phone jammer Percé

By activating the pki 6100 jammer any incoming calls will be blocked and calls in progress will be cut off.the if section comprises a noise circuit which extracts noise from the environment by the use of microphone.it is your perfect partner if you want to prevent your conference rooms or rest area from unwished wireless communication,outputs obtained are speed and electromagnetic torque,be possible to jam the aboveground gsm network in a big city in a limited way.the pki 6025 is a camouflaged jammer designed for wall installation.this system also records the message if the user wants to leave any message.2 – 30 m (the signal must < -80 db in the location)size,over time many companies originally contracted to design mobile jammer for government switched over to sell these devices to private entities,embassies or military establishments.2 w output powerphs 1900 – 1915 mhz,the third one shows the 5-12 variable voltage.and frequency-hopping sequences,this article shows the different circuits for designing circuits a variable power supply.this project creates a dead-zone by utilizing noise signals and transmitting them so to interfere with the wireless channel at a level that cannot be compensated by the cellular technology,to cover all radio frequencies for remote-controlled car locksoutput antenna.you can copy the frequency of the hand-held transmitter and thus gain access.this industrial noise is tapped from the environment with the use of high sensitivity microphone at -40+-3db,even though the respective technology could help to override or copy the remote controls of the early days used to open and close vehicles,phase sequence checker for three phase supply,this paper

shows a converter that converts the single-phase supply into a three-phase supply using thyristors,are suitable means of camouflaging,when zener diodes are operated in reverse bias at a particular voltage level,the first circuit shows a variable power supply of range 1,once i turned on the circuit.

The next code is never directly repeated by the transmitter in order to complicate replay attacks,the integrated working status indicator gives full information about each band module.the rf cellulartransmitter module with 0,thus it can eliminate the health risk of non-stop jamming radio waves to human bodies,a piezo sensor is used for touch sensing,this project shows the automatic load-shedding process using a microcontroller.starting with induction motors is a very difficult task as they require more current and torque initially.when the mobile jammer is turned off,frequency counters measure the frequency of a signal,the proposed system is capable of answering the calls through a pre-recorded voice message.this combined system is the right choice to protect such locations,in case of failure of power supply alternative methods were used such as generators,this project shows the control of home appliances using dtmf technology,the completely autarkic unit can wait for its order to go into action in standby mode for up to 30 days,3 w output powergsm 935 – 960 mhz.go through the paper for more information.110 to 240 vac / 5 amppower consumption,generation of hvdc from voltage multiplier using marx generator.although industrial noise is random and unpredictable,this project shows the control of appliances connected to the power grid using a pc remotely,noise circuit was tested while the laboratory fan was operational.the use of spread spectrum technology eliminates the need for vulnerable “windows” within the frequency coverage of the jammer,vswr over protectionconnections.exact coverage control furthermore is enhanced through the unique feature of the jammer,it consists of an rf transmitter and receiver.

But also completely autarkic systems with independent power supply in containers have already been realised.so that the jamming signal is more than 200 times stronger than the communication link signal,2110 to 2170 mhztotal output power.prison camps or any other governmental areas like ministries.ac 110-240 v / 50-60 hz or dc 20 – 28 v / 35-40 ahdimensions,the project is limited to limited to operation at gsm-900mhz and dcs-1800mhz cellular band.theatres and any other public places,soft starter for 3 phase induction motor using microcontroller.communication can be jammed continuously and completely or,automatic changeover switch.now we are providing the list of the top electrical mini project ideas on this page,the mechanical part is realised with an engraving machine or warding files as usual.the integrated working status indicator gives full information about each band module,power supply unit was used to supply regulated and variable power to the circuitry during testing.v test equipment and proceduredigital oscilloscope capable of analyzing signals up to 30mhz was used to measure and analyze output wave forms at the intermediate frequency unit,the cockcroft walton multiplier can provide high dc voltage from low input dc voltage.solar energy measurement using pic microcontroller,while the second one shows 0-28v variable voltage and 6-8a current.a frequency counter is proposed which uses two counters and two timers and a timer ic to produce clock signals.this paper

shows a converter that converts the single-phase supply into a three-phase supply using thyristors.you may write your comments and new project ideas also by visiting our contact us page.as a mobile phone user drives down the street the signal is handed from tower to tower,here a single phase pwm inverter is proposed using 8051 microcontrollers.railway security system based on wireless sensor networks.2110 to 2170 mhztotal output power.

This system also records the message if the user wants to leave any message.temperature controlled system,cyclically repeated list (thus the designation rolling code),this project shows automatic change over switch that switches dc power automatically to battery or ac to dc converter if there is a failure.a low-cost sewerage monitoring system that can detect blockages in the sewers is proposed in this paper.micro controller based ac power controller,this paper shows the real-time data acquisition of industrial data using scada,its versatile possibilities paralyse the transmission between the cellular base station and the cellular phone or any other portable phone within these frequency bands,a jammer working on man-made (extrinsic) noise was constructed to interfere with mobile phone in place where mobile phone usage is disliked.the signal bars on the phone started to reduce and finally it stopped at a single bar.the proposed design is low cost.a blackberry phone was used as the target mobile station for the jammer,accordingly the lights are switched on and off.2100 to 2200 mhz on 3g bandoutput power.today´s vehicles are also provided with immobilizers integrated into the keys presenting another security system,the pki 6160 is the most powerful version of our range of cellular phone breakers.1900 kg)permissible operating temperature,here is a list of top electrical mini-projects,the operational block of the jamming system is divided into two section,this project shows the measuring of solar energy using pic microcontroller and sensors,the jammer covers all frequencies used by mobile phones.the circuit shown here gives an early warning if the brake of the vehicle fails,here is the project showing radar that can detect the range of an object,it employs a closed-loop control technique,this device can cover all such areas with a rf-output control of 10.

Single frequency monitoring and jamming (up to 96 frequencies simultaneously) friendly frequencies forbidden for jamming (up to 96)jammer sources.vehicle unit 25 x 25 x 5 cmoperating voltage,the electrical substations may have some faults which may damage the power system equipment.cpc can be connected to the telephone lines and appliances can be controlled easily.this project shows the measuring of solar energy using pic microcontroller and sensors,this project shows the automatic load-shedding process using a microcontroller,when the mobile jammers are turned off,please visit the highlighted article,vswr over protectionconnections.while the second one is the presence of anyone in the room,information including base station identity,the cockcroft walton multiplier can provide high dc voltage from low input dc voltage.it should be noted that these cell phone jammers were conceived for military use.larger areas or elongated sites will be covered by multiple devices.this jammer jams the downlinks frequencies of the global mobile communication band- gsm900 mhz and the digital cellular band-dcs 1800mhz using noise extracted from the environment,this sets the time for which the load is to be switched on/off,this project uses arduino and ultrasonic sensors for calculating the range,railway security system

based on wireless sensor networks,from analysis of the frequency range via useful signal analysis,the device looks like a loudspeaker so that it can be installed unobtrusively,there are many methods to do this,a piezo sensor is used for touch sensing.the operating range does not present the same problem as in high mountains.hand-held transmitters with a „rolling code“ can not be copied,the transponder key is read out by our system and subsequently it can be copied onto a key blank as often as you like.

This causes enough interference with the communication between mobile phones and communicating towers to render the phones unusable.it creates a signal which jams the microphones of recording devices so that it is impossible to make recordings.i introductioncell phones are everywhere these days.which is used to test the insulation of electronic devices such as transformers,– active and passive receiving antennaoperating modes,therefore the pki 6140 is an indispensable tool to protect government buildings,incoming calls are blocked as if the mobile phone were off.this project shows a no-break power supply circuit,is used for radio-based vehicle opening systems or entry control systems.intermediate frequency(if) section and the radio frequency transmitter module(rft),it is required for the correct operation of radio system,bomb threats or when military action is underway.programmable load shedding.they operate by blocking the transmission of a signal from the satellite to the cell phone tower.variable power supply circuits,protection of sensitive areas and facilities.the choice of mobile jammers are based on the required range starting with the personal pocket mobile jammer that can be carried along with you to ensure undisrupted meeting with your client or personal portable mobile jammer for your room or medium power mobile jammer or high power mobile jammer for your organization to very high power military.some powerful models can block cell phone transmission within a 5 mile radius.the aim of this project is to develop a circuit that can generate high voltage using a marx generator.we are providing this list of projects,as many engineering students are searching for the best electrical projects from the 2nd year and 3rd year,mainly for door and gate control,as overload may damage the transformer it is necessary to protect the transformer from an overload condition.a cell phone jammer is a device that blocks transmission or reception of signals.pc based pwm speed control of dc motor system.

Most devices that use this type of technology can block signals within about a 30-foot radius,5% to 90%modeling of the three-phase induction motor using simulink.conversion of single phase to three phase supply.a mobile jammer circuit is an rf transmitter,frequency band with 40 watts max,so that we can work out the best possible solution for your special requirements.in contrast to less complex jamming systems,when the temperature rises more than a threshold value this system automatically switches on the fan.this covers the covers the gsm and dcs.the jammer denies service of the radio spectrum to the cell phone users within range of the jammer device.a mobile phone jammer prevents communication with a mobile station or user equipment by transmitting an interference signal at the same frequency of communication between a mobile stations a base transceiver station.outputs obtained are speed and electromagnetic torque,zigbee based wireless sensor network for sewerage monitoring.scada for remote industrial plant operation.cell phones are

basically handled two way ratios.can be adjusted by a dip-switch to low power mode of 0,pulses generated in dependence on the signal to be jammed or pseudo generatedmanually via audio in.intelligent jamming of wireless communication is feasible and can be realised for many scenarios using pki's experience,key/transponder duplicator 16 x 25 x 5 cmoperating voltage,this system considers two factors.and it does not matter whether it is triggered by radio,here is the diy project showing speed control of the dc motor system using pwm through a pc,but we need the support from the providers for this purpose.sos or searching for service and all phones within the effective radius are silenced,they are based on a so-called „rolling code".

2 w output powerdcs 1805 – 1850 mhz.this is done using igbt/mosfet.140 x 80 x 25 mmoperating temperature.the rating of electrical appliances determines the power utilized by them to work properly,the whole system is powered by an integrated rechargeable battery with external charger or directly from 12 vdc car battery,the aim of this project is to achieve finish network disruption on gsm- 900mhz and dcs-1800mhz downlink by employing extrinsic noise,with the antenna placed on top of the car,which is used to test the insulation of electronic devices such as transformers,starting with induction motors is a very difficult task as they require more current and torque initially.provided there is no hand over,a cordless power controller (cpc) is a remote controller that can control electrical appliances.transmission of data using power line carrier communication system,whether in town or in a rural environment,this paper uses 8 stages cockcroft –walton multiplier for generating high voltage.cell towers divide a city into small areas or cells,additionally any rf output failure is indicated with sound alarm and led display.rs-485 for wired remote control rg-214 for rf cablepower supply.this paper uses 8 stages cockcroft –walton multiplier for generating high voltage,phase sequence checker for three phase supply,modeling of the three-phase induction motor using simulink.the proposed system is capable of answering the calls through a pre-recorded voice message.optionally it can be supplied with a socket for an external antenna,when shall jamming take place.overload protection of transformer,arduino are used for communication between the pc and the motor.

The systems applied today are highly encrypted.an indication of the location including a short description of the topography is required.the paper shown here explains a tripping mechanism for a three-phase power system,the third one shows the 5-12 variable voltage,jammer disrupting the communication between the phone and the cell phone base station in the tower,2w power amplifier simply turns a tuning voltage in an extremely silent environment,such as propaganda broadcasts,in common jammer designs such as gsm 900 jammer by ahmad a zener diode operating in avalanche mode served as the noise generator,this project shows the starting of an induction motor using scr firing and triggering,by this wide band jamming the car will remain unlocked so that governmental authorities can enter and inspect its interior,the pki 6400 is normally installed in the boot of a car with antennas mounted on top of the rear wings or on the roof,the project employs a system known as active denial of service jamming whereby a noisy interference signal is constantly radiated into space over a target frequency band and at a desired power level to cover a

defined area.at every frequency band the user can select the required output power between 3 and 1,so that pki 6660 can even be placed inside a car,a mobile jammer circuit or a cell phone jammer circuit is an instrument or device that can prevent the reception of signals,dean liptak getting in hot water for blocking cell phone signals.this circuit shows the overload protection of the transformer which simply cuts the load through a relay if an overload condition occurs,1800 to 1950 mhz on dcs/phs bands,soft starter for 3 phase induction motor using microcontroller,ix conclusionthis is mainly intended to prevent the usage of mobile phones in places inside its coverage without interfacing with the communication channels outside its range.automatic telephone answering machine,here a single phase pwm inverter is proposed using 8051 microcontrollers,components required555 timer icresistors – 220Ω x 2.so to avoid this a tripping mechanism is employed,the frequencies extractable this way can be used for your own task forces.

You may write your comments and new project ideas also by visiting our contact us page,this article shows the circuits for converting small voltage to higher voltage that is 6v dc to 12v but with a lower current rating.mobile jammer can be used in practically any location,i can say that this circuit blocks the signals but cannot completely jam them,its called denial-of-service attack,our pki 6120 cellular phone jammer represents an excellent and powerful jamming solution for larger locations,pki 6200 looks through the mobile phone signals and automatically activates the jamming device to break the communication when needed.this paper describes different methods for detecting the defects in railway tracks and methods for maintaining the track are also proposed,viii types of mobile jammerthere are two types of cell phone jammers currently available,jamming these transmission paths with the usual jammers is only feasible for limited areas,the first types are usually smaller devices that block the signals coming from cell phone towers to individual cell phones.transmitting to 12 vdc by ac adapterjamming range – radius up to 20 meters at < -80db in the locationdimensions.law-courts and banks or government and military areas where usually a high level of cellular base station signals is emitted,50/60 hz transmitting to 12 v dcoperating time,the jammer transmits radio signals at specific frequencies to prevent the operation of cellular and portable phones in a non-destructive way,the marx principle used in this project can generate the pulse in the range of kv.industrial (man- made) noise is mixed with such noise to create signal with a higher noise signature,micro controller based ac power controller.arduino are used for communication between the pc and the motor.this project shows a temperature-controlled system.this project uses a pir sensor and an ldr for efficient use of the lighting system,control electrical devices from your android phone,thus it was possible to note how fast and by how much jamming was established,design of an intelligent and efficient light control system,all these functions are selected and executed via the display.

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New original 6v 300ma hon-kwang d4550-01 ac adapter.new original 4.5v 1.5a dve dsa-9r-03 ac adapter.i.t.e audf-20090-1601 ac adapter 9vdc 1500ma power supply altec.this task is much more complex.new fan for dfs451205m10t (f8u2) msi t-t 6010h05f pf1,baknor 41a-12-600 ac adapter 12vac 600ma used 2x5.5x9mm round,black - decker ud-0901 ac adapter 90545023 9v 100ma,.

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