

Radio ZS

Volume 62 No./Nr 4

Julie - Augustus 2009

July - August 2009



Over-the-horizon Optical Communication
Kul Jou Hier, Kul Jou Daar
Another Voice in the Sky

Amateur Radio - Communication Technology in Action



Amateur Radio... Professional Technology

[amateur • n. 2.a. one who cultivates anything as a pastime
radio • n. 1. the transmission and reception of
radio-frequency electromagnetic waves]

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Suid-Afrikaanse Radioliga

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SARL News Bulletins

SARL Nuusbuletins

Sundays / Sondae

08:15 CAT Afrikaans

08:30 CAT English

HF 20 m, 40 m, 80 m HF
VHF 2 m and 70 cm BHF

Front Cover / Buiteblad

SARL Youth Day Sprint, 16 June.
Niall Hardman (15), the son of Craig,
ZS5CD, was one of the participants.
Another young person enjoying ama-
teur radio is Ben Erasmus (13).

Address for news items

Adres vir nuusitems

www.sarl.org.za/newsinbox.asp

SARL Jeugdag Naelloop, 16 Junie.
Niall Hardman (15) seun van Craig,
ZS5CD, was een van die deelnemers.
Nog 'n jong mense wat amateur radio
geniet is Ben Erasmus (13).

Amateur Radio Mirror International
Sundays 10:00 CAT Sondae
17,590 and 7,205 MHz AM; 7,082

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CQ de ZS1YT

We have reached the end of July and our membership for this year has already reached 600! This is quite an achievement to start the new financial year in this fashion, but it is still a long way away from our target of 1 500 for this year. I am however convinced that with the help of all of our members and the affiliated clubs, our target can be realised. Please promote the SARL to non-members and even consider sponsoring a member for a year. Also a hearty word of thanks to all those members who have included a donation with their subscription towards the funds of the SARL. This generous gesture is much appreciated in these difficult financial times.

To those members who have not renewed yet, please do the correct thing and do so immediately.

On the 10th of June, the greatly awaited news of the extension of the 40 m band, as well as the correction to the 20 m band for ZRs, was gazetted! This opened a totally new segment of the 40 m spectrum for amateur use in South Africa. I am confident that all of us are enjoying this new addition to the band. This is an-

other example of the work done by the SARL for amateur radio. A huge applause for the parties involved in getting this privilege gazetted.

The SARL is now continuing its discussion with the relevant authorities to also update and renew the radio regulations thus to bring them in line with those in the rest of the world.

Oor minder as 'n jaar skop die Sokker-wêreldbeker-gebeurtenis in Suid Afrika af. Dit gaan waarskynlik dié sportgeleentheid van hierdie dekade wees. Om aan die feesvierings deel te neem het die SARL aansoek gedoen vir die roepsein ZS10WCS. Ek sien daarna uit dat klubs wat vir hierdie roepsein aansoek gedoen het, die stasie sommer elke dag op die lug sal hê en vir die buitewêreld sal wys hoe aktief Suid Afrikaanse radio-amateurs kan wees.

Die RTA-program vir hierdie jaar het dan ook in Augustus ten einde geloop met die laaste aanbieding in Kaapstad. Vir alle lede wat hierdie

(Continued on page 6)



(CQ de ZS1YT from page 5)

geleentheid bygewoon het, wil ek hartlik bedank. Dit maak dit vir ons moontlik om volgende jaar weer so 'n inisiatief aan te pak. Dit was 'n riem onder die hart om die goeie bywoning te ervaar. Die aanbieders van die onderskeie radio-verwante onderwerpe en demonstrasies word deur u groot bywoning op prys gestel. Sulke entoesiasme maak dit ook vir ons gasprekers aangenaam

om te sien hoeveel belangstelling daar in hulle aanbiedings is.

Met die somermaande wat nou weer om die draai lê hou ek duim vas dat voortplantings-toestande drasties gaan verbeter en dat u baie plezier uit u stokperdjie gaan put.



Groete van hok tot hok,

de Rassie Erasmus, ZS1YT.

Ham Pride Our Legacies and Traditions

By Dave Ingram, K4TWJ

An Easy Brew Battery Checker/Monitor

Today's radio amateurs are quite proud of their VHF/UHF FM handheld transceivers and with good reason. These go-anywhere units are perfect for exchanging notes with radio friends, and they are a priceless communications aid during emergencies. Many owners of handheld transceivers, however, say their rechargeable NiCad battery pack seems to always "run out of energy" right when it is most needed. The transceiver may have a built-in battery monitor, but it typically indicates when the battery is depleted rather than forewarning you of an approaching discharge condition. Do not despair. The battery monitor described in this Ham Pride can alert you when batteries are ap-

proaching discharge condition. Then you can make short transmissions and/or reduce power to sign off properly rather than "disappearing into the band noise."

This battery monitor operates on the fact a rechargeable NiCad battery pack's voltage holds steady during use, then drops very slightly before reaching actual discharge condition. That "warning drop in voltage" is small, but it is easily detected by a zener diode and indicated by a regular LED. The zener conducts in its reverse/avalanche direction and the LED shines bright when battery voltage is normal/good. It then extinguishes when battery voltage drops 0,6 or 0,7 volt as it does when

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(Ham Pride from page 6)

approaching full discharge condition.

Exact value of the zener diode should be slightly below the battery pack's full charge voltage level, and a small amount of genuine amateur radio experimenting is helpful here. If your transceiver's (fully charged) battery pack is 12,0 to 12,5 volt, combining a zener in the 10,8 to 11,5 volt range with a resistor between 240 and 300 ohm and an LED of your choice should be close to ideal. If the battery pack is 7,2 or 7,6 volt, combining a zener in the 6,5 to 7,0 volt range with a resistor between 220 and 270 ohm and an LED of your choice usually works fine. Other value zeners and resistors for different voltage battery packs can likewise be combined to make a custom monitor. In each case, you tweak (vary) resistor value slightly to produce your desired LED brightness at full charge and dimming or extinguishing at discharge.

The (wall charger) socket on many handheld transceivers often includes rectifier diodes that prevent checking or monitoring battery voltage. In such cases, you change and measure/check voltage at the battery

pack's back or bottom "rapid charge" terminals. Measure the voltage at full charge and at discharge before purchasing zeners and/or resistors, and then use Figure 1 and 2 as a guide to making your battery monitor. Remember the LED should light brightly until approaching discharge then extinguish around 11,6 volt for a 12 or 12,5-volt pack, or around 6,9 volt for a 7,6-volt pack.

A quick and easy way to assemble this battery checker/monitor is "sandwiching" its series-connected zener, LED and resistor between two pieces of perfboard. Cut the board the size (width) of your transceiver's battery pack and install screws with 3 nuts each to serve as contacts plus spacers for components. Attach all wires and components to the top board's screws for easy assembly.

Using the battery checker/monitor is easy: just hold it to your transceiver's battery charging terminals, transmit at full power and note the LED shines brightly at full charge condition. When the battery pack begins approaching discharge, the LED will no longer light. You can then decide how to best use remain-

(Continued on page 8)

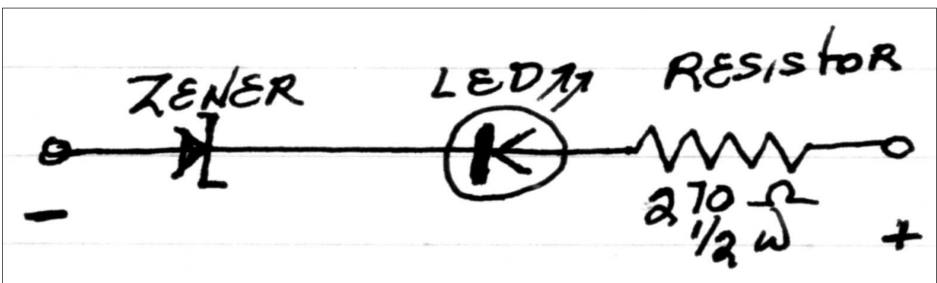


Figure 1. Circuit diagram of the battery monitor/checker discussed in text.

(Ham Pride from page 7)

ing energy. One additional note: this checker is also a good alternative to the battery light replacing a battery

gauge in many automobiles - and you can build it into an accessory socket plug for easy use.

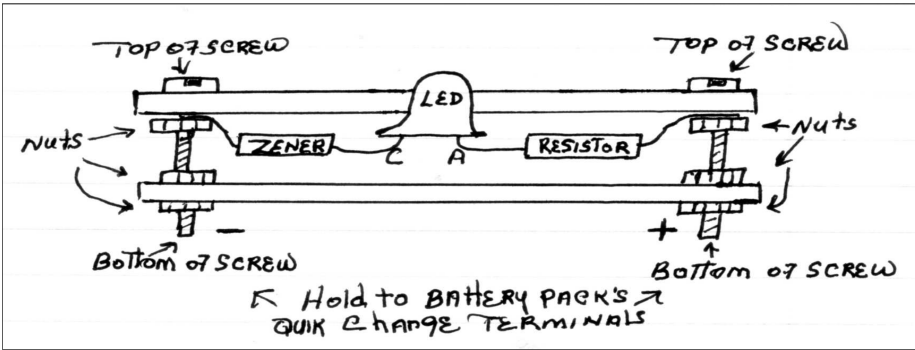


Figure 2 Assembly outline for the battery monitor/checker, showing placement of parts. LED protrudes through hole drilled in top board.

Over-the-horizon optical communication, a new challenge

Hans van de Groenendaal, ZS6AKV

When I opened one of the latest editions of a magazine called DUBUS, my interest was drawn to an article entitled "Over-the-horizon Optical Communication", describing the experiments carried out by three Australian Radio Amateurs, Rex Moncur, VJK7MO, Justin Giles-Clark, VK7TW, and Ken Sulman, VK7DY.

DUBUS is a specialist journal for Amateur Radio covering VHF/UHF and Microwaves. For more information about the journal, visit www.dubus.org or contact Ivo, ZS6AXT, at zs6axt@telkomsa.net.

Distances of up to 209 km have been achieved with the digital mode JT65a on cloud-bounce propagation using red light on a frequency of 478 Tera Hertz using banks of LED's focussed by small plastic lenses (as used in torches) and a large area avalanche photo diode (APD) receiver. Signals were measured on the WSJT scale as -6 dB which works to -28 dB, so there is still a further 20 dB to play with.

Extensive propagation experiments have been conducted over a distance of 27 km using a single LED at milli Hertz bandwidths. The success of the Australian team re-

(Continued on page 9)

(Optical Communications from page 8)

lies on the use of relatively wide bandwidths (up to 10 degrees) to overcome the difficulty of alignment on clouds, the use of new high power Luxeon light emitting diodes and large (395 x 395 mm) plastic Fresnel lenses, to capture as much light as possible, combined with narrow bandwidth digital modes and a low noise receiver. The team works at night as the receivers are overloaded by even twilight. Luxeon is the trade name for a LED with enhanced optical output manufactured by Philips.

Two other Australians, Mike Groth, VK7MJ, and Chris Long, VK3AML, pioneered the use of Luxeon LED transmitters and low noise receivers using Fresnel lenses for line-of-sight optical communication. Their record is 165 km achieved in 2005. A year later Clint Turner, KA7OEI, achieved a line of sight record of 278 km between high mountains in Utah, USA.

In the late 2006, the trio started to examine options for non-line-of-sight optical communication and added the WSJT computer program to bring in much weaker signals out of the noise.

Lenses are like antennas. With a small plastic lens such as used in a torch, one can achieve optical gains in the order of 24 dBi with bandwidths of around 10 degrees. Large Fresnel lenses can deliver up to 50 dBi.



Joe Gelston, VK7JG, operates the wide beamwidth transmitter; Rex, VK7MO, was at the receiver end. Picture by courtesy of Alvin de Quincey, VK7NDQ.

Scattering From Clouds

Scattering optical signals from clouds has its own challenges. The issue of alignment on clouds becomes easier over longer distances because at short distances of a few kilometres the elevation angle to the clouds can vary widely. However, over longer distances such as 50 km the cloud height limits the possible elevation angles to a few degrees, which means that a narrow vertical bandwidth can cover the full range of possible elevations by beaming just above the horizon. The team found that aside the problem of alignment it is best to use as narrow a beamwidth as practical to increase the optical gain and the resultant system performance.

Another plus over longer distances is that the clouds tend to average out the signal such that even with minimal cloud cover signals are

(Continued on page 10)

(Optical Communications from page 9)
usually quite consistent in signal strength. At shorter distances, the signal frequently drops out completely due to gaps between the clouds.

The trio use Luxeon Type LXHL-LD3C, which gives maximum light output 627 nm of red light. The LED comes with a small aluminium heat transfer arrangement and produces around 0,5 Watt average light output. Various lenses are available. The team uses a 20 mm lens, which gives around 85% efficiency with a 10 degree bandwidth or around 24 dBi optical gain. Because of their small size and reasonable price, it is practical to build a 60 led array to increase power. While it would be better to use narrower bandwidths for longer path lengths, larger lenses would be required to narrow the bandwidth, which presents a size problem.

Over-the-horizon optical communication present a new challenge to radio amateurs. It not simply a question of equipment, it involves the study of light propagation, understanding weather conditions, red light versus blue light, external noise and internal noise, to mention just a few of the areas of study and to understand.

As I have said so many times, amateur radio is the most challenging of all the scientific hobbies and perhaps that is the reason why it provides so much satisfaction.

In a box - Some terminology explained

A Fresnel lens is a type of lens invented by French physicist Augustin-Jean Fresnel. It was originally developed for lighthouses; the design enables the construction of lenses of large aperture and short focal length without the weight and volume of material, which would be required in conventional lens design. Compared to earlier lenses, the Fresnel lens is much thinner, thus passing more light and allowing lighthouses to be visible over much longer distances (Wikipedia).

JT65a is part of the WSJT computer program suite used for weak-signal radio communication. The program was initially written by Joe Taylor, K1JT, but is now open source and is developed by a small team. The digital signal processing techniques in WSJT make it substantially easier for radio amateurs to employ esoteric propagation modes.

ZS1EL VIP Paddle

Kevin McDonald, ZS6KMD kevin@warpc.co.za

This little story starts at the beginning of June 2009 when Vidi la Grange, ZS1EL, made a posting on

the SARL swap forum for some home brewed paddles for sale. Always one for a bargain (as most

(Continued on page 11)

(ZS1EL VIP Paddle from page 10)

radio amateurs are) I dropped Vidi a mail and hoped to hear from him in a few days with good news about the VIP Paddles.

Sure enough, a day or two later I got a mail with some pictures and the simple yet functional "User Manual" that Vidi had created. Surprise is not explanatory enough; these little beasts were well made and definitely worth having to compliment the radio on my bench. Vidi and I struck up a conversation via e-mail and soon enough I had posted a page with some pictures of the various colours as well as a brief description and my findings on my web site.

Lo and behold, Vidi started getting calls from all and sundry for their "Bumble Bee" or "Red Herring." I posted a note in several QRP forums and I discussed the paddles with some QRP fanatics in the USA. Eddie, ZS6BNE, got one customised for Shack in the Sack, and he reports that he is very happy with it. Barney, ZS4U, has a "Blue Flash" and William, ZS4L, has a

"Bumble Bee." Each one has a serial number and I am sure that these early models will be sought after by collectors in the years to come.

Suffice it to say that Vidi is currently in negotiations with Elecraft in the USA to market and manufacture internationally on his behalf. An awesome achievement by any standards. Wayne, N6KR, from Elecraft should have his "Red Herring" by the time you read this article and I hope to be working him pretty soon.

Not only has Vidi become a little famous for his accomplishments in his "tuisnywerheid" as he calls his workshop, Dave Ingram, K4TWJ, who most of us know from his articles in Radio ZS and other publications, has offered to do an article on Vidi and the VIP Iambic Paddle that he designed, in CQ magazine as well as possibly his new book Keys III (World of Keys).

Now I am proud to say that Vidi has sent me my own little "Red Herring," serial no 023, and it works beautifully. The gift from Vidi for the small contribution I made to assist-

ing him in selling his VIP products was well worth it. It makes one think that during times like these we should all stand together, help each other by sharing our knowledge and contacts, (the old
(Continued on page 12)



(ZS1EL VIP Paddle from page 11) boys club), and grow Amateur Radio in our country.

As for Vidi and the VIP Paddle, well I guess I will be ordering an-

other one or two, which I will be holding onto as prizes for some CW competition in the future.

Hope to work you all soon on my little "Red Herring"

Kul Jou Hier, Kul Jou Daar

Deur Ean Retief, ZS1PR/HZ, Al-Khobar

Op 6 Junie was dit die 65ste herdenking van die "D-Dag"-landings sestig jaar gelede wees.

Iets wat baie belangrik van die Geallieerde kant af was om die plekke waar die landings gaan plaasvind geheim te hou. Baie dinge is gedoen om die Duitsers te mislei sodat hulle nie die regte area identifiseer nie.

'n Groot aantal uiteenlopende dinge wat aanmeekaarskakel is gedoen, maar relatief min mense is bekend met die elektroniese "Spoof Operations" wat vir 'n paar uur in die nag voor die landing gedoen is om die verdedigers tot op die laaste oomblik te verwar sodat hulle eenhede weg van die landings-areas ontplooi het en op die wyse te sorg dat daar minder verdedigers "in posisie" op die werklike invalfront was.

Die "fop-planne" waarmee daar laat in 1943 begin is het dus twee doele voor oë gehad, naamlik om die reuse invalsvloot so lank as moontlik te verbloem en ook "invalsmag" daar te stel wat die verdedigers na ander plekke sal laat beweeg as waar die regte inval sou plaasvind.

Dr. Robert Cockburn, hoof van



In this article, Ean Retief discusses the electronic "Spoof Operations" used by the Allied Forces before the D-Day landings in June 1944. The aim of these operations was to deceive the German Forces in France about the landings.

He discusses the work done by Dr Robert Cockburn, head of the Counter Measures department of the **Telecommunications Research Establishment**. The work involved ways of creating misinformation on German radars with regard to shipping movement in the English Channel.

die teenmaatreëlafdeling van die **"Telecommunications Research Establishment"** in Malvern het in samewerking met die Amerikaanse ABL-15 teenmaatreëlgroep gewerk en met 'n vierdelige plan voor die

(Na bladsy 13)

(Kul jou hier vanaf bladsy 12)

dag gekom:

Dat elkeen van die verdedigers se kusradarinstallasies geïdentifiseer word.

Meeste (maar nie almal nie) moes die nag van die inval buite aksie wees.

Die nag voor die inval moet vals invalsmagte die aandag aflei.

In die gebied waar die werklike inval gaan plaasvind moet alle nog werkende Radars “verblind” word.

Die uitsendings wat ’n radarinstallasie uitstuur kan baie verder ontvang word as wat die radar se werkafstand is, want ’n radar moet ’n baie sterk sein uitstuur om refleksie terug te ontvang. Mens kan dit met ’n motor se hoofligte vergelyk in die sin dat die ligte net voldoende is om vir die bestuurder ’n kort afstand voor hom te verlig. Daarna is enige weerkaatste lig te swak om waargeneem te word. Die ligte van die motor is egter nog sigbaar vir iemand wat baie kilometer voor die motor is.

Die Duitse radars het nog nie op mikrogolffrekwensies gewerk nie maar op UHF en die seine het dus oor die Engelse kanaal voortgeplant wat in die betrokke gebied slegs 130 km op die wydste plek is. Dr. Cockburn en sy span het drie rigtingvinders gebou (kodenaam “Ping-Pong”) wat langs die suidkus van Engeland ontplooi is. Met driehoeksmeting kon baie van die Radars se posisie min of meer bepaal word. Daarna is die presiese posisie deur lugfotografie bevestig.

Die tweede fase kon toe begin om die radars deur lugaanvalle buite aksie te stel. Om nie die invalsg gebied te verrai nie is daar elke keer as ’n installasie aangeval is, ook drie ander buite die beplande invalsg gebied terselfdertyd aangeval.

Tegniese Agtergrond

Om gou weer tot die vergelyking met die motor se hoofligte terug te keer: Weerkaatsers en padtekens wat die lig baie effektiw terugkaats maak hulle baie sigbaar vir die motoris.

Dieselfde prinsiep van fisika geld met radar. As ’n voorwerp resonant gemaak word op die werkfrewensie van die radarstel kaats dit ’n baie groter sein terug as die omliggende voorwerpe. Meeste seiljagte het ’n radarweerkaatser bo-op die mas omdat veral hout-, glasvesel- en sementseiljagte nie ’n baie goeie weerkaatser vir groter skepe se radars is nie. So vind mens ook radarweerkaatsers op hawe hoofde om hulle op skepradars te laat uitstaan.

Stroke aluminiumfoelie word gedurende militêre aksies uit vliegtuie gegooi om Radars te “verblind” met ’n groot aantal sterk weerkaatsings. Hierdie foelie word “window” of “chaff” genoem.

Nog ’n radartegniek is die “transponeerder”. Dit is ’n ontvanger/sender wat die radar se sein ontvang en dan ’n puls terugstuur. Dit word vandag baie algemeen gebruik. Dit maak kleiner vliegtuie

(Na bladsy 14)

(Kul jou hier vanaf bladsy 13)

makliker sigbaar op lang afstande (net soos die seiljagte) en word ook gebruik om spesifieke vliegtuie te identifiseer deur 'n unieke kode wat die transponeerder mag uitstuur. Dit word ook gebruik in die skeepvaart om bv. 'n hawehoof of vuurtoring te identifiseer.

'n Ander tegniese puntjie van radar om ons storie duidelik te maak: Een van die operasionele parameters van elke radar is die "Helderheidsêl" ("Resolution cell"). Dit is die minimum onderskeid wat die radar tussen twee voorwerpe kan weergee. So sal op 'n skeepsradar 'n klein kus-vragskip wat voor anker lê en twee diepsee vistreilers, wat aan mekaar vas geanker lê, dieselfde vertoon en dit maklik vir een skip aangesien word.

Die "Helderheidsêl" is 'n funksie van hoofsaaklik twee dinge, naamlik die straalwydte van die antennestelsel en die pulslengte. Die straalwydte bepaal hoe "wyd" die helderheidsêl is, want hoe vêrder weg van die radar hoe meer 'spasie' tussen die 'kante' van die sein. Om genoeg energie in 'n radarpuls te kry moet die sender lank genoeg met elke puls aanbly. In die tyd wat die sender aan is beweeg die RF-energie van die 'begin' al uit van die antenne en die 'agterkant' word bepaal deur hoe lank die radar "vuur". Die senderpuls is 300 meter lank vir elke mikro-sekonde wat 'n radarsender "vuur".

Die "helderheidsêl" is in praktyk egter kleiner as die teoretiese grootte, want eerstens neig die

twee "teikens" naby die 'kante' van die puls om 'n dubbele sein te gee wat 'n bedrewe waarnemer/operateur sal opmerk en daar is ook prosesse in die radarontvanger om sulke seine te skei.

Dr. Cockburn se Spookvlote

Dr. Cockburn het met 'n merkwaardige plan te vore gekom wat twee "spook-vlote" daar sou stel. Om dit werklik realisties te maak moes hierdie vlote teen sowat 7 tot 8 knope beweeg na twee moontlike landingsplekke redelik naby die werklike invalsg gebied.

Die een vloot ("Glimmer") sou in die rigting van Boulogne/Calais beweeg wat in die hoofgebied was wat die Geallieerdes altyd subtiel probeer voorgee het as die mees moontlike gebied waar die aanval sou plaasvind.

Die tweede ("Taxable") sou in die rigting van die Le Havre/Fécamp-gebied beweeg wat redelik naby aan die werklike hoofinvalsg gebied was. Die Geallieerdes wou hê dat wanneer dit vir die Duitsers duidelik word dat die aanval nie oor die nou gedeelte van die Engelse kanaal plaasvind nie (Boulogne/Calais) dat hulle sou dink dat die hoofteiken die hawe by Le Havre sou wees. Dit sou help om die hoofmag te verbloem en wanneer die waarheid ontdek word dan sou die verdedigers met 'n draai om die baai en diep riviermond moes beweeg na die ware front en die Seine-rivier moet kruis waar hulle

(Na bladsy 15)

(Kul jou hier vanaf bladsy 14)

met aanvalle op brûe verdraag sou kon word.

Die meeste van die Duitse kus-radarinstallasies was die Seetakt-tipe wat in die 80 cm-band (370 MHz) gewerk het en Dr. Cockburn het sy spookvloteplan hoofsaaklik teen hierdie installasies beplan. Die Seetakt se straalwydte was 15 grade wat sou beteken dat op 'n afstand van 16 km die straal reeds meer as 4 km breed sou wees. Die RF-pulslengte was 3 mikro-sekondes wat die puls so 900 meter lank sou maak. Dit was bereken dat met die Seetakt sou operateurs nie teikens nader as 3 200 meter in wydte en 475 meter in diepte van mekaar kon uitken nie.

Die plan was om 'n blok vals teikens sowat 22 km wyd en 25 km diep daar te stel wat stadig vorentoe beweeg. Vir die doel sou lang rolle met die regte lengte reflekerende aluminiumfoelie uit vliegtuie gegooi moes word. Hierdie was bekend onder die kodenaam "Rope" en sou 'n baie sterk sein op die Duitse radars teruggee weens die effek van baie reflektors feitlik reg bo mekaar.

Vir die "Taxable"-vloot sou agt vliegtuie gebruik word. Vier vliegtuie het langs mekaar gevlieg met 'n spasiëring van vier myl (6,4 km) tussen hulle. Elke vliegtuig het 'n "renbaan"-patroon gevolg in die sin dat dit nadat dit agt myl (12,8 km) vorentoe gevlieg het, dit dan met 'n sirkel na links teruggedraai het na die "terugbaan" wat twee myl (3,2 km) weg van die baan is wat dit gevolg het toe dit "ingekom" het.

Terwyl hulle gevlieg het moes 'n bondel "Rope"-reflektors elke vyf sekondes uitgegooi word. Die vliegtuie het teen 'n konstante 288 km/h gevlieg, wat beteken dat 'n bondel "rope" elke vierhonderd meter uitgegooi is. Agter die eerste vier vliegtuie was nog vier wat dieselfde gedoen het, maar net agt myl (12,8 km) agtertoe. Die spulletjie sou 'n baie soliede refleksie op die Seetakt-radars veroorsaak.

Met die terugrit het die vliegtuie nie agt myl teruggevlieg nie, maar na sewe myl weer teruggesirkel na die "vorentoe"-baan. Die agterste vier vliegtuie het dieselfde gedoen. Op die vorentoebaan is daar dan weer 8 myl gevlieg wat beteken dat met die volgende terugdraai die vliegtuie 'n myl nader aan die land sou wees. Op die wyse sou die "spookvloot" dan teen 'n realistiese 8 knope vorentoe beweeg.

Die "Glimmer"-spookvloot sou dieselfde wees maar net uit ses vliegtuie bestaan (drie rye voor met drie agter).

Twee RAF eskaders het met opleiding begin: 617 met Avro Lancasters ("Taxable") en 218 met Short Stirlings ("Glimmer"). Nou dit klink miskien maklik, maar eers moes die loodse/navigators in die nag hulle posisies teenoor mekaar en die formasie presies hou en vêrder is die "Rope" met die hand uitgegooi, dus moes die bondels foelie ritmies elke vyf sekondes uitgaan. Na maande van oefening is 'n onaangekondigde proeflopie teen 'n Britse kusradar by Flamborough

(Na bladsy 16)

(Kul jou hier vanaf bladsy 15)

Head in Yorkshire gedoen. Die operateurs van Flamborough Head is nie vooraf gewaarsku nie en hulle het 'n konsentrasie van meer skepe, as wat hulle nog ooit gesien het, gerapporteer. Tot dusvêr goed en wel.

Daar was egter nog 'n probleem: Dit sou redelikerwys verwag kan word dat wanneer die eerste rapporte van 'n groot vloot skepe aan die Duitse Ops-sentrums gerapporteer word, hulle vir bevestiging deur lugverkenning sou vra. Die Luftwaffe se maritieme verkenningsvliegtuie se Hohentwiel-radar het op 'n ander golf lengte as die Seetakt gewerk en sou nie sterk seine van die "Rope"-reflektorstroke kry nie. Hulle sou dus letterlik deur die spookvloot kon sien...

Om die Luftwaffe te fop is vier RAF-motorreddingsbote aan elke spookvloot toegeken. Elkeen van hulle het 'n spesiale transponeerder (kodenaam "Moonshine") aan boord gehad. Die sou die Hohentwiel-radar se sein ontvang en dan 'n sein terugstuur wat sou lyk na 'n groot klomp skepe wat naby mekaar vaar. Vêrder het elkeen ook 'n 8,8 meter lange ballon aan 'n kabel gesleep. Binne die ballon was 'n radarreflektor van 2,7 meter deursnit. 'n Vêrdere 14 kleiner bote sou ook sulke ballonne sleep. Hulle was reg onder die vallende "Rope" en sou dus die hele kullery versterk.

Drie dinge sou nog gedoen word om die kullery nog meer geloofwaardigheid te gee: Twee RAF-eskaders (101 en 214) sou tussen die twee gebiede op en af vlieg en die Duitse

radars aan doelbewuste steuring ("jamming") onderwerp. Die steurings sou egter nie so sterk gemaak word dat die Seetakt totaal verblind is nie, maar net om dit te laat lyk asof daar gepoog word om die "spookvlote" te verskuil.

Die patrolliebote sou wanneer die spookvlote naby die kus was begin om met kragtige klankstelsels die klank van baie skeepsenjins uit te saai. Dit is later gevolg deur die geluid van ankers wat neergelaat word. Rookskerms sou ook vrygelaat word. Daarna kon hulle en die vliegtuie laat spaander huistoe.

Die oomblik as dit gebeur sou 'n vêrdere vier eskaders groot vliegtuie massas "Window" oor die vals landingsareas uitgooi en die Duitse radars totaal verblind. Saam met die "Window" is ook spesiale vuurwerk afgegooi wat die indruk van gevegte op die grond sou skep. Dit sou die indruk gee dat iets groot daar aan die gang was.

Die kersie op die koek sou wees dat net soos dit wil begin lig word sou vals valskermsoldate (Poppe) agter die Frecamp/Le Havre-gebied neergelaat word. Dit sou die verdedigers besig hou. Fopvalskerm-soldate sou ook aan beide kante van die werklike landingsareas neergelaat word, maar in die veld weg van die paaie. Dit sou die aandag van die werklike valskermsoldate aftrek en ook die Duitse infanterie wegneem van die werklike landingsgebiede af. Teen die tyd dat hulle agterkom dit is 'n vals landing sou die Geallieerde magte hopelik al 'n vas-

(Na bladsy 17)

(Kul jou hier vanaf bladsy 16)

trapplek aan wal hê. Hierdie deel van die operasie was onder die kodedewoord "Titanic".

Sou Dit Werk?

Toe hy gevra is of dit sou werk was Dr Cockburn se antwoord aan Dr Alfred Price: "Stel jou die situasie voor:- 'n Senuagtige jong dienspligtige radaroperateur sien die 'spookvloot' op sy radar en rapporteer dit aan sy hoofkwartier as die langverwagte vyandelike invalsmag. Sy kollegas by ander radars teen die kus rapporteer dieselfde vloot. Gou-gou verskyn daar 'n lekker dik pyl op die situasiekaart in die hoofkwartier: Die 'spookvloot' is nou 'n werklikheid. Sou 'n vliegtuig dan in die area invlieg en sê dat hy niks gesien het nie, sal die rapport geglo word? Waarskynlik nie. Die operasie gaan in die nag plaasvind en die vliegtuie mag vêr van hulle beplande roetes wees. As 'n vet pyl wat 'n vyandelike aanval voorstel eers op die situasiekaart in 'n militêre hoofkwartier verskyn het, is dit 'n militêre feit en dit sal baie verg om dit te verwyder."

Uit my eie beperkte militêre ondervinding glo ek die elemente van die plan was perfek. Eers kom daar rapporte van doelbewuste sturing ("jamming") by die ops-kamer aan. Onmiddellik besef die offisiere daar dat iets gaan gebeur. Nou wag almal. Dan kom die radarrapporte. Die senior offisier vra die lugskakeloffisier vir lugverkenning. Omdat dit nag is, en alles is verduister, sien die

verkenningsvliegtuig nie iets met die oog nie, maar rapporteer dieselfde vlote a.g.v. "radarkontak". As daar nog enige twyfel was sal dit verdwyn wanneer observasieposte begin rapporteer hulle hoor die vloot. Nou gons die telefoonlyne en die teledrukkers ratel. Dan kom die bevestigende berigte van massas "Window/Chaff" op die kus en van gevegte (die vuurwerk) net waar die aanvalle behoort te gebeur en dan teen dagbreek nog valskermsoldate ook – 'n klassieke teksboekinval!

Resultate

Teen die tyd wat hierdie operasie begin het, was slegs 16 van die 92 radars teen die Franse noordkus en België in werking, terwyl nie een in die werklike invalsaarea ten volle gewerk het nie.

Sturing ("jamming") het nou begin maar die vliegtuie (101 en 214 eskaders) se roetes was in 'n gebied tussen die twee spookvlote sodat die sturing nie so erg sou wees om die spookvlote te verskuil nie.

Die bomwerpers wat die "Rope" moes afgooi was van neus tot stert gepak met die foeliebondels. Onder die vallende "Rope" het die "Moonshine" operateurs seine opgetel en "met rente" teruggestuur.

Toe die inval werklik begin is die Luftwaffenagvegters se radiokanale hewig versteur deur die "Airborne Cigar"-apparaat wat ook deur 101 en 214 eskaders se vliegtuie gedra is en kon die grondbeheer geen instruksie aan hulle vliegtuie gee nie.

(Na bladsy 20)



Comfortable for long operating stints, the Pro Set Plus represents the highest evolution of the Heil Sound Boom Mic/Headset line. The oversized earmuff-type headsets provide 40 dB of outside sound rejection.

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(Kul jou hier vanaf bladsy 17)

Van die 1 069 swaar gelaaide Geallieerde vliegtuie was net een Lancaster 'n verlies, maar alle vragvliegtuie kon hulle valskermsoldate redelik suksesvol "aflewer".

In die werklike landingsarea het meer as 200 skepe hulle warapparaat ("Jammers") aangeskakel en die kusradars feitlik heeltemal verblind. Net een radar het die werklike invalsvloot skramsweg gesien en sy rapport is by die gebiedshoofkwartier geïgnoreer. Die Seetakt-radars kon ook nie vuurleiding gee nie en op die ou end is net een Geallieerde torpedojaer deur vuur van kusartillerie tot sink gebring.

Die eerste rapporte van die werklike invalsvloot het eers die Duitse leër se gebiedshoofkwartier om 02:00 bereik toe observasieposte die skepe gerapporteer het.

Uit Duitse rekords is dit duidelik dat die kleiner "Glimmer"-spookvloot gerapporteer was en alarm gemaak is dat die aanval in die Calais-Duinkerkengebied gaan plaasvind.

Dr. Cockburn se "vet pyl" het toe ook verskyn en lank gebly. Die "Spoof" het om 05:00 tot 'n einde gekom, maar 'n telefoonboodskap wat om 10:15 in die Luftwaffe-hoofkwartier aangeteken is, rapporteer wat toe bekend was oor die werklike landing, maar gaan dan

voort om te sê: "Die rapporte van skepe wat vergader voor Calais en Duinkerken is so vêr nog nie bevestig nie", en dit meer as vyf ure nadat die fopspul afgehandel was!

Op daardie stadium was daar nog Duitse verkenningsvliegtuie en patrolliebote wat na die landingsvloot voor Boulogne en Calais gesoek het. Belangrikste egter is dat Duitse leëreenhede wegbeweeg het om aanvalle af te slaan wat nooit sou kom nie. Vêrder is ander magte (veral die swaar tenks) weg van die kus in reserwe gehou totdat die situasie duideliker was. Dit was 'n bydraende faktor daartoe dat daar op twee van die vyf strande die invallers relatief ligte verliese geleidelik het, hoewel die verliese op die ander strande baie hoog was.

Die groter "spookvloot" (Taxable) het baie min aandag gekry, hoofsaaklik omdat meeste radars in die gebied buite werking was.

Die hele operasie is uitgevoer teen relatief minimale koste en was die eerste voorbeeld van regtig grootskaalse en fyn beplande geïntegreerde elektroniese oorlogvoering om eie magte se verliese te beperk.

Dr Cockburn is na die oorlog tot ridder geslaan vir dienste deur die oorlogsjare gelewer.

Amateur Radio in Space

By Eddie Leighton, ZS6BNE

OSCAR 7 "The veteran satellite"

These South African statistics have been updated since the last

issue of Radio ZS. It is always good to have this information recorded on

(Continued on page 21)

(Amateur Radio in Space from page 20) paper, as it were. Three maximum distances per call sign.

Oscar 7 is enjoying more sunlight lately and, after being “Locked” in Mode B (fortunately) while in eclipse at the switchover time, is now toggling once again between modes A and B, the most popular being Mode B. The beacon is not always available for an unknown reason.

AMATEUR RADIO STATION
ZS6BNE
 Website: www.nvintnet.za.org/zs6bne
 Eddie Leighton
 P.O. Box 499
 Lichtenburg
 2740
 060-93831

NO-1 Satellite

Confirming our QSO World Amateur radio day

TO	DATE	TIME	REPORT	MODE	FREQUENCY
Evangelos SV1EEK	18/04/2009	17:08 UTC	59	SSB	TX: 432.195 RX: 145.943

KM17vx 71.90km Ref "Tinylocator" 73 and Good DX de Eddie

Working the SSB Satellites

Much has been said in the past on how to work the FM LEO Satellites. It is time to discuss the SSB Birds! I had a sked with Brian, ZS5SB, the past weekend. Brian only had an Icom 706 mkIIg and Elk antenna so had no option but to work a SSB satellite running “Half duplex.”

We made a sked for an easterly pass, which suited his QTH restrictions to the west. We decided to use a seldom used SSB satellite, the FO-29. I had my first SSB QSO on this satellite in September 2005 with Denis, ZR6DNS. FO-29 is an ideal satellite to introduce SSB operations.

(Continued on page 22)

Andre, ZS2BK / LU2DPW Argentina- 7 540 km

Pierre, ZS6BB / PY1UNU Brazil - 7 171 km

Eddie, ZS6BNE / PY4AJ - 7 168 km

Kieth, ZS6TW / PY1UNU - 7 155 km

Pierre, ZS6BB / SV1EEK - 7 141 km

Eddie, ZS6BNE / SV1EEK - 7 130 km

Etienne, ZS6Y / PY1UNU - 7 123 km

Andre, ZS2BK / Miguel, CX1TH - 7 108 km, 4 Jan 2009

Kieth, ZS6TW / SV1EEK - 7 107 km

Andre, ZS2ACP / Juan Miguel, CX1TH - 7 106 km, new 18 May 2009

Andre, ZS2ACP / PY4AJ - 6 994 km

Andre, ZS2BK / Louis, PY2ACM - 6 990 km in 1978

Andre, ZS2ACP / PY4ZBZ 6 989 km, **New**

Allen, ZS1LS / CX1TH - 6 746 km

Hal, ZS6WB / 4Z1WS - 6 445 km

Chris, ZS1TX / PY2CDS - 6 356 km in 2005

Chris, ZS1TX / PY4ZBZ - 6 354 km

Allen, ZS1LS / PY4AJ - 6 339 km

(Amateur Radio in Space from page 21)

It should be noted that Doppler has quite an effect, so fine tuning is necessary for SSB. Ideally with using the SSB satellites, Doppler correction on the up and downlink is crucial and should preferably be computer controlled by software such as SatPC32 or similar. When working in the field, as portable, these support structures are not always there so the next best option is chosen, a fixed uplink frequency tuning the downlink for Doppler (similar to the FM birds like AO-51). It may be a good idea to mention "Half duplex" when working via the SSB satellites this way, that the other station can compensate and understand that different frequencies come into play between the two stations. It may be necessary to tune around to find the other station after each over.

FO-29 Activity

Give FO-29 a try, the downlink is 435,850 MHz USB and the uplink is 145,950 MHz LSB (+- Doppler).

It is a SSB satellite that can provide DX opportunities. It stays in the same mode every day and is easily accessible with at least two good passes per day. The signals are clear and strong even with a 70 cm downlink. It has a beacon that is always on, CW at about 15 w.p.m.

There is nothing like a Doppler and fade affected SSB signal, Donald Duck to Mickey Mouse. It sounds very "machine like." This satellite is ideal for listeners to

sharpen up their tracking and tuning skills.

Automatic tracking of satellites.

Much has been said on the SARL forum on this subject but is included here for the benefit of those not frequently accessing the forum via the Net. SatPC32 has facilities for sending direction and elevation information via a serial interface (COM Port) to a controller. The controller used here is the LVB Tracker, a PIC based system simulating a Yaesu elevation and azimuth rotator communicating using the Yaesu GS-232 protocol. With an LVB tracker, you are not limited to a specific commercial rotator make and model, in fact there are no limitations at all! You can even homebrew your own rotator system and still enjoy automatic satellite tracking. The LVB tracker gives anticlockwise/clockwise signals, which can be sent to a relay to operate a rotator motor. In much the same way, an elevation rotator's up/down signals can be controlled. The firmware is very intelligent and can cater for greater than 360 degree rotation and also 90 or 180 degree elevation movements. A linear potentiometer is normally used to provide positional feedback in form of a voltage level. The LVB Tracker is calibrated to the positions of the rotators in software (stored within the PIC) The LVB tracker has been so designed, that it is a PIC programmer too. The latest firmware can be downloaded from the

(Continued on page 23)

(Amateur Radio in Space from page 22)

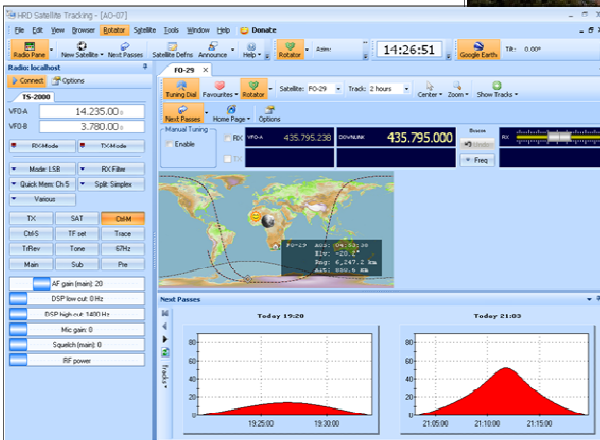
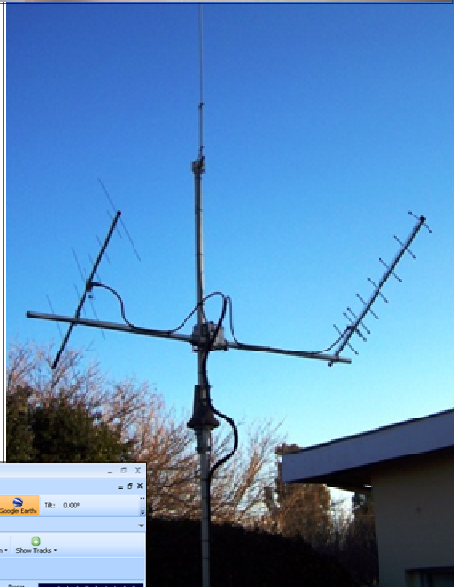
Net and the LVB Tracker parameters can be set using a simple program like Hyper Terminal via the PC's COM port.

Here is a picture of my tracking system using an old CD45 azimuth rotator and a Kenpro 500A elevation rotator. This system is truly an intelligent robot and is fondly known as "Henry." Henry, ZS1AAZ, originally built the system.



Ham Radio Deluxe version 5 Beta

A new version of HRD is downloadable from the web. This version looks a little different from previous versions and it seems a lot of work has been done on the satellite module. There is also a rotator control program that looks pretty interesting! It takes a little getting used to the new user interface but the journey of discovery is interesting with many new options included.



I have yet to test the rig control facilities with the new version. Here is a preview of the very configurable satellite "Panel."

CU on the Sats! 73

Amateur Radio gets another Voice in the Sky

by Hans van de Groenendaal, ZS6AKV

If there was ever a misconception about amateur radio then it is that it is a dying activity - only of interest to old people. Not true! It is alive, well and very much in tune with new trends in communication

Over the next few months, we will highlight some of the new technologies that have taken amateur radio to an unprecedented technology level and what's more, it is an activity that offers something for any age group and background. It entertains and educates.

Amateur radio is not a newcomer to satellites. In fact the first amateur satellite, Oscar 1, was launched on 12 December 1961, merely three years after man's first entry into space (Sputnik 1). While only including a simple telemetry transmission of inside and outside temperature and running on dry cells, it heralded the beginning of a new and exciting era for amateur radio. Over the many years since then radio amateurs have made major contributions to the development of satellite technology and have led the way to the development of the low earth satellite (LEO) industry. When you are using your satellite phone today just remember that it was all started by radio enthusiasts, as a hobby.

Oscar 1 (orbiting satellite carrying amateur radio) created a new wave in amateur radio, which has brought about the launch of many satellites in various types of orbits

and of various technological complexities.

South Africa's entry into the space age was in 1997 with the launch of Sunsat 1, a fairly basic satellite built by students and lecturers at the University of Stellenbosch. The satellite carried various experiments and an amateur radio transponder that delighted radio enthusiasts worldwide. From this modest beginning grew SunSpace and Information systems, today a successful company in the space communications field.

Besides offering radio amateurs an entry into space communication and learning more about orbits, satellite tracking, Doppler shift and satellite antennas, Sunsat provided an important social element. Sunsat was the ideal satellite to demonstrate technology in the classroom. It also offered language teachers the opportunity, on an innovative basis, to teach learners articulation. The excitement of using the satellite to listen to one's own voice far outstripped any conventional methods to teach learners to speak clearly.

Soon South Africans will get another local voice in the sky when South Africa's second satellite (for the time being named ZA002) is

(Continued on page 25)

(Voice in the Sky from page 24)

launched in December. The satellite is sponsored by the Department of Science and Technology and is being built at SunSpace in co-operation with the University of Stellenbosch. The amateur payload will offer similar activities to that of Sunsat but implemented in a new and innovative way.

The amateur radio payload will be operating in conjunction with the University of Stellenbosch Software Defined Receiver project, as it will share the VHF receiver and UHF transmitter used by the SDR project. SA AMSAT has designed and built a control system to facilitate the following operations:

- V/U voice transponder with an uplink in the 2 m band and a downlink in the 70 cm band.
- A parrot repeater (voice digipeater)
- A voice beacon.

The control unit will command the various functions of the transponder and handle the parrot and beacon messaging. On receipt of a tone from the VUCU VHF receiver, the CTCSS tone will be decoded and depending on the tone received, the unit will command the VU transponder operation or the parrot repeater. In the transponder mode, the satellite will act like a cross-band FM repeater and allow two-way communications with other stations on the ground.

If the tone received indicates parrot operation, the interface unit will record 20 seconds of audio on its VHF uplink receiver and replay the recorded audio on the UHF downlink.



Hannes Coetzee building the prototype controller for the SA AMSAT Payload on ZA002.

Should there be, for a predetermined period, no tones received, the controller will initiate a voice beacon, transmitting a pre-recorded message at regular intervals. This facility will offer many opportunities for educational projects.

The technical team comprising of Andrew Roos, ZS6AA, and Hannes Coetzee, ZS6BZP, have faced a real challenge to complete two prototypes of the controller in time for evaluation and integration in the main unit by end July.

The launch of the satellite is scheduled for early December. ZA002 is expected to be followed by two more satellite projects and with

(Continued on page 26)

(Voice in the Sky from page 25)

more time available, a more sophisticated amateur payload is envisaged.

To follow amateur satellite activity visit www.amsatsa.org.za.

SARL QSL Bureau

July/August 2009 newsletter

The new arrangement regarding the distribution of QSL cards is now in full swing. All divisions are now sorting and distributing cards to members in their various Provinces/divisions with Division 5 almost on line! I will be sending out a CD to all Provinces regarding the Database in due course, which will be updated every month, or so!

There is just one thing I need to expand on, as this is a problem that creeps in every now and again – receiving cards not intended for you.

This can happen quite easily. Cards tend to stick to each other or cards get miss-sorted occasionally. This is inevitable and we apologise for such little errors.

We suggest quite simply please return the card to us for forwarding to the correct recipient!

We do occasionally get the odd phone call regarding the scarcity of cards being sent out. Quite simply,

there is a lack of cards coming from overseas Bureau's. Hence, very little to sort and very little to send to you!

I must again emphasize the benefit of being a member of the SARL – especially looking at cards for non members. We are retaining them for one year. After one year, we retain them for another 6 months or so and then we are allowed to destroy them. This is a great pity! Some of those cards are collector's items and it is sad to see them discarded.

However, we do see a large increase in the number of operators making use of electronic facilities which is probably another reason why we are not receiving so many cards lately.

For more information on the QSL Bureau, please do not hesitate to contact Francois Botha, ZS6BUU, email jfbotha@iburst.co.za or 011 679 5260.

Calculating a Link Budget

By Frank van Wensveen, PA3GMP / ZS6TMV

From numerous discussions among radio amateurs, it is clear that many hams struggle with the concept of link

budgets. Bold statements are not unheard of:

- "Antenna X is always better than

(Continued on page 27)

(Link Budget from page 26)

antenna Y."

- "If A can hear B it doesn't mean that B can hear A, which is proof that propagation paths are not bidirectional."
- "RG-58 coax should never be used for serious DX."
- "If both stations use the same amount of power, their signal reports should be the same."

These and other fallacies could all be heard on the air here in Gauteng during the past few months. Clearly many hams have trouble grasping the fact that a QSO between two stations is a chain with many links.

What is a link budget?

Simply put, a link budget is the sum and total of all gains and losses in the radio connection between two parties from end to end, including antennas, feed lines and the path between the antenna's, but also the relevant portions of the transmitter and the receiver, as well as miscellaneous gains and losses.

For a line-of-sight radio link, the link budget might look like this: $P_{rx} = P_{tx} + G_{tx} - L_{tx} - L_{fs} - L_m + G_{rx} - L_{rx}$, where:

- P_{RX} = received power (dBm)
- P_{TX} = transmitter output power (dBm)
- G_{TX} = transmitter antenna gain (dBi)
- L_{TX} = transmitter losses (coax, connectors...) (dB)
- L_{FS} = free space loss or path loss (dB)

- L_M = miscellaneous losses (fading margin, body loss, polarization mismatch, other losses...) (dB)
- G_{RX} = receiver antenna gain (dBi)
- L_{RX} = receiver losses (coax, connectors...) (dB)

To dispense with the mathematical formula, in plain language the above means that:

1. We start with the power of the signal that comes out of the transmitter;
2. To that we add the gain of the transmitter's antenna, also known as isotropic antenna gain, or gain relative to an isotropic antenna;
3. From that we subtract the losses between the transmitter and the antenna, which include all the antenna cables, connectors, baluns and other components;
4. Then we subtract the free space or path loss, which occurs between the two antennas and is a factor of the distance between the antennas (see below);
5. We also subtract whatever miscellaneous losses may occur, e.g. due to polarisation mismatch;
6. We then add the receiver's antenna gain;
7. And once again, we subtract all losses between the antenna and the receiver cables, connectors, baluns, etc.

In order to add all these factors, all power levels must be specified in dBm or dBW. For example, if the transmitter puts out 10 Watt (or 10 000 mW) its power is 10 000 times

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the reference power of 1 mW. Since 10 000 is ten to the fourth power, this gives us a transmitter power of 40 dBm. To clarify:

0,01 mW = -20 dBm

0,1 mW = -10 dBm 1 mW = 0 dBm

10 mW = 10 dBm 100 mW = 20 dBm

1 000 mW = 30 dBm and so on.

Once we have expressed our power levels in dBm or dBW (where 30 dBm = 0 dBW and 40 dBm = 10 dBW) we can simply add or subtract all gains and losses. For example a power of 40 dBm is transmitted through an antenna with a gain of 6 dB, which gives us an Effective Isotropic Radiated Power (EIRP) of 46 dBm, or 10 to the power of 4.6 (in mW) which comes to 39,8 Watts. That means that a 10 W transmitter connected to a 6 dB gain antenna delivers the same amount of power to the receiver at the other end as a 39,8W transmitter connected to an isotropic radiator.

An example

For short distance line-of-sight communications (e.g. from your hand-held to a nearby 70 cm repeater of which you can see the antenna tower with the naked eye) we can ignore the path loss, as it will be minimal. For example, take a hand-held with a nominal transmitter output power of 100 mW (or 20 dBm). The hand-held uses a small "rubber duck" antenna, which is notorious for its bad efficiency. Let us assume this particular rubber duck is a typical one with a gain of, say, -3dB. (In

other words it has a "negative gain", otherwise known as "loss". That means that it's less efficient than an isotropic radiator, which is quite common for rubber ducks on hand-helds! The repeater however has a decent antenna with a gain of, say, 6 dB, and its receiver input stage has a sensitivity of -130 dBm (at 12 dB SiNAD, or signal-to-noise-and-distortion, which is generally considered the minimum signal-over-noise ratio for a workable QSO). The cable between the repeater's antenna and the repeater input is 20 meter of Belden RG-213 coax. According to the manufacturer, this cable has a loss of 16 dB per 100 meter at 435 MHz, which works out to 3.2 dB for 20 metre. (Obviously this repeater was built on a budget!) If the repeater has a cavity filter at the input with an insertion loss of, say, 1 dB (not too good, but in this example let's assume that that's what it is) and the total loss of all the connectors used is another 0.3 dB, our link budget works out as follows:

1. Transmitter power: 100 mW = 20 dBm = 20 dBm.
2. Transmitter antenna gain: -3 dB = 17 dBm.
3. Transmitter loss = zero (no antenna cable!).
4. Path loss = zero (ignored).
5. Receiver antenna gain = 6 dB = 23 dBm.
6. Receiver loss (cable, filter, connectors) = 3.2 + 1 + 0.3 = 4,5 dB = 18,5 dBm.
7. Miscellaneous losses = zero

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(ignored).

Therefore, in this case, the input of the repeater receives 18.5 dBm. Since the minimum for a QSO is considered -130 dBm, we can easily work the repeater. Which is unsurprising, since in this example we are assumed to stand practically next to it? However, in the real world we will usually be much farther away and we have to consider the path loss involved.

Path loss through free space

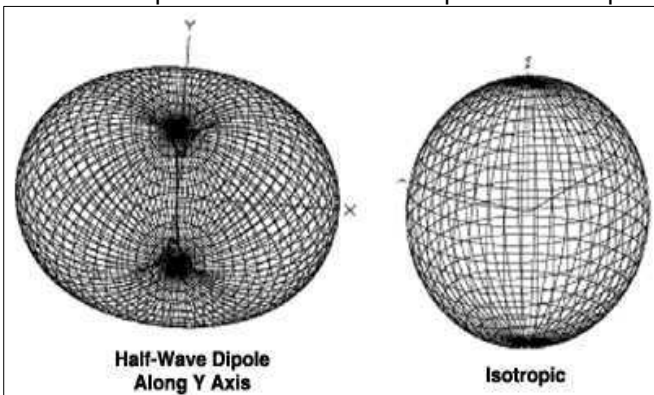
The path loss occurs on the path traversed by the radio signal between the two antennas. In free space this loss is a factor of the distance between the antennas; through the atmosphere or ionosphere other factors come into play as well.

In order to understand path loss, consider an isotropic radiator, which is a theoretical point source that radiates in all directions. In order to visualize this, imagine that your antenna is a very small metal ball, which radiates equally in all directions so that the wave front emitted by the antenna is completely spherical. The larger the distance from the source the wave front travels, the larger the spherical wave

front gets, and therefore the larger the surface of the spherical wave front that moves outward from the antenna. Therefore the energy radiated from the source will be spread across a larger surface whenever the distance increases, and therefore the strength of the signal at any given point of the spherical wave front will diminish accordingly.

In real life an antenna is not isotropic. A dipole, for example, radiates a toroid-shaped (donut-shaped) pattern when it is suspended in free space, and in a pattern affected by the ground plane, surrounding obstacles and other factors when it is not. In the drawing below, the isotropic radiation pattern is shown on the right hand side, while the radiation pattern of a half wave dipole (in this case positioned vertically) is shown to the left:

The donut-shaped radiation pat-



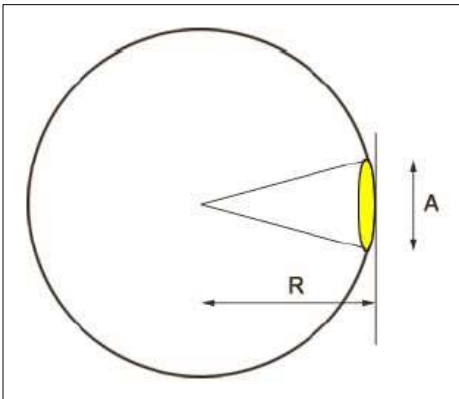
tern of the dipole is totally different from the isotropic, i.e. in each direction we have a different amount of energy that is being radiated. This

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makes it very complicated to calculate a line-of-sight link budget. A Yagi antenna, however, is much easier to work with. The Yagi radiates the bulk of its energy in a bundle (ignoring side lobes for the moment). That bundle may be considered a cone-shaped segment of the isotropic sphere, assuming that no other significant environmental factors distort the Yagi's "ideal" radiation pattern too much.

The surface of a Yagi antenna's "cone of radiation" is determined by its aperture, which, in turn, is a measure for how "wide" the surface of the cone is. In the drawing below, the radius of the isotropic sphere (i.e. the distance from the antenna) is shown as 'R', while the aperture is shown as A. The radiant area (the surface of the radiated "cone") is shown in yellow:



The higher the gain of the antenna, the smaller the aperture will be. In physics we get nothing for nothing; the gain of the antenna is in fact nothing but the antenna's ability

to "concentrate" the radiated energy on one spot, just like a lens can focus a beam of light: the smaller the spot, the brighter the light.

The surface of a sphere is equal to $4 * \pi * R^2$. Therefore, the amount of power received by surface A is equal to:

$$\frac{A}{4 * \pi * R^2} * P_{tx}$$

where P_{tx} is the power emitted by the transmitting antenna.

The isotropic gain (the gain of an antenna over the isotropic sphere) is dependent on the frequency used. An isotropic antenna has an isotropic gain of 1, while a half wave dipole in free space has an isotropic gain of 1,64 (or roughly 2,15 dB).

A half wave dipole in, say, the 70 cm band has roughly 1/3rd of the length of a half wave dipole in the 2-metre band. Therefore its effective surface is only 1/9th (the square of its length). In other words, a 70 cm antenna will intercept a much smaller portion of the wave front than a 2 m antenna.

Because the 'cone of radiation' (see the drawing above) increases with distance, while the portion of the cone's base that is intercepted by the receiving antenna decreases with the frequency, it follows that the path loss is both a factor of distance and the inverse of the wavelength used. In other words, path loss increases when the distance increases, but it also increases when the frequency (in kHz,

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MHz or GHz) goes up.

Without bothering with all the mathematics (deriving the formula is left as an exercise to the reader -HI) the path loss may be calculated as follows - Free Space Path Loss (dB) = $32,44 + 20 \cdot \log(F(\text{MHz})) + 20 \cdot \log(D(\text{km}))$

An example of path loss

Let's take another look at the above example, in which we try to work a 70 cm repeater with a handheld at 100 mW. Standing next to the repeater, we could (of course) work it without problems. Now let's see what happens when we are 10 km away. The path loss over that distance at 435 MHz is $32,44 + 20 \cdot \log(435) + 20 \cdot \log(10) = 105,2$ dB

If we add the path loss to our link budget calculation above, we end up with the following:

1. Transmitter power: 100 mW = 20 dBm = 20 dBm.
2. Transmitter antenna gain: -3 dB = 17 dBm.
3. Transmitter loss = zero (no antenna cable!).
4. Path loss = -105 dB = -88 dB.
5. Receiver antenna gain = 6 dB = -82 dBm.
6. Receiver loss (cable, filter, connectors) = $3,2 + 1 + 0,3 = 4,5$ dB = -86,5 dBm.
7. Miscellaneous losses = zero (ignored).

Since the minimum power into the repeater's input for a QSO is -130 dBm, we can still work the repeater at this distance... but that is because we have a line-of-sight

path!

Non-line- of- sight path loss

Standing on a high site with the repeater at another high site and no obstructions in between, we generally will be able to work this repeater in practice with fairly low power levels, such as in the above example. However, in practice we have the environment to deal with: buildings, trees, hills and what not. The absorption of a few healthy, well-watered trees at 70 cm is easily 6 dB or more. Then there's also the absorption of the atmosphere and the humidity therein. Even more important: without a line-of-sight path we are reduced to reflection and/or refraction.

All this means that the "miscellaneous loss" factor in our link budget is no longer zero, but quickly jumps up to well over 45 dB, and we can no longer work this repeater from the ground at 100 mW. We need to increase the transmitter power, use a better antenna, and/or move to a higher location where we will have a path to the repeater that is closer to line-of-sight in order to make a QSO.

On HF the situation becomes much more complicated. The reflection of the ionosphere is susceptible to significant short-term fluctuations, which causes the received signal to fluctuate in both amplitude and polarization; a phenomenon known as 'fading' or QSB. The radiation patterns of the antennas used are also much more complex. While on VHF

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and higher we could consider the radiated signal to resemble a cone-shaped segment of the isotropic sphere (especially when using a Yagi boom or a dish), on HF we no longer have that luxury. Even a chunky monoband HF dipole on top of a high tower will show a radiation pattern that is sufficiently deformed by the earth's surface, reflective surfaces such as buildings and hillsides, and other "real world" factors, and we will have to substitute expectation for calculation, and experimentation for prediction. Calculating accurate link budgets for non-line-of-sight communication is always difficult and often impossible, since a multitude of environmental and highly variable factors cannot be determined accurately.

Satellites and moon bouncing

In another practical example of line-of-sight communications, we try to receive the OSCAR-51 satellite ("Echo") using a hand-held radio and a hand-held antenna with a gain of 10 dB. Let us start with the satellite's FM transponder mode down link. Echo will produce a minimum power of 1 Watt (+30 dBm) on 70 cm. The transmit antenna system has a net gain of 2 dB (i.e. cable losses etc. have already been subtracted). The path loss at maximum range (3 000 km) is 155 dB. We should allow an extra 3 dB loss for polarisation mismatch and another 1 dB from travelling through the ionosphere.

To be continued

Radio, Museums and Scouting

Dave Gemmell, ZS6AAW

with the Old Timers and the Broomstick Warriors



Hangar 3 - Progress at SAAF Museum

Planning is going "full steam" ahead with the planning of a new display operational area in Hangar 3. Affectionately known as the "Wireless Hut" because this "shell" actually looks like a garden shed or hut!! We have decided to renovate or patch up this hut and bring it back to some semblance of its former glory. In the hey day of Swartkop I think this hut was an office or store room.

Richard, ZS6TF, did the planning

whilst Wally, ZS6BCI, the erstwhile Chairman of the Friends of the Museum is arranging for a contractor to do the job. The recent rains emphasised the fact that there was a bit of a leak in the roof of the hangar just above one corner of the planned display. This leak has been plugged by Nic, one of the hard working friends of the Museum.

The first work party was held on 18 July (also World Jet Masters.) By the end of the morning of Saturday 25 July the walls of the Wireless Hut

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had been washed and work on repairing the woodwork at the bottom of the front wall had been started.

CW!!!! Again!!!!

I have always said "Remember petrol is 'classified' as a fossil fuel but it's still used in the 'modern' motor car!"

This also applies to CW/ likewise morse code! I do not mean that most Hams are 'old fossils' either, but a lot of us are "pushing it a bit"

The SA Antique Wireless Association

Thanks to joining in with these "antique lads" has actually boosted my interest in museums. Apart from the Saturday morning, 08:30 Net on 7 070 kHz and 3 615 kHz, there are other nets during the week.

Regarding 80 metre AM, Andy, ZS6ADY, reports "We have found that 80 m seems to fade out at around 18:30 to 19:00 in the evening, but then comes back strongly around 20:00 with S9 signals and almost full."

Listen out for Andy, ZS6ADY, and the AM Gang on Wednesday and Friday evenings. Then again on Saturdays at 06:00 but keep listening as sometimes the 80 m band may only come in around 06:45 – 07:00 depending on your QTH.

Jamboree-on-the-Air 17 & 18 October 2009

For the most up to date information on the 2009 JOTA, visit <http://jota.sub.cc>.

Also have a look at the Scout Radio Nets. Some of them run on a weekly basis!

Other "youthful" ham activities

Occasionally there seems to be a "flurry" of activity amongst a lot of radio amateurs for outdoor events. Many of very suited to the Youth. Amongst other there are certain field days, Summits-on-the-Air (SOTA), CW afternoons, BACAR launches, 40 metre Sprints, SSB contests, CW contests, High School Science Day/Week

I believe BACAR has one limitation (apart from the financing angle!) that it is better to launch the balloon in late autumn and winter when the layers of air are more stable. JOTA in October, whilst not in the height of summer, the air is not as stable. Judging from the weather we had in June I think October could be interesting.

I do not see any objections for any SARL members to arranging one or two of the above mentioned activities.

The main point is - "If this can be done during the year, why can it not be done during the JOTA/CQ Hou Koers weekend as well?" For that matter, why not on Youth Day as well? What better advert for your Club or Amateur Radio than have a JOTA station contact you and ask you what you are doing?

A big point to remember is that

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JOTA, being international, the dates cannot be changed very easily. And another thing, CQ Hou Koers will also be on the go on Friday 17 and Saturday 18 October. This means more young ears and minds on the Air!

"Rules/instructions"

- have fun
- first listen, do not interrupt/break-in just to gain a contact and/or QSL card.
- be prepared to spend a little time explaining and describing your station set-up and demonstrating your favourite modes used.
- please send morse slowly but accurately.
- use correct international phonetic alphabet.
- use the correct voice procedure.

Remember the "ball is in your

court." Any one can organise the arrangements without any undue or extra work for any Council member.

Now the idea is to have extra stations on the air with whom the young people can chat. Just as long as the contestants do not say, "Sorry, I can not talk to you, I am working a contest."

If you think this column contains too much of Dave's Wit and Wisdom feel free to send some of your own. Every contribution to this and the other column well be gratefully accepted.

Both of the following addresses can be used to send me suitable information for the Radio Scouting and Museum columns, PO Box 77, Irene, 0062, tel 012 667 2153 and e-mail dave@zs6mus.org.za and davegem-mell@bmknet.co.za.

Silent Keys Stil Sleutels

They shall grow not old as we that are left grow old
Age shall not weary them nor the years condemn
At the going down of the sun and in the morning
We will remember them."

Hulle word nie oud soos ons wat bly vergrys,
Die jare sal hulle nie raak nog die tyd se eis
En, soos die son sak of die more ontvou,
Eer hul herinnering – ons sal onthou."

Hubertus Paquay, ZS6EO
Kobus Geldenhuys, ZR6ABG
Cornelis Genis, ZS6CBG
Hans Jurgens Brits, ZS6HJB

EZ10-GPS-ZS

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- + Mitsubishi RA08H1317M RF power module
- + APRSTracker OpenSource firmware on PIC
- + Frequency : 144.800 MHz, RF Power : 8W (variable)
- + Connectors : SMA-F (TX), MCX-F (GPS)
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