

Introduction

Sonardyne Wideband® is a new generation of acoustic positioning technology utilising digital signal processing to provide a more robust and reliable acoustic ranging and telemetry solution than systems using tone signals. The technology offers hundreds of operating channels, greater immunity to noise interference, centrimetric ranging accuracy and faster, more efficient USBL and LBL operations.

This pocket guide is intended to assist users of Sonardyne acoustic positioning systems when planning or undertaking USBL and LBL subsea operations in the presence of both Wideband and previous generation tone-burst systems.

Why Undertake Frequency Planning?

Wideband signals are short transmissions of a modulated carrier frequency allowing multiple signals to be encoded over a single frequency. The frequency band used for Wideband signals is the same Medium Frequency (MF) band used for tone based USBL and LBL equipment.

Modern digital transceivers can detect the difference between tone and Wideband signals allowing both signals to be used in conjunction in simultaneous operations. Analogue transceivers do not know the difference between Wideband and tone which means that they can falsely detect Wideband signals as though they are tone signals. In a USBL operation, for example, this false detection could cause a sudden jump in position.

When to Undertake Frequency Planning

Wideband signals do not interfere with each other. Therefore, if only Wideband systems are in use in the area, then apart from ensuring there are no duplicated transponder address codes or interrogation frequencies in use, there is no need to conduct Wideband frequency planning.

Digital transceivers such as Sonardyne's Type 8021/8023 USBL transceivers, Inverted USBL and RovNav 5 LBL transceivers and also Kongsberg's HiPAP® can detect the difference between Wideband and tone signals which also negates the requirement to conduct Wideband frequency planning.

Digital systems operating in tone-only mode (i.e. with previous generation transponders) still require traditional tone based planning as the tone signals can still interfere with each other.

If Wideband signals are to be used in the vicinity of the legacy Sonardyne transceivers shown on the planning chart, then Wideband frequency planning should be conducted.

How to Undertake Frequency Planning

As highlighted, the use of Wideband signals negates the requirement to conduct traditional frequency planning unless you are operating tone Sonardyne transceivers or will be conducting simultaneous operations in an area where another vessel is operating tone equipment. Consider the scenario in Figure 1.

A survey vessel using a Sonardyne Wideband® USBL system has entered the field close to a DP drilling rig operating an analogue tone Sonardyne LUSBL system. Using the Wideband Address Lookup Table (opposite), it is possible to look up the bandwidth being used by the transmitted Wideband signals and then plot them on the chart overleaf. If the survey vessel then deploys its own Wideband LBL transponder array, further frequency management planning would have to be undertaken.

Highlighting the frequency bands on the Frequency Management Chart (overleaf), Figure 2 shows the frequency band of the Wideband signals in red and the tone signals in blue.

It is apparent that the Wideband reply for both transponders 0112(xx12) and 0106(xx06) overlap the tone channels. The legacy transceiver may now detect these Wideband signals as an expected tone reply. Therefore, something needs to be changed.

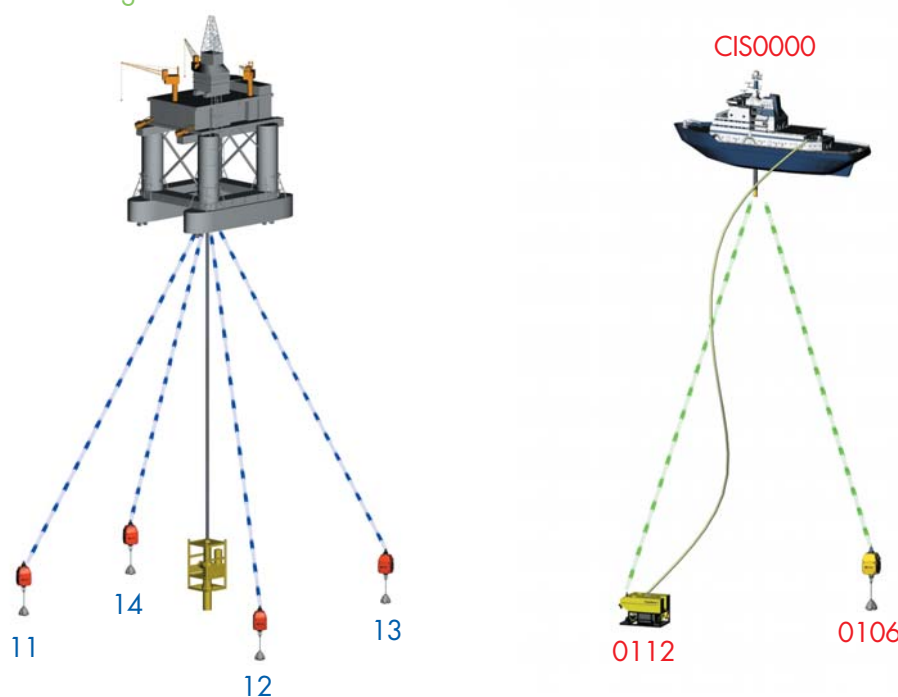
Looking back at the plan in Figure 2, and comparing it with the Sonardyne tone line on the chart overleaf, it is clear that the tone signals 1 to 8 are clear from any Wideband signals. Thus by changing the DP drilling rig to use these channels, it will prevent any false validations.

It may be the case that the drilling rig's tone transponders cannot be easily changed because they are deployed and in continuous use. The only option then is to change the Wideband signals being used by the survey vessel. If the two Wideband transponders were changed to reply in frequency bandwidth xx14 (i.e. 0114, 0214, 0314, etc), the Wideband bandwidth in use would be greatly reduced. This is shown in Figure 3. With the new signals in use, there will be nothing to cause any false signal validation.

Figure 1 – A Potential Simultaneous Operation Clash

Key: ■ Tone LUSBL ■ Wideband USBL Signals

Drilling rig operating an analogue tone LUSBL system as a DP reference with a survey vessel operating a Wideband USBL system for DP and ROV tracking



Wideband Address Look-up Table

Interrogation Carriers	Interrogation Signals														Reply Carriers														
	xx01	xx02	xx03	xx04	xx05	xx06	xx07	xx08	xx09	xx10	xx11	xx12	xx13	xx14	CIS 0000	xx14	xx13	xx12	xx11	xx10	xx09	xx08	xx07	xx06	xx05	xx04	xx03	xx02	xx01
Individual Interrogation Signals	CIS 1	CIS 2	CIS 3	CIS 4	CIS 5	CIS 6	CIS 7	CIS 8	CIS 9	CIS 10	CIS 11	CIS 12	CIS 13	CIS 14	CIS 0														
	0101 (3301)	0102 (3302)	0103 (3303)	0104 (3304)	0105 (3305)	0106 (3306)	0107 (3307)	0108 (3308)	0109 (3309)	0110 (3310)	0111 (3311)	0112 (3312)	0113 (3313)	0114 (3314)	CRS 1	0114 (3315)	0113 (3316)	0112 (3317)	0111 (3318)	0110 (3319)	0109 (3309)	0108 (3308)	0107 (3307)	0106 (3306)	0105 (3305)	0104 (3304)	0103 (3303)	0102 (3302)	0101 (3301)
	0201 (3401)	0202 (3402)	0203 (3403)	0204 (3404)	0205 (3405)	0206 (3406)	0207 (3407)	0208 (3408)	0209 (3409)	0210 (3410)	0211 (3411)	0212 (3412)	0213 (3413)	0214 (3414)	CRS 2	0214 (3415)	0213 (3416)	0212 (3417)	0211 (3418)	0210 (3419)	0209 (3409)	0208 (3408)	0207 (3407)	0206 (3406)	0205 (3405)	0204 (3404)	0203 (3403)	0202 (3402)	0201 (3401)
	0301 (3501)	0302 (3502)	0303 (3503)	0304 (3504)	0305 (3505)	0306 (3506)	0307 (3507)	0308 (3508)	0309 (3509)	0310 (3510)	0311 (3511)	0312 (3512)	0313 (3513)	0314 (3514)	CRS 3	0314 (3515)	0313 (3516)	0312 (3517)	0311 (3518)	0310 (3519)	0309 (3509)	0308 (3508)	0307 (3507)	0306 (3506)	0305 (3505)	0304 (3504)	0303 (3503)	0302 (3502)	0301 (3501)
	0401 (3601)	0402 (3602)	0403 (3603)	0404 (3604)	0405 (3605)	0406 (3606)	0407 (3607)	0408 (3608)	0409 (3609)	0410 (3610)	0411 (3611)	0412 (3612)	0413 (3613)	0414 (3614)	CRS 4	0414 (3615)	0413 (3616)	0412 (3617)	0411 (3618)	0410 (3609)	0409 (3608)	0408 (3607)	0407 (3606)	0406 (3605)	0405 (3604)	0404 (3603)	0403 (3602)	0402 (3601)	0401 (3600)
	0501 (3701)	0502 (3702)	0503 (3703)	0504 (3704)	0505 (3705)	0506 (3706)	0507 (3707)	0508 (3708)	0509 (3709)	0510 (3710)	0511 (3711)	0512 (3712)	0513 (3713)	0514 (3714)	CRS 5	0514 (3715)	0513 (3716)	0512 (3717)	0511 (3718)	0510 (3709)	0509 (3708)	0508 (3707)	0507 (3706)	0506 (3705)	0505 (3704)	0504 (3703)	0503 (3702)	0502 (3701)	0501 (3700)
	0601 (3801)	0602 (3802)	0603 (3803)	0604 (3804)	0605 (3805)	0606 (3806)	0607 (3807)	0608 (3808)	0609 (3809)	0610 (3810)	0611 (3811)	0612 (3812)	0613 (3813)	0614 (3814)	CRS 6	0614 (3815)	0613 (3816)	0612 (3817)	0611 (3818)	0610 (3819)	0609 (3809)	0608 (3808)	0607 (3807)	0606 (3806)	0605 (3805)	0604 (3804)	0603 (3803)	0602 (3802)	0601 (3801)
	0701 (3901)	0702 (3902)	0703 (3903)	0704 (3904)	0705 (3905)	0706 (3906)	0707 (3907)	0708 (3908)	0709 (3909)	0710 (3910)	0711 (3911)	0712 (3912)	0713 (3913)	0714 (3914)	CRS 7	0714 (3915)	0713 (3916)	0712 (3917)	0711 (3918)	0710 (3909)	0709 (3908)	0708 (3907)	0707 (3906)	0706 (3905)	0705 (3904)	0704 (3903)	0703 (3902)	0702 (3901)	0701 (3900)
	0801 (4001)	0802 (4002)	0803 (4003)	0804 (4004)	0805 (4005)	0806 (4006)	0807 (4007)	0808 (4008)	0809 (4009)	0810 (4010)	0811 (4011)	0812 (4012)	0813 (4013)	0814 (4014)	CRS 8	0814 (4015)	0813 (4016)	0812 (4017)	0811 (4018)	0810 (4019)	0809 (4009)	0808 (4008)	0807 (4007)	0806 (4006)	0805 (4005)	0804 (4004)	0803 (4003)	0802 (4002)	0801 (4001)
	0901 (4101)	0902 (4102)	0903 (4103)	0904 (4104)	0905 (4105)	0906 (4106)	0907 (4107)	0908 (4108)	0909 (4109)	0910 (4110)	0911 (4111)	0912 (4112)	0913 (4113)	0914 (4114)	CRS 9	0914 (4115)	0913 (4116)	0912 (4117)	0911 (4118)	0910 (4109)	0909 (4108)	0908 (4107)	0907 (4106)	0906 (4105)	0905 (4104)	0904 (4103)	0903 (4102)	0902 (4101)	0901 (4100)
	1001 (4201)	1002 (4202)	1003 (4203)	1004 (4204)	1005 (4205)	1006 (4206)	1007 (4207)	1008 (4208)	1009 (4209)	1010 (4210)	1011 (4211)	1012 (4212)	1013 (4213)	1014 (4214)	CRS 10	1014 (4215)	1013 (4216)	1012 (4217)	1011 (4218)	1010 (4219)	1009 (4209)	1008 (4208)	1007 (4207)	1006 (4206)	1005 (4205)	1004 (4204)	1003 (4203)	1002 (4202)	1001 (4201)
	1101 (4301)	1102 (4302)	1103 (4303)	1104 (4304)	1105 (4305)	1106 (4306)	1107 (4307)	1108 (4308)	1109 (4309)	1110 (4310)	1111 (4311)	1112 (4312)	1113 (4313)	1114 (4314)	CRS 11	1114 (4315)	1113 (4316)	1112 (4317)	1111 (4318)	1110 (4309)	1109 (4308)	1108 (4307)	1107 (4306)	1106 (4305)	1105 (4304)	1104 (4303)	1103 (4302)	1102 (4301)	1101 (4300)
	1201 (4401)	1202 (4402)	1203 (4403)	1204 (4404)	1205 (4405)	1206 (4406)	1207 (4407)	1208 (4408)	1209 (4409)	1210 (4410)	1211 (4411)	1212 (4412)	1213 (4413)	1214 (4414)	CRS 12	1214 (4415)	1213 (4416)	1212 (4417)	1211 (4418)	1210 (4409)	1209 (4408)	1208 (4407)	1207 (4406)	1206 (4405)	1205 (4404)	1204 (4403)	1203 (4402)	1202 (4401)	1201 (4400)
	1301 (4501)	1302 (4502)	1303 (4503)	1304 (4504)	1305 (4505)	1306 (4506)	1307 (4507)	1308 (4508)	1309 (4509)	1310 (4510)	1311 (4511)	1312 (4512)	1313 (4513)	1314 (4514)	CRS 13	1314 (4515)	1313 (4516)	1312 (4517)	1311 (4518)	1310 (4509)	1309 (4508)	1308 (4507)	1307 (4506)	1306 (4505)	1305 (4504)	1304 (4503)	1303 (4502)	1302 (4501)	1301 (4500)
	1401 (4601)	1402 (4602)	1403 (4603)	1404 (4604)	1405 (4605)	1406 (4606)	1407 (4607)	1408 (4608)	1409 (4609)	1410 (4610)	1411 (4611)	1412 (4612)	1413 (4613)	1414 (4614)	CRS 14	1414 (4615)	1413 (4616)	1412 (4617)	1411 (4618)	1410 (4609)	1409 (4608)	1408 (4607)	1407 (4606)	1406 (4605)	1405 (4604)	1404 (4603)	1403 (4602)	1402 (4601)	1401 (4600)
1501 (4701)	1502 (4702)	1503 (4703)	1504 (4704)	1505 (4705)	1506 (4706)	1507 (4707)	1508 (4708)	1509 (4709)	1510 (4710)	1511 (4711)	1512 (4712)	1513 (4713)	1514 (4714)	CRS 15	1514 (4715)	1513 (4716)	1512 (4717)	1511 (4718)	1510 (4709)	1509 (4708)	1508 (4707)	1507 (4706)	1506 (4705)	1505 (4704)	1504 (4703)	1503 (4702)	1502 (4701)	1501 (4700)	
Key																													
0101 (3301)															Compatt (DPT/WSM)														

Figure 2 – Frequency Plan Plot Before Optimisation

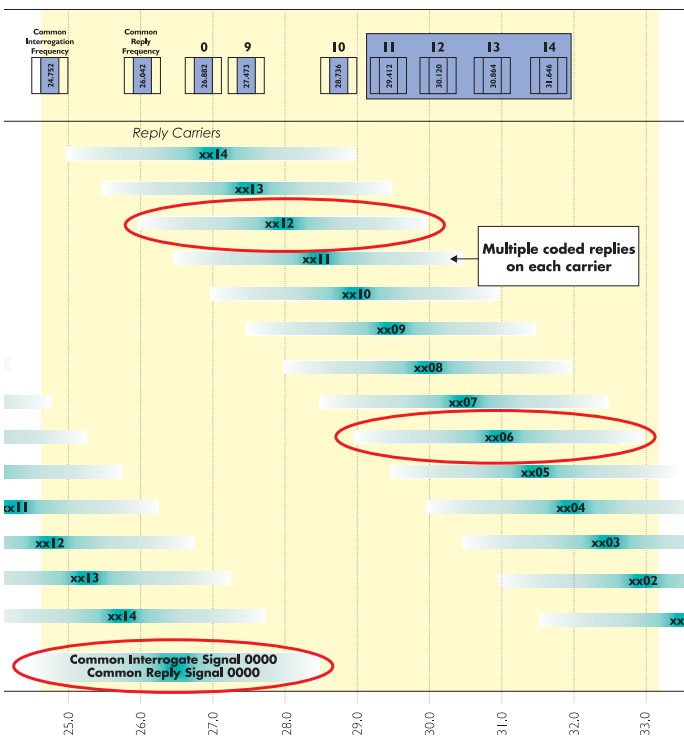
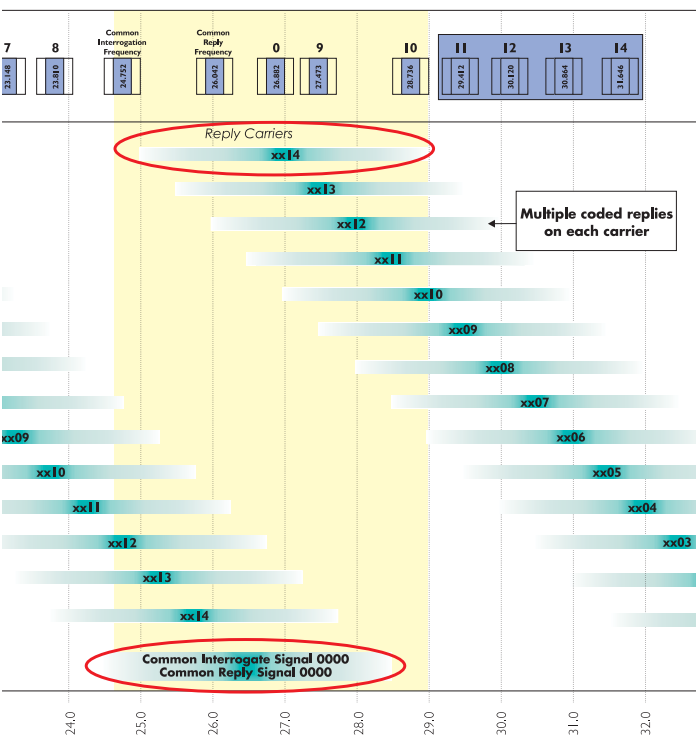


Figure 3 – Frequency Plan Plot After Optimisation



Frequency Management For Medium Frequency Positioning Systems

