Digital Exchange of Harmonic Constants

Christopher Jones

United Kingdom Hydrographic Office

Background

- Harmonic Constant (HC) data is passed freely between Foreign Government Hydrographic Offices (FGHO's) on request.....BUT.....
- ....it is frequently in a variety of differing digital formats and layouts

Some Examples....

Brazil

```
| 35341.0300000607198430091984301 14TERMINAL ALUMAR                          02407S044218W+030
0MSF     001.0158958                      1    -1  00011.7200030.38
1O1      013.9430356                          -1  00010.9000216.96
1P1      014.9589314                          -1  00004.0600252.36
1K1      015.0410686                          -1  00012.2600255.23
12N2     027.8953549                          -1  00005.5100180.37
1MU2     027.9682084                          -1  00010.8500271.59
1N2      028.4397295                          -1  00041.7700193.75
1NU2     028.5125831                          -1  00007.9400195.54
1M2      028.9841042                          -1  00218.7200207.12
1LAMBD2  029.4556253                          -1  00001.5300225.07
1L2      029.5284789                          -1  00016.4500176.92
1T2      029.9589333                          -1  00003.5300244.26
1S2      030.0000000                          -1  00059.7600245.81
1K2      030.0821373                          -1  00016.2500248.94
0MO3     042.9271398   1                  1      00002.3600314.60
1M3      043.4761563                          -1  00002.3500307.75
0MK3     044.0251728          1             1      00004.2600016.26
0MN4     057.4238337              1         1      00003.2800225.12
0M4      057.9682084                        2      00009.1900239.81
0MS4     058.9841042                        1    1 00006.1400277.20
0SL4     059.5284789                          1   1 00001.0100234.37
0MNO5    071.3668693   1        1           1      00000.5500317.31
02MO5    071.9112440   1                    2      00000.8800358.08
0MSK5    074.0251728          1             1    1 00000.6200216.63
03MNS6   085.3920422              1         3   -1 00000.8400007.40
02MN6    086.4079380              1         2      00002.5900290.85
0M6      086.9523127                        3      00005.0200311.64
0MSN6    087.4238337              1         1    1 00001.1900350.90
02MS6    087.9682084                        2    1 00004.3900341.33
0MKL6    088.5967204                        1 1   100000.8500241.09
02SM6    088.9841042                        1    2 00001.2400053.40
02SMK7   104.0251728          1             1    2 00000.7500088.61
0M8      115.9364169                        4      00000.5500320.94
03MS8    116.9523127                        3    1 00000.7300000.77
02M2S8   117.9682084                        2    2 00000.5400041.01
```

United Kingdom Hydrographic Office

Spain

	15	arrecife		GMT 2857 1334		
1	ZO	.00000000	15	197/1297	1.5540	0.00
2	SSA	.00022816	15	197/1297	0.0168	85.28
3	MSM	.00130978	15	197/1297	0.0116	309.35
4	MM	.00151215	15	197/1297	0.0020	328.92
5	MSF	.00282193	15	197/1297	0.0109	122.04
6	MF	.00305009	15	197/1297	0.0129	5.27
7	ALP1	.03439657	15	197/1297	0.0016	188.98
8	2Q1	.03570635	15	197/1297	0.0046	200.94
9	SIG1	.03590872	15	197/1297	0.0034	219.80
10	Q1	.03721850	15	197/1297	0.0184	244.70
11	RHO1	.03742087	15	197/1297	0.0023	250.49
12	O1	.03873065	15	197/1297	0.0509	296.64
13	TAU1	.03895881	15	197/1297	0.0015	33.86
14	BET1	.04004044	15	197/1297	0.0010	61.34
15	NO1	.04026860	15	197/1297	0.0068	33.51
16	CHI1	.04047097	15	197/1297	0.0013	112.74
17	P1	.04155259	15	197/1297	0.0211	27.00
18	K1	.04178075	15	197/1297	0.0696	44.23
19	PHI1	.04200891	15	197/1297	0.0009	60.76
20	THE1	.04309053	15	197/1297	0.0012	96.23
21	J1	.04329290	15	197/1297	0.0012	78.84
22	SO1	.04460268	15	197/1297	0.0012	117.27
23	OO1	.04483084	15	197/1297	0.0027	125.05
24	UPS1	.04634299	15	197/1297	0.0004	73.13
25	OQ2	.07597495	15	197/1297	0.0054	347.65
26	EPS2	.07617731	15	197/1297	0.0076	335.88
27	2N2	.07748710	15	197/1297	0.0262	8.79
28	MU2	.07768947	15	197/1297	0.0333	356.02
29	N2	.07899925	15	197/1297	0.1739	21.11
30	NU2	.07920162	15	197/1297	0.0324	25.54
31	M2	.08051140	15	197/1297	0.8337	36.00
32	MKS2	.08073956	15	197/1297	0.0127	68.62

Netherlands

Bath
(N 51 24 E 4 13)
Harmonic constituents computed from hourly levels 1997...2000
(SA and SM from hourly levels 1976...1994)
Mean level = 2.79 meter above chart datum
Resp. name, phase angle (g) in degree (time zone : MET = UT + 1 hour),
amplitude (H) in meter, speed in degrees per hour, and Extended Doodson Number

SA	219.20	.06550	.041069	056555
SM	45.80	.08250	1.015896	073555
Q1	169.87	.03812	13.398661	135655
O1	214.13	.11095	13.943036	145555
M1C	148.71	.00810	14.492052	155555
P1	18.74	.03790	14.958931	163555
S1	8.47	.01076	15.000000	164555
K1	32.92	.07017	15.041069	165555
3MKS2	305.83	.02433	26.870174	217555
3MS2	304.03	.04844	26.952312	219555
OQ2	354.34	.01561	27.341696	225655
MNS2	170.12	.04209	27.423834	227655
2ML2S2	339.94	.03023	27.496687	229455
NLK2	21.11	.05082	27.886070	235555
MU2	187.27	.20563	27.968208	237555
N2	68.82	.34417	28.439730	245655
NU2	54.72	.12188	28.512583	247455
MSK2	263.17	.02979	28.901966	253555
MPS2	152.04	.03604	28.943035	254555
M2	92.03	2.10941	28.984104	255555
MSP2	146.56	.00771	29.025173	256555
MKS2	260.15	.01820	29.066240	257555
LABDA2	104.14	.06988	29.455626	263655
2MN2	286.76	.18402	29.528479	265455
T2	138.40	.03415	29.958933	272556
S2	155.65	.54475	30.000000	273555
K2	156.43	.15648	30.082136	275555
MSN2	.10	.03611	30.544374	283455
2SM2	22.23	.04873	31.015896	291555
SKM2	34.47	.02409	31.098034	293555
NO3	185.98	.01874	42.382767	335655
2MK3	224.94	.04165	42.927139	345555
2MP3	242.64	.00679	43.009277	347555
SO3	311.44	.02151	43.943035	363555
MK3	30.67	.03419	44.025173	365555
SK3	91.24	.01331	45.041069	383555

United Kingdom Hydrographic Office

Germany

506 Cuxhaven Steubenhoef 15 53 52N 008 43E

1	Z0	.00000000	506	1	1/12	1	1184.0000	.00	515.3334	.00
2	SSA	.00022816	506	1	1/12	1	4.6340	93.79	4.6340	252.59
3	MSM	.00130978	506	1	1/12	1	3.1439	311.62	3.1439	129.43
4	MM	.00151215	506	1	1/12	1	10.7527	243.08	10.7527	148.50
5	MSF	.00282193	506	1	1/12	1	.8476	89.67	.8476	172.91
6	MF	.00305009	506	1	1/12	1	5.7937	344.11	5.7937	226.15
7	ALP1	.03439657	506	1	1/12	1	.3806	140.38	.3859	70.02
8	2Q1	.03570635	506	1	1/12	1	.4287	162.65	.4518	270.38
9	SIG1	.03590872	506	1	1/12	1	.9406	34.37	.9471	227.67
10	Q1	.03721850	506	1	1/12	1	2.3069	210.85	2.3621	222.75
11	RHO1	.03742087	506	1	1/12	1	1.1721	220.42	1.1367	316.36
12	O1	.03873065	506	1	1/12	1	9.5686	264.02	9.5837	180.29
13	TAU1	.03895881	506	1	1/12	1	.6317	217.04	.6707	108.91
14	BET1	.04004043	506	1	1/12	1	1.0199	254.58	1.0219	166.76
15	NO1	.04026859	506	1	1/12	1	1.1642	274.65	1.1208	339.00
16	CHI1	.04047097	506	1	1/12	1	.4777	330.59	.4827	156.24
17	P1	.04155259	506	1	1/12	1	3.1869	55.59	3.1881	66.76
18	K1	.04178075	506	1	1/12	1	7.0270	56.86	7.0419	55.13
19	PHI1	.04200891	506	1	1/12	1	.8369	162.94	.8647	307.35
20	THE1	.04309053	506	1	1/12	1	.5503	239.48	.5328	59.31
21	J1	.04329290	506	1	1/12	1	.3004	212.75	.3245	116.85
22	SO1	.04460268	506	1	1/12	1	.3930	260.35	.3936	343.96
23	OO1	.04483084	506	1	1/12	1	.4093	130.14	.4031	28.56
24	UPS1	.04634299	506	1	1/12	1	.4783	255.08	.4870	64.27
25	OQ2	.07597494	506	1	1/12	1	1.7487	326.48	2.0141	177.79
26	EPS2	.07617731	506	1	1/12	1	3.1475	46.92	3.3648	340.13
27	2N2	.07748710	506	1	1/12	1	4.5215	354.13	5.0346	106.78
28	MU2	.07768947	506	1	1/12	1	13.5897	101.04	13.8726	297.51
29	N2	.07899925	506	1	1/12	1	22.0550	341.58	22.1392	354.79
30	NU2	.07920162	506	1	1/12	1	8.0515	325.00	8.1679	65.81
31	M2	.08051140	506	1	1/12	1	136.7370	10.92	137.4238	289.74
32	MKS2	.08073957	506	1	1/12	1	1.8893	133.49	1.8652	228.88
33	LDA2	.08182118	506	1	1/12	1	5.4992	26.27	5.5305	303.38
34	L2	.08202355	506	1	1/12	1	11.5236	36.96	12.1924	27.60
35	S2	.08333334	506	1	1/12	1	34.6370	80.17	34.6344	80.04
36	K2	.08356149	506	1	1/12	1	10.5368	83.92	10.3515	260.37
37	MSN2	.08484548	506	1	1/12	1	2.6139	268.63	2.6369	174.11
38	ETA2	.08507364	506	1	1/12	1	.0862	351.21	.0974	75.50
39	MO3	.11924210	506	1	1/12	1	1.4782	189.39	1.4879	24.48
40	M3	.12076710	506	1	1/12	1	.4448	250.61	.4481	308.95
41	SO3	.12206400	506	1	1/12	1	.8740	287.35	.8753	203.49
42	MK3	.12229210	506	1	1/12	1	.9571	316.81	.9640	233.89

United Kingdom Hydrographic Office

France

Calais

temps en usage: UT +1.0 h
L=50 58N G= 1 51E

longues periodes

onde	nb argument	vitesse (°/h)	amplitude (cm)	situation (°)
NIV MOY	055555	0.00000000	406.58	0.03
SA	056555	0.04106864	8.41	221.82
SSA	057555	0.08213728	2.33	94.68
MSM	063655	0.47152109	0.58	63.24
MM	065455	0.54437469	1.16	218.11
MSF	073555	1.01589578	1.76	186.92
MF	075555	1.09803306	0.91	351.46

diurnes

onde	nb argument	vitesse (°/h)	amplitude (cm)	situation (°)
2Q1	125755	12.85428619	0.68	111.68
SIGMA1	127555	12.92713980	0.22	253.43
Q1	135655	13.39866088	1.67	114.21
RHO1	137455	13.47151449	0.55	136.04
O1	145555	13.94303558	5.52	155.01
MS1	146555	13.98410422	1.42	61.95

Canada

```
WaterLevConstit 00065 SAINT JOHN                                          0/00/00||
!Computed     45 16.00  N  66 04.00  W                          +04    0000:00   ||
         60 0365days 100.0%                                             0000:00 06||
Stephenson,FE                                                                    ||
Reference v2.2 002                                                             0||
                                    0   0                                        ||
01 Const Name [Ref Nam]       0       TW                                         ||
02 Nominal Period hours       1       3W                                         ||
03 Amplitude      metres      2       4W                                         ||
04 Phase Lag[g]       deg     1       2W                                         ||
05 Doodson Numbers            0       TW                                         ||
06 Security                   0       TW                                         ||
Tides & Currents, IOS      Shore                                                 ||
00065const.wlev                                        fl__00065cyyddda.wlev     ||
**                                                                               ||
Constitutents from Crawford's analysis at IOS (Jan 2/97)                        ||
Z0 changed from 4.4100 to previous "Bluebook" value of 4.4200 m BdLB 9 Jan 97||
Checked against Crawford's results ok BdLB 9 Jan 1997                            ||
Doodson numbers as defined by Godin's The Analysis of Tides. pp 25-27            ||
                                                                                 ||
                                                                                 ||
                                                                                 ||
                                                                                 ||
                                                                                 ||

Z0        0.000   4.4200    0.00  0  0  0  0  0  0 46
SA     8766.231   0.0240  108.00  0  0  1  0  0 -1 21
SSA    4382.906   0.0510  114.10  0  0  2  0  0  0 5e
MM      661.309   0.0100  205.70  0  1  0 -1  0  0 29
MSF     354.367   0.0080  211.50  0  2 -2  0  0  0 54
MF      327.859   0.0090  242.60  0  2  0  0  0  0 2e
SIG1     27.848   0.0030  124.90  1 -3  2  0  0  0 53
Q1       26.868   0.0190  102.80  1 -2  0  1  0  0 50
RHO1     26.723   0.0050  105.80  1 -2  2 -1  0  0 51
```

United Kingdom Hydrographic Office

UK

IPS1 Tides – Harmonic constants

Run by jonescy at 10:59:40 on 17/05/2007

No: 0089 Name: DOVER STANDARD PORT

Time Zone: GMT Position: 51 07 N 001 19 E

Authority: HO 19 YRS 1979-2006 Units: METRES

Z0: +3.758

Shallow Water Corrections

	"H"	"g"
F4:f4	0.0464	278.7
F6:f6	0.0041	186.1

A0:

Key: S = Suspect
I = Inferred

Constituents

Name	"H"	"g"	Name	"H"	"g"	Name	"H"	"g"
Sa	0.065	211.8	2MS3	0.001	265.5	MSN6	0.014	141.7
Ssa	0.023	094.7	2MP3	0.005	141.0	4MN6	0.009	274.8
Mnum	0.005	263.4	M3	0.011	035.3	MNK6	0.001	101.4
Mm	0.007	184.7	MP3	0.003	352.4	2(MS)K6	0.002	303.2
Msf	0.015	220.1	MS3	0.003	341.6	2MT6	0.003	140.5
Mf	0.018	236.1	MK3	0.015	008.9	2MS6	0.060	150.0
Q1	0.023	121.0	2MQ3	0.003	102.2	2MK6	0.017	154.2
rho1	0.006	121.7	SP3	0.003	078.0	2SM6	0.012	217.1
O1	0.057	180.2	S3	0.001	191.3	MSK6	0.007	218.7
MS1	0.001	100.2	SK3	0.007	081.3	S6	0.002	017.7
MP1	0.003	216.7	3MK4	0.008	302.8	2MNO7	0.003	068.6
M1	0.003	192.5	3MS4	0.024	292.1	2NMK7	0.001	045.7
chi1	0.002	033.3	MSNK4	0.003	028.0	M7	0.002	141.1
pi1	0.003	054.3	MN4	0.092	197.2	2MSO7	0.003	167.2
P1	0.021	022.1	Mnu4	0.024	181.2	2(MN)8	0.006	318.2
S1	0.006	239.1	2MSK4	0.009	004.2	5MS8	0.003	095.1
K1	0.049	042.4	MA4	0.007	168.9	3MN8	0.016	343.8
psi1	0.002	315.8	M4	0.255	221.1	3Mnu8	0.005	328.2

United Kingdom Hydrographic Office

Exchange of data is important between FGHO's

- Ensures that the most up-to-date information is used in tidal / navigational products
- The less manual intervention the better – reduces the likelihood of random human error

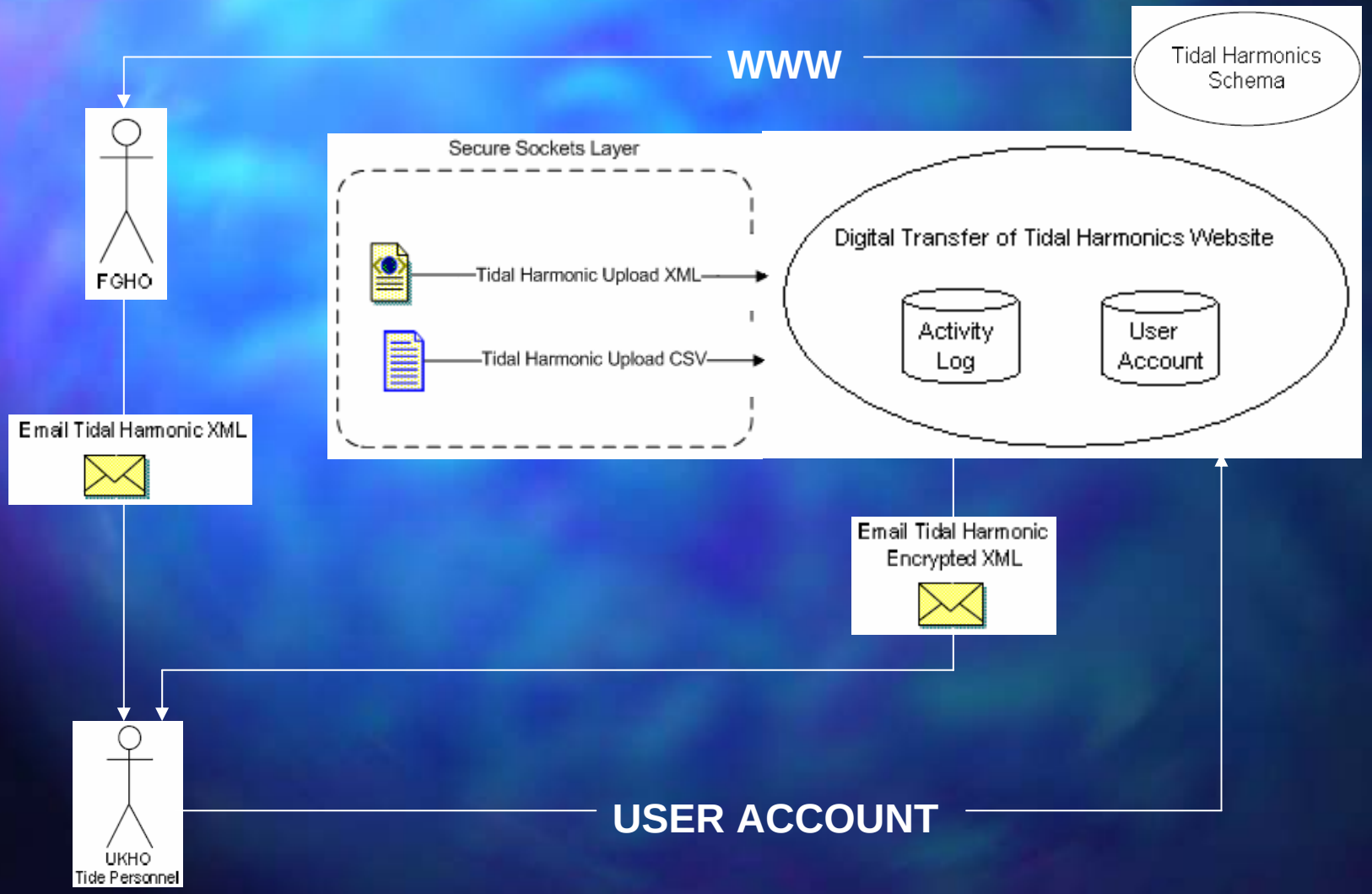
Proposal

- To develop a new way of exchanging HC's between FGHO's
- A convenient way of transferring data - like that of the International Exchange format for predictions (ASCII)
- Web application will transfer tidal harmonic constants in an XML format

The project

- IHO Tidal Committee (TC) tasked the IHO Transfer Standard Maintenance and Application Development Working Group (TSMAD) to develop a standard transfer mechanism for harmonic constants
- Draft Product Specification prepared
- Aim - to develop a web application that will output an Extensible Mark-up Language (XML) file for transfer between FGHO's

How will it work?



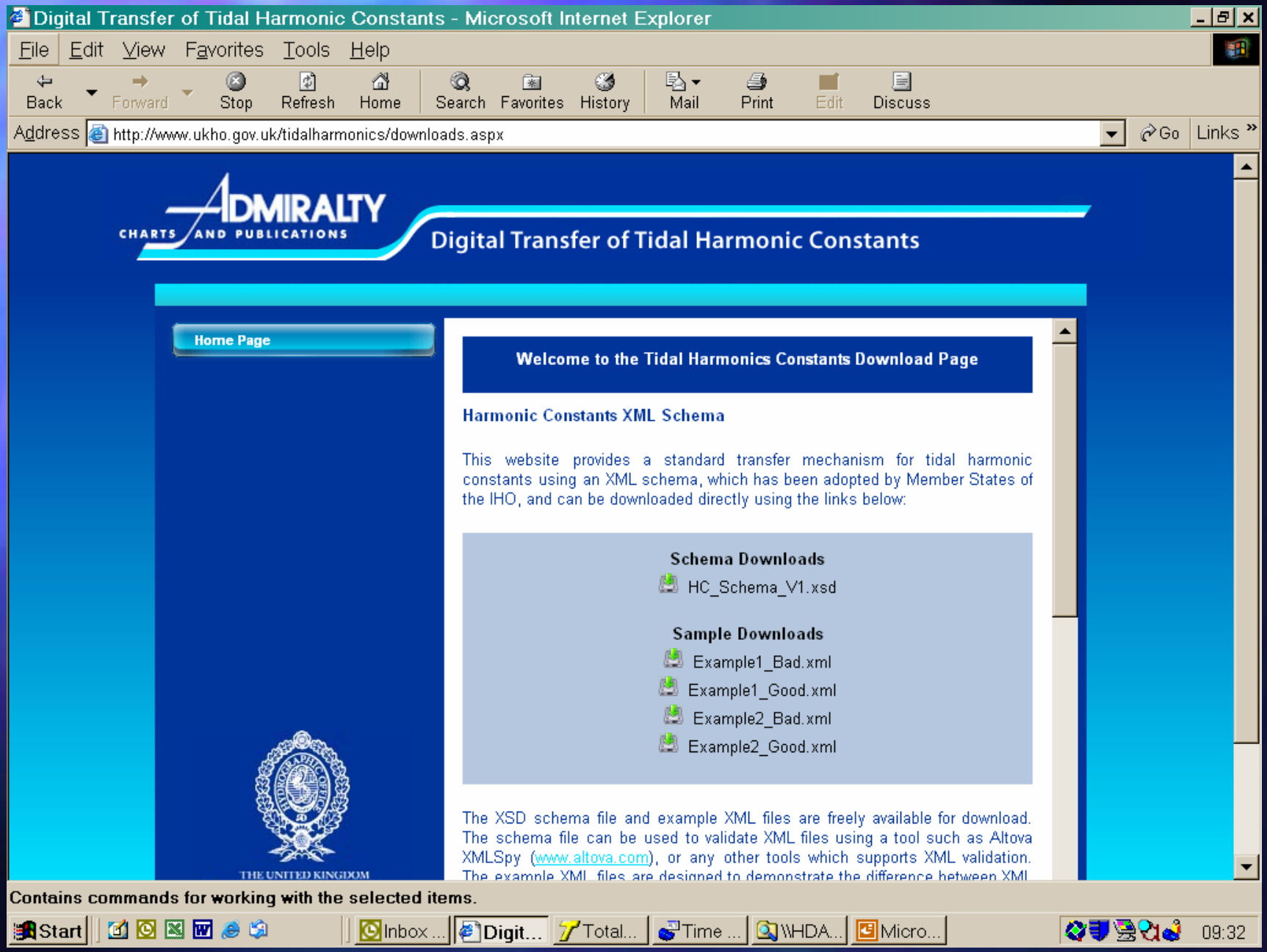
United Kingdom Hydrographic Office

Product Specification: Gives details of.....

- Header Information and Data Record
- Precision of Phase Angle (g) and Amplitude (H) relative to observation period
- Extended Doodson Number (XDO)
- Computation of the Astronomical Argument and use of the XDO
- General information on the major tidal constituents
- Reproduces the Standard List of Tidal Harmonic Constituents (as published on the IHO website)
- Application and Computation of Nodal Corrections
- Derivation of Speeds and values of Nodal Corrections from Constituent Names

Web Link

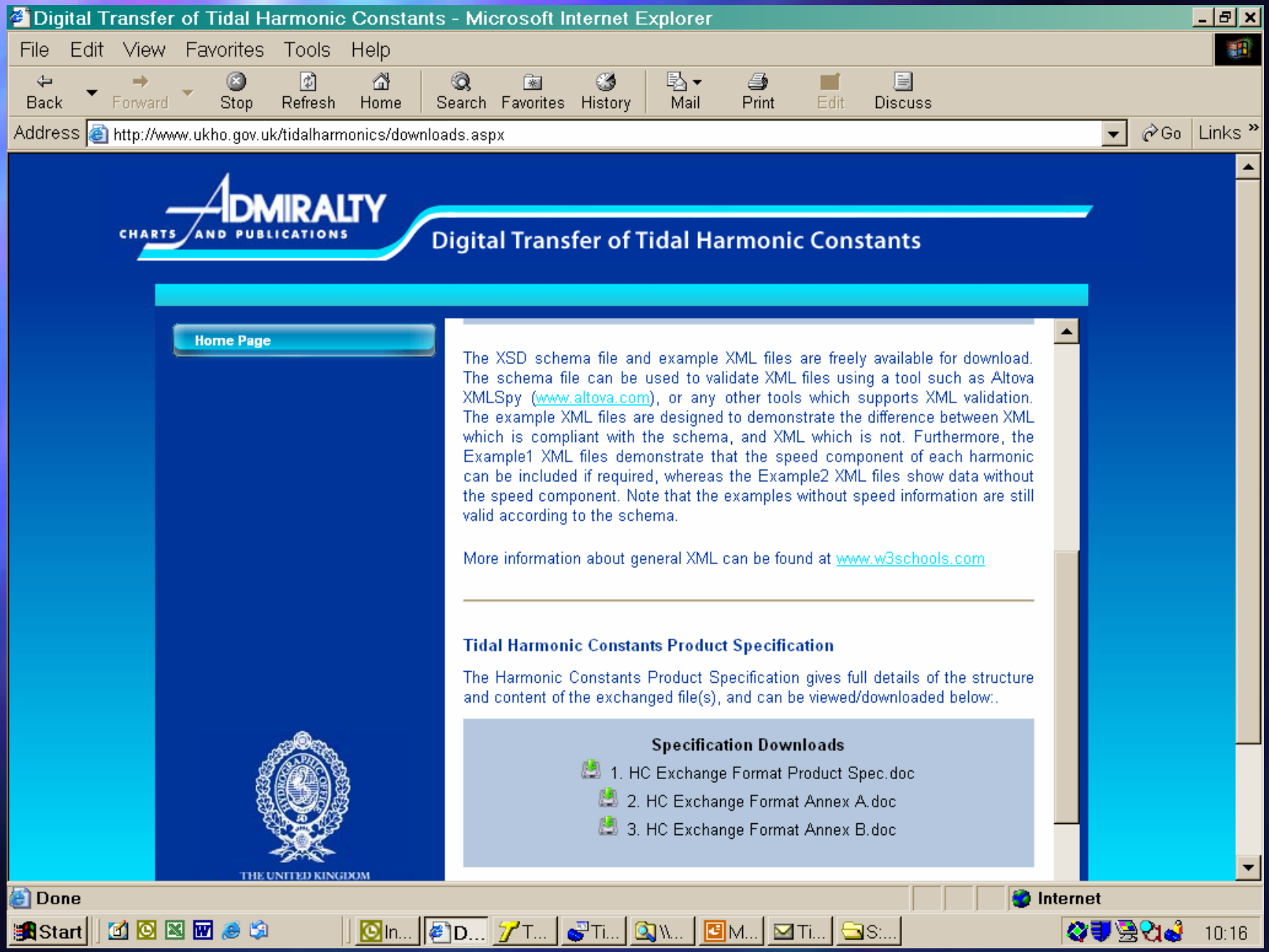
http://www.ukho.gov.uk/tidalharmonics/downloads.aspx



United Kingdom Hydrographic Office

Schema Downloads

- Schema Download “HC_Schema_V1.xsd’
- Example 1_Good.xml = Well formed, valid against the schema, and contains speeds of each harmonic constituent.
- Example 1_Bad.xml = Well formed, not valid against the schema, and contains speeds of each harmonic constituent.
- Example 2_Good.xml = Well formed, valid against the schema, does not contain speeds of each harmonic constituent.
- Example 2_Bad.xml = Well formed, not valid against the schema, does not contain speeds of each harmonic constituent.
- There are no non-well-formed files available for download, as well-formedness is a by-product of valid XML.



United Kingdom Hydrographic Office

- The XSD schema file and example XML files are freely available for download.
- The schema file can be used to validate XML files using a tool such as Altova XMLSpy (www.altova.com), or any other tools which supports XML validation.
- The example XML files are designed to demonstrate the difference between XML which is compliant with the schema, and XML which is not.
- Furthermore, the Example1 XML files demonstrate that the speed component of each harmonic can be included if required, whereas the Example2 XML files show data without the speed component. Note that the examples without speed information are still valid according to the schema.
- More information about general XML can be found at www.w3schools.com