Number Systems Conversion 1

Numbering System Conversions

Conversion between numbering systems must be performed without the use of a calculator
This is especially true when network professionals use IPv4 addresses to determine network and host addressing.

Hexadecimal to Decimal Conversion

Converting hexadecimal numbers to decimal values:
If necessary, convert digits to their decimal equivalent (eg A = 10, B=11)
Multiply the digit value by its place value
Add the results
Example 1- Ox907 converted to decimal would be:
$(9 * 16^2) + (0 * 16^1) + (7 * 16^0)$ =
*(9 * 256) + (0 * 16) + (7 * 1) =*
2304 + 0 + 7 = 2311
Example 2:
Convert 0xAB7 to decimal
$(A * 16^2) + (B * 16^1) + (7 * 16^0)$ =
*(10 * 256) + (11 * 16) + (7 * 1) =*
2560 + 176 + 7 = 2743

Binary to Decimal Conversion

Converting binary numbers to decimal values:
Example:
11001100 converts to:
$(1 * 2^7) + (1 * 2^6) + (0 * 2^5) + (0 * 2^4) + (1 * 2^3) + (1 * 2^2) + (0 * 2^1) + (0 * 2^0)$ =
(1 * 128) + (1 * 64) + (0 * 32) + (0 * 16) + (1 * 8) + (1 * 4) + (0 * 2) + (0 * 1) =
128 + 64 + 8 + 4 = 204
Hint: add the place values of the 'ON' bits

Using place value addition to convert binary numbers to decimal values:

0	1	1	1	0	1	1	0	0	1
512	256	128	64	32	16	8	4	2	1

256 + 128 + 64 + 16 + 8 + 1 = 473

Decimal to Binary Conversion

Draw a number of binary bits and their corresponding place values
Decide on the largest power of 2 that is close to but not greater than the decimal value
Turn that place value 'ON'
Subtract the place value from the decimal number
Check each successive base 2 digit to determine whether that place or bit should be 'ON' (1) or 'OFF' (0)

Example:
Convert 473 to binary

```
__  __  __  __  __  __  __  __  __  __
512 256 128 64  32  16  8   4   2   1
```

512 is too large; 256 is required so turn the place value (or bit) of 256 'ON'

```
 0   1
512 256 128 64  32  16  8   4   2   1
```

Subtract 256 from 473. 473 – 256 = 217
128 is less than 217 so set that bit to 'ON'

```
 0   1   1
512 256 128 64  32  16  8   4   2   1
```

Subtract 128 from 217. 217 – 128 = 89
64 is less than 89 so set that bit 'ON'

```
0   1   1   1
512 256 128 64  32  16  8   4   2   1
```

Subtract 64 from 89. 89 – 64 = 25
32 will not subtract from 25 so set that place value (or bit) to 0

```
 0   1   1   1   0
512 256 128 64  32  16  8   4   2   1
```

16 is less than 25 so set the 16 place value to 'ON' and subtract 16 from 25. 25 – 16 = 9

```
0   1   1   1   0   1
512 256 128 64  32  16  8   4   2   1
```

Now, 8 and 1 are required to make 9 so turn both of those bits 'ON'

```
0   1   1   1   0   1   1   0   0   1
512 256 128 64  32  16  8   4   2   1
```

Therefore, 473 in binary is 111011001

Alternate Decimal to Binary Conversion

An alternate method of converting decimal to binary is to divide the decimal number by two
Write down the answer and the remainder (which will always be 1 or 0)
Divide the quotient (answer) of the first division by two and track the same information
Continue until you end up with a final quotient of 0 or 1. This final quotient becomes the last remainder
When all the remainders are lined up in reverse order you have the binary equivalent of the decimal number

Alternate Decimal to Binary Conversion

Example
Convert 473 to binary

Formula	Quotient	Remainder
473/2	236	1
236/2	118	0
118/2	59	0
59/2	29	1
29/2	14	1
14/2	7	0
7/2	3	1
3/2	1	1
		1

473 in binary is 111011001