## Cipher Challenge 2 Solution:

As the snippet of transmission suggests, the message was encrypted by converting the letters to their ASCII (American Standard Code for Information Interchange) equivalent number. A codeword was added to the plaintext to produce the ciphertext. You can tell by the numbers that the base 10 representation of the ASCII code was used. The [CAPS ONLY] hint was meant to indicate that only capital letters were used (the caps are numbered 65-90) (see for example, http://www.ascii-code.com/ )

We don't know how long the code word is, but one might notice that the sequence of numbers 148, $154,155,172,145,152,152$ repeats several times. We guess that those indicate places where a new message was begun reusing the code word. Thus we can break the code into several messages indicated by the repeating numbers.


Although we don't know the length of the code word, we can guess that the columns were encrypted using the same letter. It seems that the first 7 letters of each line correspond to the same plaintext letters and so we start our analysis with column 8 . If we assume that the plaintext and codeword both used capital letters, then they were each in the range 65-90. So the largest the codeword letter number (code number) for each column could be is 90 and the smallest is 65 . If we subtract 65 and 90 from each number in this column we get a range for the number of the code letter.

Here's the analysis for column 8:
(1) $157: 157-90=67$ and 157-65=92 - this says the code number is between 67 and 92 - not helpful since we know it is between 65 and 90 already.
(2) 169: 169-90 = 79 and 169-65=104 - this says the code number is greater than or equal to 79
(3) 146: 146-90=56 and 146-65=81 - this says the code number is less than or equal to 81
(4) 167: 167-90=77 and 167-65=102 - this says the code number is greater than or equal to 77
(5) 145-90=55 and 145-65=80 - this says the code number is less than or equal to 80

So from this information we gather by putting (2) and (5) together that the code number used to encrypt column 8 is between 79 and 80 which correspond to the letters $o$ and $p$.

You will note that we need not look at all the numbers in the column, the tightest bounds will come from looking at the largest and smallest number in the column.

Here's the analysis for column 9:

The largest number is 169 and the smallest is 154 :
(1) 169: 169-90 $=79$ and 169-65 $=104$
(2) 154: $154-90=64$ and $154-65=89$

Putting these together we see that the code number used to encrypt column 9 is between 79 and 89 which correspond to the letters $o-y$.

If you repeat this analysis for each column you get the following information where an $x$ indicates that that number is a possible code number for the column:

|  |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 65 | A |  |  |  |  |  |  | x |  |  |  |  |  |  | x |  |  |  |  |  | x |  |
| 66 | B |  |  |  |  |  |  | x |  |  |  |  |  |  | x |  |  |  |  | x | x | x |
| 67 | C |  |  |  |  |  | x | x |  |  |  |  |  |  | x |  |  |  |  | x | x | x |
| 68 | D |  |  |  |  |  | x | x |  |  |  |  |  |  | x |  |  |  |  | x | x | x |
| 69 | E |  |  |  |  |  | x | x | x |  |  |  |  | x | x | x |  |  |  | x | x | x |
| 70 | F |  |  |  |  | X | X | x | X |  |  |  |  | x |  | X |  |  |  | X | X | x |
| 71 | G |  |  |  |  | X | X | x | x |  |  |  |  | x |  | x |  |  |  | x |  |  |
| 72 | H |  |  |  |  | X |  | x | x |  |  |  |  | X |  | x |  |  |  | x |  |  |
| 73 | I |  |  |  |  | x |  |  | x |  |  |  | x | X |  | x |  |  |  | x |  |  |
| 74 | J |  |  |  |  | x |  |  | x |  |  |  | x |  |  | x |  |  |  | x |  |  |
| 75 | K |  |  |  |  | X |  |  | X |  |  |  | x |  |  | x |  |  |  | x |  |  |
| 76 | L |  |  |  |  | X |  |  | X |  |  |  | x |  |  | x |  |  |  | x |  |  |
| 77 | M |  |  |  |  | x |  |  | X |  |  |  | x |  |  | x |  |  |  | x |  |  |
| 78 | N |  |  |  |  | X |  |  | x |  |  |  | x |  |  | x |  |  |  | x |  |  |
| 79 | 0 | x | X |  |  | X |  |  | X | X |  |  | x |  |  | x |  |  |  |  |  |  |
| 80 | P | X | x |  |  | X |  |  | X | X |  |  | x |  |  | X |  |  |  |  |  |  |
| 81 | Q |  | X |  |  |  |  |  |  | X |  |  | x |  |  |  | X |  |  |  |  |  |
| 82 | R |  | X |  |  |  |  |  |  | X |  |  | x |  |  |  | x |  |  |  |  |  |
| 83 | S |  | X |  |  |  |  |  |  | X |  |  | x |  |  |  | X |  |  |  |  |  |
| 84 | T |  | X | X | X |  |  |  |  | X | X | x |  |  |  |  | X | X |  |  |  |  |
| 85 | U |  | X | X | X |  |  |  |  | x | x | x |  |  |  |  | X | x | x |  |  |  |
| 86 | V |  | X | X | X |  |  |  |  |  | X | X |  |  |  |  | X | X | x |  |  |  |
| 87 | W |  | x | x | x |  |  |  |  |  | x | x |  |  |  |  |  | X | x |  |  |  |
| 88 | X |  | X | X | X |  |  |  |  |  | X | x |  |  |  |  |  | X | X |  |  |  |
| 89 | Y |  | X | X | X |  |  |  |  |  | X | X |  |  |  |  |  | X | x |  |  |  |
| 90 | Z |  |  | x | X |  |  |  |  |  | X | x |  |  |  |  |  | X | X |  |  |  |

It appears that code numbers 3 and 4 might repeat at 10 and 11 and again at 17 and 18 . Since these numbers differ by 7 , this suggests the codeword is 7 letters long. Working on that assumption we get that columns 1,8 , and 15 were encrypted with the same code number.
Likewise 2,9 and 16 were encrypted with the same code number, etc. Putting the information from the columns together we can eliminate more possibilities and get the following choices for each letter in the code word.
1

$N<x \Sigma<\subset \perp$


The next step is to find the codeword. After some guess and checking one will find the code word to be "PUZZLED". In ASCII, $P=80, U=85, Z=90, Z=90, L=76, E=69, D=68$. So now we need to subtract this from the ciphertext then translate back to letters using the ASCII table.

| Cipher | 148 | 154 | 155 | 172 | 145 | 152 | 152 | 157 | 154 | 159 | 174 |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Code | 80 | 85 | 90 | 90 | 76 | 69 | 68 | 80 | 85 | 90 | 90 |  |  |  |  |  |  |
| Plain | 68 | 69 | 65 | 82 | 69 | 83 | 84 | 77 | 69 | 69 | 84 |  |  |  |  |  |  |
| Letters | D | E | A | R | E | S | T | M | E | E | T |  |  |  |  |  |  |
|  | 160 | 148 | 145 | 159 | 167 | 172 | 169 | 163 |  |  |  |  |  |  |  |  |  |
|  | 76 | 69 | 68 | 80 | 85 | 90 | 90 | 76 |  |  |  |  |  |  |  |  |  |
|  | 84 | 79 | 77 | 79 | 82 | 82 | 79 | 87 |  |  |  |  |  |  |  |  |  |
|  | T | 0 | M | 0 | R | R | 0 | W |  |  |  |  |  |  |  |  |  |
| Cipher | 148 | 154 | 155 | 172 | 145 | 152 | 152 | 169 | 154 | 173 | 173 | 149 | 157 | 148 | 157 | 150 | 174 |
| Code | 80 | 85 | 90 | 90 | 76 | 69 | 68 | 80 | 85 | 90 | 90 | 76 | 69 | 68 | 80 | 85 | 90 |
| Plain | 68 | 69 | 65 | 82 | 69 | 83 | 84 | 89 | 69 | 83 | 83 | 73 | 88 | 80 | 77 | 65 | 84 |
| Letters | D | E | A | R | E | S | T | Y | E | S | S | I | X | P | M | A | T |
|  | 169 | 161 | 151 | 145 | 149 | 154 | 174 | 163 | 154 | 140 | 148 | 156 | 150 | 157 | 159 |  |  |
|  | 90 | 76 | 69 | 68 | 80 | 85 | 90 | 90 | 76 | 69 | 68 | 80 | 85 | 90 | 90 |  |  |
|  | 79 | 85 | 82 | 77 | 69 | 69 | 84 | 73 | 78 | 71 | 80 | 76 | 65 | 67 | 69 |  |  |
|  | 0 | U | R | M | E | E | T | 1 | N | G | P | L | A | C | E |  |  |
| Cipher | 148 | 154 | 155 | 172 | 145 | 152 | 152 | 146 | 167 | 163 | 168 | 147 | 153 | 140 | 149 | 158 | 174 |
| Code | 80 | 85 | 90 | 90 | 76 | 69 | 68 | 80 | 85 | 90 | 90 | 76 | 69 | 68 | 80 | 85 | 90 |
| Plain | 68 | 69 | 65 | 82 | 69 | 83 | 84 | 66 | 82 | 73 | 78 | 71 | 84 | 72 | 69 | 73 | 84 |
| Letters | D | E | A | R | E | S | T | B | R | 1 | N | G | T | H | E | 1 | T |
| Cipher | 159 | 153 | 142 | 146 | 145 | 151 | 166 | 155 | 143 | 144 | 135 | 145 | 168 | 159 |  |  |  |
| Code | 90 | 76 | 69 | 68 | 80 | 85 | 90 | 90 | 76 | 69 | 68 | 80 | 85 | 90 |  |  |  |
| Plain | 69 | 77 | 73 | 78 | 65 | 66 | 76 | 65 | 67 | 75 | 67 | 65 | 83 | 69 |  |  |  |
| Letters | E | M | 1 | N | A | B | L | A | C | K | C | A | S | E |  |  |  |
| Cipher | 148 | 154 | 155 | 172 | 145 | 152 | 152 | 167 | 157 | 159 | 172 | 145 | 152 | 140 | 145 | 161 | 166 |
| Code | 80 | 85 | 90 | 90 | 76 | 69 | 68 | 80 | 85 | 90 | 90 | 76 | 69 | 68 | 80 | 85 | 90 |
| Plain | 68 | 69 | 65 | 82 | 69 | 83 | 84 | 87 | 72 | 69 | 82 | 69 | 83 | 72 | 65 | 76 | 76 |
| Letters | D | E | A | R | E | S | T | W | H | E | R | E | S | H | A | L | L |
| Cipher | 174 | 148 | 138 | 134 | 145 | 152 | 165 | 175 | 156 | 135 | 137 |  |  |  |  |  |  |
| Code | 90 | 76 | 69 | 68 | 80 | 85 | 90 | 90 | 76 | 69 | 68 |  |  |  |  |  |  |
| Plain | 84 | 72 | 69 | 66 | 65 | 67 | 75 | 85 | 80 | 66 | 69 |  |  |  |  |  |  |


| Cipher | 148 | 154 | 155 | 172 | 145 | 152 | 152 | 145 | 169 | 174 | 162 | 145 | 136 | 137 | 158 | 169 | 172 |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Code | 80 | 85 | 90 | 90 | 76 | 69 | 68 | 80 | 85 | 90 | 90 | 76 | 69 | 68 | 80 | 85 | 90 |
| Plain | 68 | 69 | 65 | 82 | 69 | 83 | 84 | 65 | 84 | 84 | 72 | 69 | 67 | 69 | 78 | 84 | 82 |
| Letters | D | E | A | R | E | S | T | A | T | T | H | E | C | E | N | T | R |
| Cipher | 155 | 152 | 159 | 147 | 159 | 171 | 155 | 166 | 145 | 153 | 156 |  |  |  |  |  |  |
| Code | 90 | 76 | 69 | 68 | 80 | 85 | 90 | 90 | 76 | 69 | 68 |  |  |  |  |  |  |
| Plain | 65 | 76 | 90 | 79 | 79 | 86 | 65 | 76 | 69 | 84 | 88 |  |  |  |  |  |  |
| Letters | A | L | Z | O | O | V | A | L | E | T | X |  |  |  |  |  |  |

Message 1: Dearest Meet tomorrow
Message 2: Dearest Yes six pm at our meeting place
Message 3: Dearest Bring the item in a black case
Message 4: Dearest Where shall the back up be
Message 5: Dearest At the central zoo valet $x$

