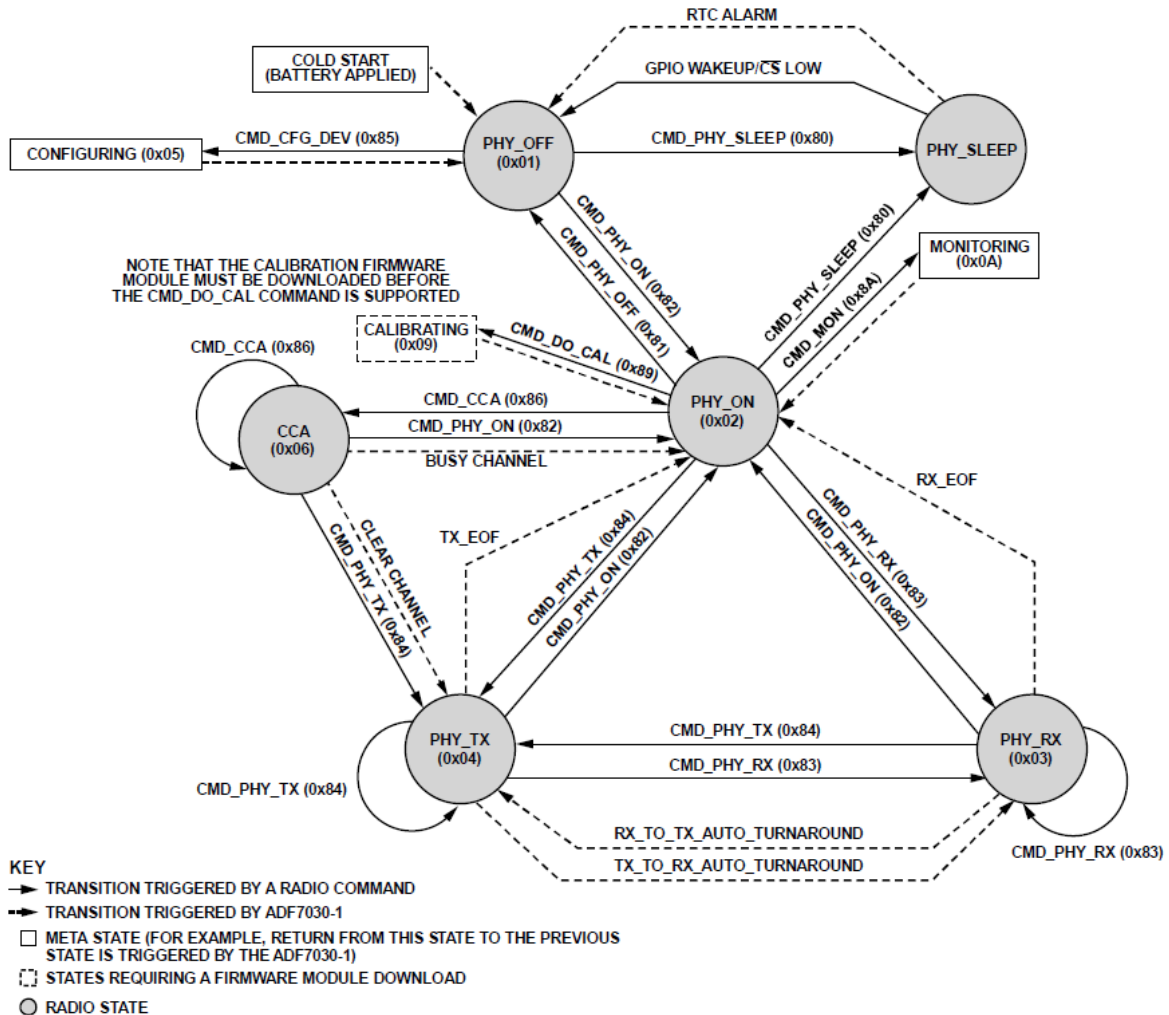# ADF7030-1 TTC Operations:

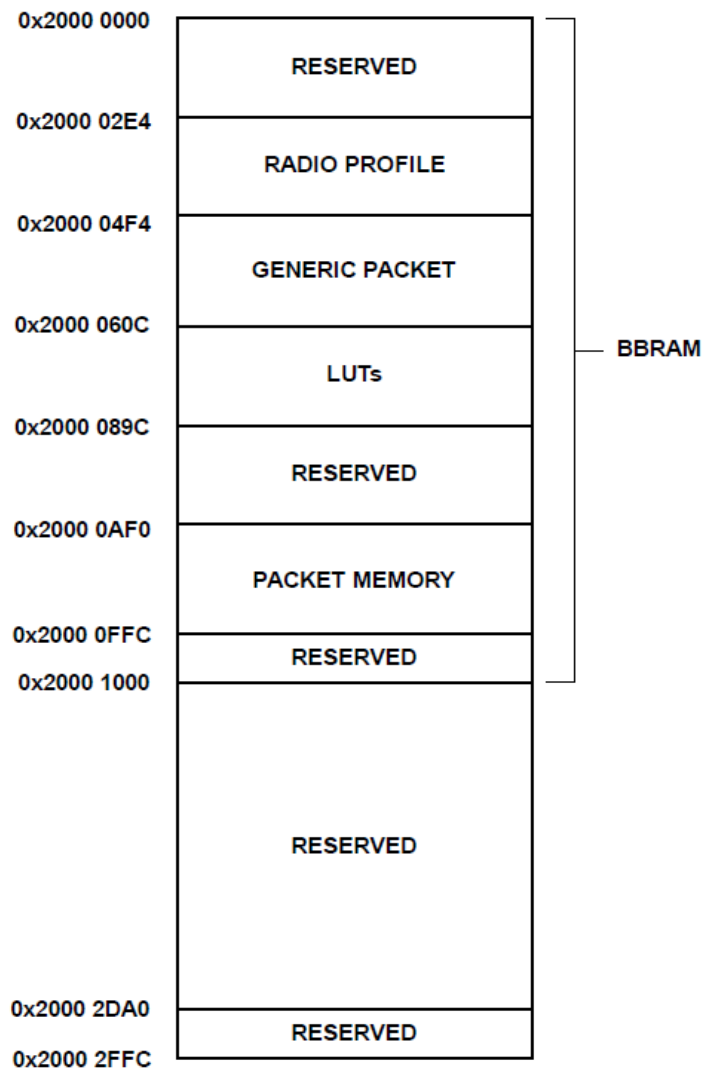1. The ADF7030-1 has the following flowgraph operations.

Using the above flowgraph we can design the concept of operations for coding the ADF chip.

The data rate specified from the OBC is 9 Mbps and the ADF has an SPI slave clocking of time period 80ns, which can provide around 12.5 Mbps of data flow.
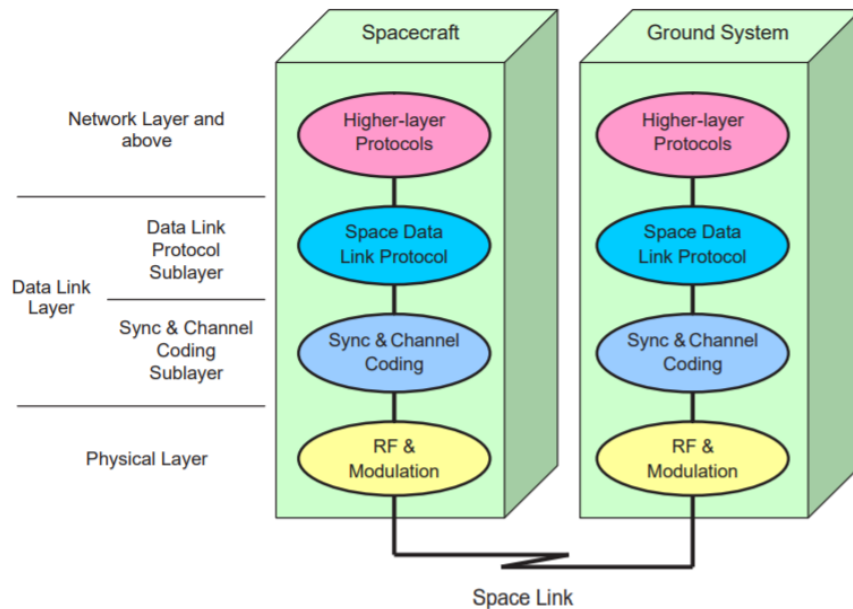
But the transmit capability of the ADF is limited to 300kbps in 2FSK modulation, which corresponds to the fact that encoding is done for each of the incoming bits.

The internal storage of the ADF7030-1 is given by an on-chip RAM, which is around 12KB, below is the division of the onboard memory. So we will be needing an external control environment to control the data flow.

Address	Region	
0x2000 0000	RESERVED	
0x2000 02E4	RADIO PROFILE	BBRAM
0x2000 04F4	GENERIC PACKET	
0x2000 060C	LUTs	
0x2000 089C	RESERVED	
0x2000 0AF0	PACKET MEMORY	
0x2000 0FFC	RESERVED	
0x2000 1000	RESERVED	
0x2000 2DA0	RESERVED	
0x2000 2FFC		

* Above is referenced from the Datasheet of ADF7030-1

Understanding CCSDS:

Space Link

The above diagram is of the standard OSI stack for networks, as space link is also a network, between the ground station and the spacecraft.

The higher layer protocols here deal with the packets from various payloads, and also with the corresponding packet assignments while it is packetized in the On-Board Computer.

Space Data Link Protocol:
1. It defines the packets in terms of PDUs (Protocol Data Units)
2. The provision that we can utilize is that of various APIDs (Application Process Identifier)

Various Packets that are collected by the OBC are concatenated and pushed for CCSDS packetizing.

1. The **Payload** is the main part of the CCSDS packet.
2. Along with the **APID** for each of the data segments.

The next step will be done at the Radio ADF7030-1
1. The length of the packet is specified, max supported by ADF7030-1 is 512 Bytes for a Tx buffer.
2. The Sync Word is added, as the transmission is always considered asynchronous.
3. Preamble and CRC bits are added to the packet before the channel encoding is done.

This will complete the Packetizing of the ADF7030-1
1. The NRZ-M encoding is performed.
2. 2-FSK modulation is done

3. The signal is upconverted to the desired RF central frequency.
4. Transmitted through the antenna.

During the process of decoding the exact process is followed in reverse order, and each of the packets is stripped off and compared to a Look-up table (LUTs) to correspondingly correlate with the various CCSDS APIDs and give us the values for the same.

Ref 1: https://public.ccsds.org/Pubs/133x0b2e1.pdf
Ref 2: https://public.ccsds.org/Pubs/130x2g3.pdf

Coding the ADF7030-1:

The buffer overflow will happen for any size of memory, and that is calculated by the network understanding from Kendall's Queuing notation.

Our system is: D/D/1/24/FCFS

Arrival Distribution: 9216 kbps
Service Time Distribution: 300kbps
Number of Servers: 1
Number of Buffers: 24 (12KB)
Calling Population: 1 (OBC)
Service Discipline: First Come First Serve (FCFS)

So the Buffer will be filled up by 0.78125 seconds.

Assuming this is when the 12KB RAM buffer will overflow.

Now the coding for the same is not explained.