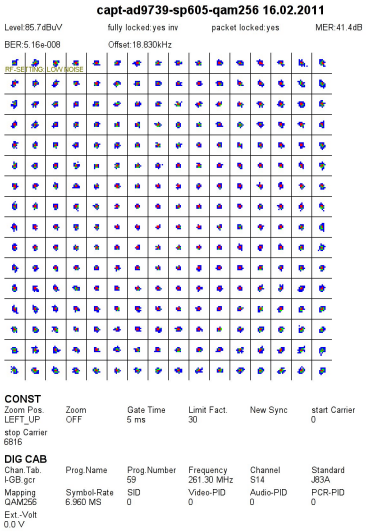
Spartan-6 based Up Converter demonstrator for Direct RF synthesis



ADF4360 Eval board (2,1GHz Clock generator)

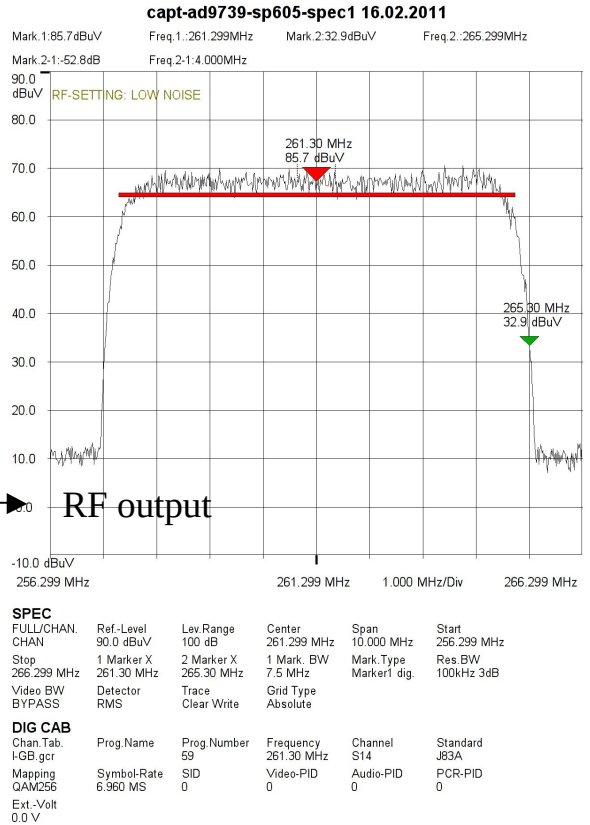
SP605 (LX45T) or SP601 (LX16)

Base band modulator + Digital Up Converter

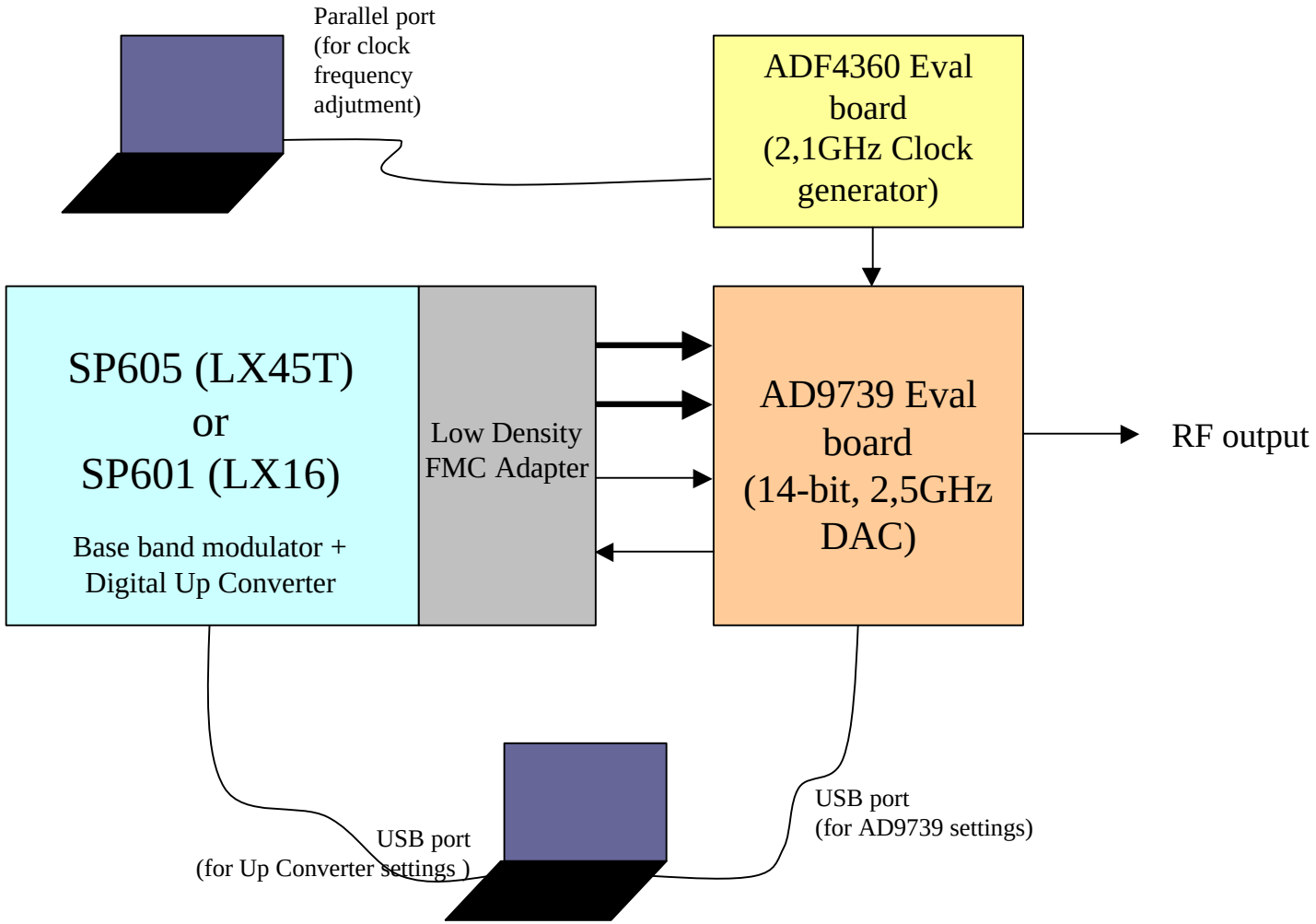
Low Density FMC Adapter

AD9739 Eval board (14-bit, 2,5GHz DAC)

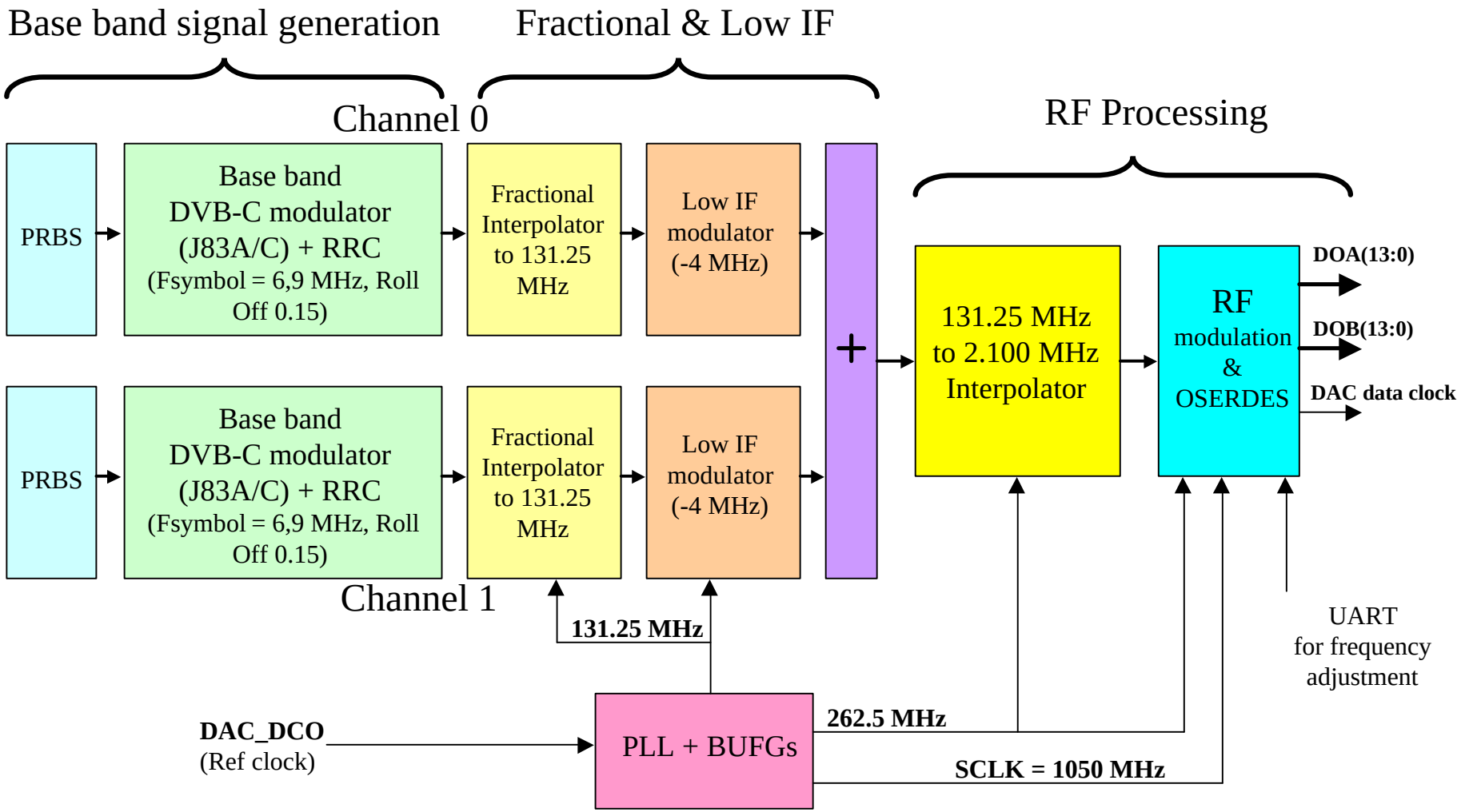
RF output



Spartan-6 based Up Converter demonstrator for Direct RF synthesis



SP605 demo
(Spartan 6SLX45T)



SP605 demo
(Spartan 6SLX45T)

- 20 MHz bandwidth Up Converter for RF modulation anywhere between 50MHz and 950 MHz

- Base band sampled input @ 131.25 MHz, output @2100 MHz
  - 18MHz available bandwidth (in this example)
  - 0.2 dB In band ripple, 65 Db+ out of band attenuation

- Spartan-6 required resources
  - 1050 Slices
  - 16 DSP48
  - 8 BRAM (18K-bit)
  - 1 PLL
  - 29 OSERDES & 29 differential (LVDS) pairs working @1050 MHz

SP605 demo
(Spartan 6SLX45T)

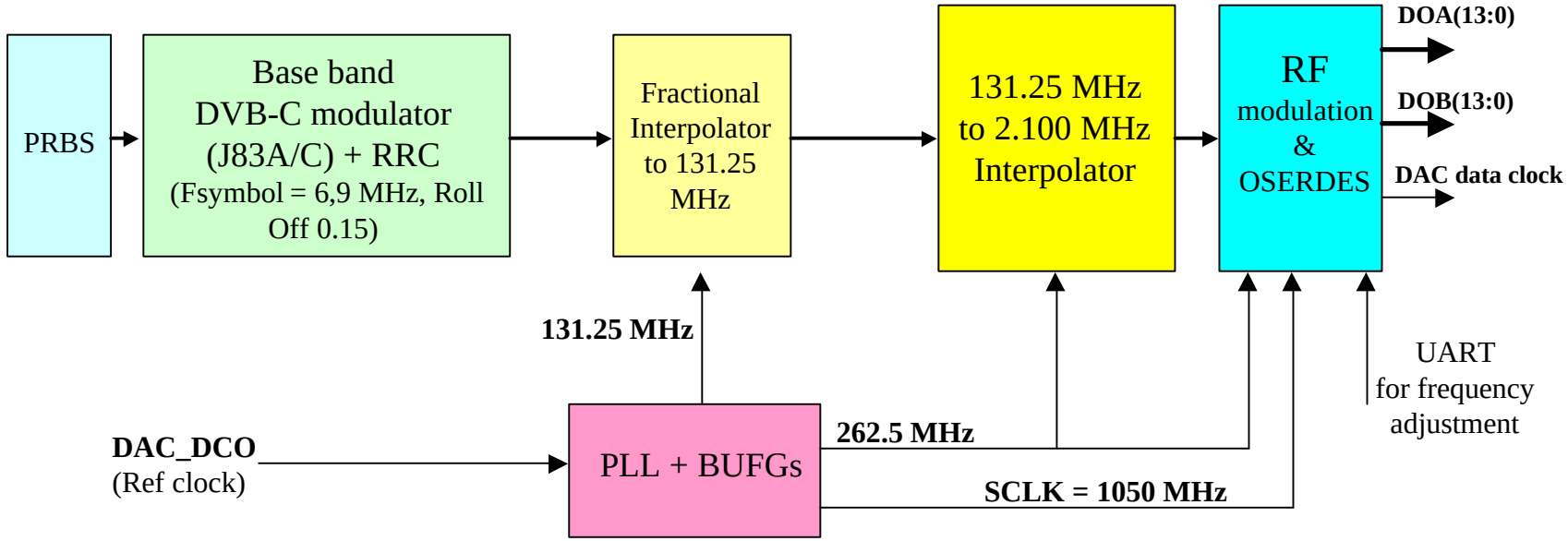
- Intermediate FRACTIONAL I/Q interpolator from Fsym to 131.25 MHz
    - Requires 4 DSP48 + 200 slices

- Low I/Q Intermediate Frequency modulation
    - Channel 0 modulated @-4 MHz (8MHz wide)
    - Channel 1 modulated @++4 MHz (also 8MHz wide)
    - Requires 2 DSP48 + 2BRAM (18K-bit) + 200 slices

- Combining the 2 I/Q IF modulated signals into a single 16MHz wide base band channel
    - Requires 2 adders (8 slices)

SP601 demo
(Spartan 6SLX16)

Includes exactly the same Up Converter than the SP605 demonstration



SP601 demo
(Spartan 6SLX16)

- MAP report sample for the global design

```
Slice Logic Distribution:
  Number of occupied Slices:                2,115 out of   2,278   92%
  Number of LUT Flip Flop pairs used:       7,455
    Number with an unused Flip Flop:        1,186 out of   7,455   15%
    Number with an unused LUT:                883 out of   7,455   11%
    Number of fully used LUT-FF pairs:      5,386 out of   7,455   72%
    Number of unique control sets:            154
    Number of slice register sites lost
      to control set restrictions:            517 out of  18,224    2%
IO Utilization:
  Number of bonded IOBs:                       63 out of     232   27%
  Number of OLOGIC2/OSERDES2s:                 29 out of     248   11%

Specific Feature Utilization:
  Number of RAMB16BWERs:                       10 out of      32   31%
  Number of DSP48A1s:                          30 out of      32   93%
  Number of BUFG/BUFGMUXs:                      3 out of      16   18%
  Number of BUFPLLs:                            2 out of       8   25%
Number of PLL_ADVs:                           1 out of       2   50%
```

SP601and SP605 demo
(Spartan 6SLX16 or 6SLX45T)

- MAP report sample for Up Converter only

```
Slice Logic Distribution:
  Number of occupied Slices:                1,047 out of   2,278   45%
  Number of LUT Flip Flop pairs used:       4,023
    Number with an unused Flip Flop:          365 out of   4,023    9%
    Number with an unused LUT:                764 out of   4,023   18%
    Number of fully used LUT-FF pairs:      2,894 out of   4,023   71%
    Number of unique control sets:              5
    Number of slice register sites lost
      to control set restrictions:              4 out of  18,224    1%
IO Utilization:
  Number of bonded IOBs:                       60 out of     232   25%
  Number of OLOGIC2/OSERDES2s:                 29 out of     248   11%

Specific Feature Utilization:
  Number of RAMB16BWERs:                        8 out of      32   25%
  Number of DSP48A1s:                          16 out of      32   50%
  Number of BUFG/BUFGMUXs:                      2 out of      16   12%
  Number of BUFPLLs:                            2 out of       8   25%
  Number of DSP48A1s:                          16 out of      32   50%
```

Spartan-6 required ressources for higher bandwidth Up Converter

- Example for 96 MHz bandwidth (Up to 16 x J83B channels, or 12 x 8MHz wide DVB-C channels, or any 96MHz wide base-band signal)

Number of required Slices:	**1,650**	**out of**	**2,278**	**45%**
Number of OLOGIC2/OSERDES2s:	**29**	**out of**	**248**	**11%**
Number of RAMB16BWERs:	**8**	**out of**	**32**	**25%**
Number of DSP48A1s:	**16**	**out of**	**32**	**50%**
Number of BUFG/BUFGMUXs:	**2**	**out of**	**16**	**12%**
Number of BUFPLLs:	**2**	**out of**	**8**	**25%**
Number of DSP48A1s:	**16**	**out of**	**32**	**50%**