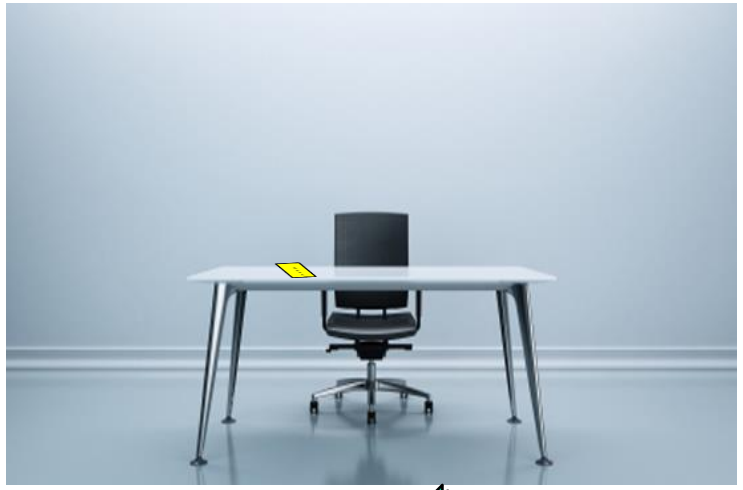
Structured Electronic Design

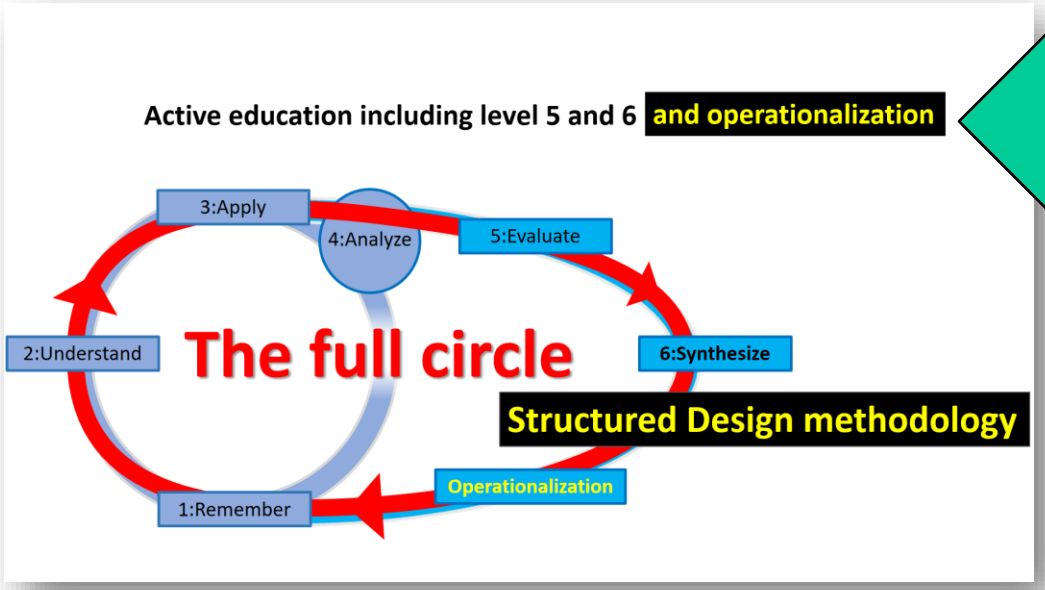
There are specifications

There is **no** circuit, so:

No simulations to "optimize"

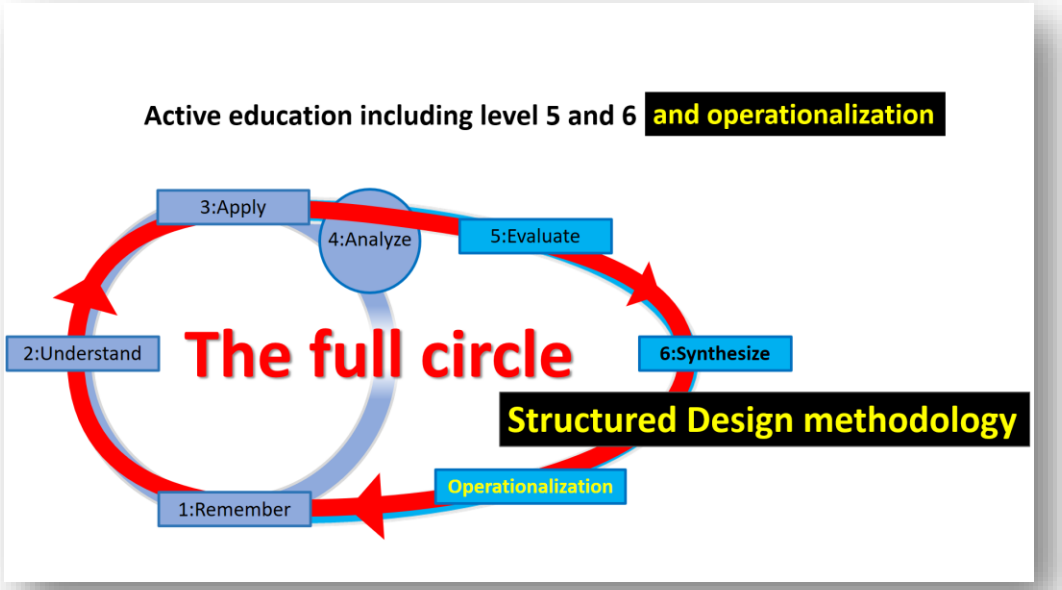
No "tweaking" of existing hardware



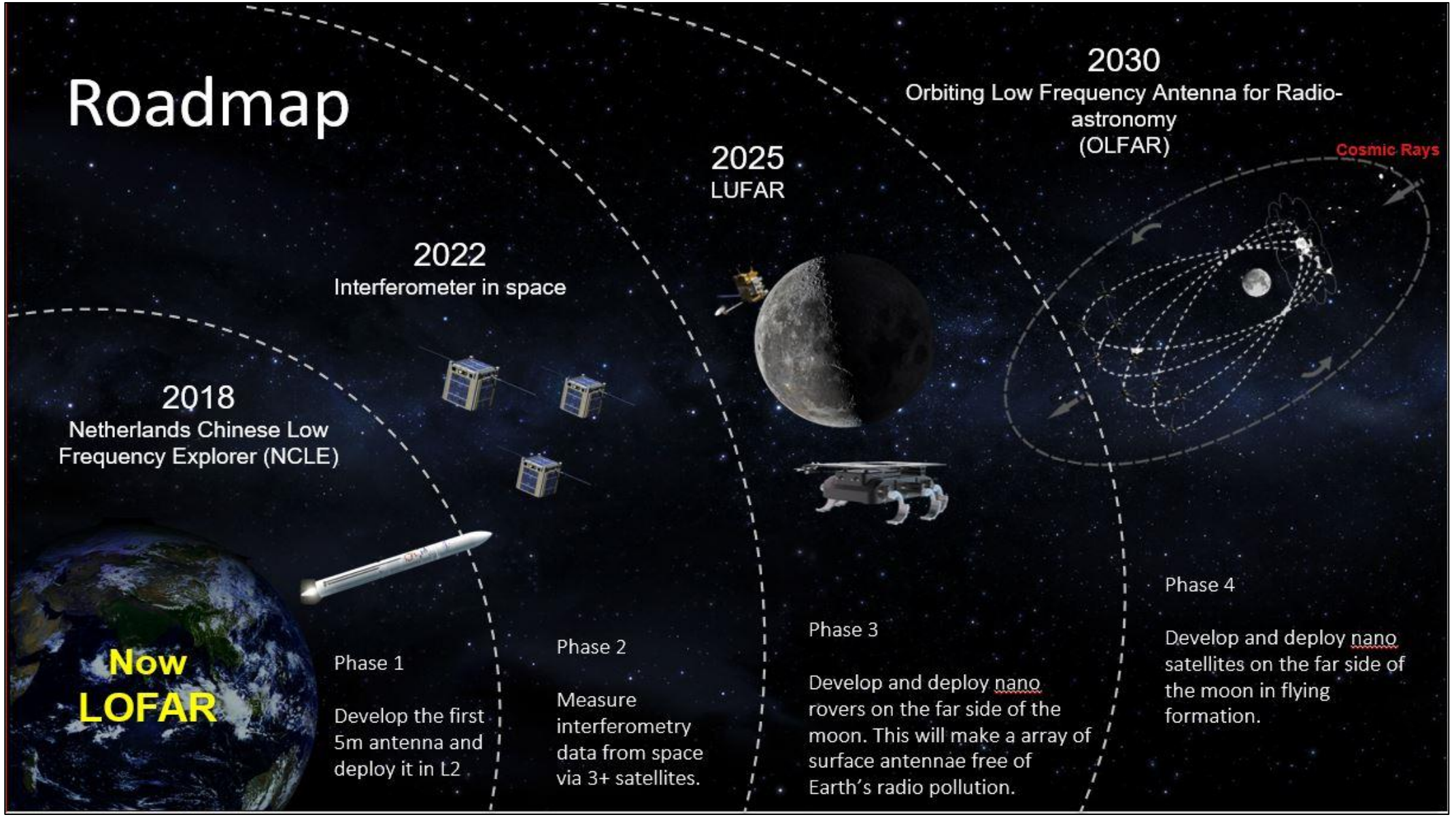


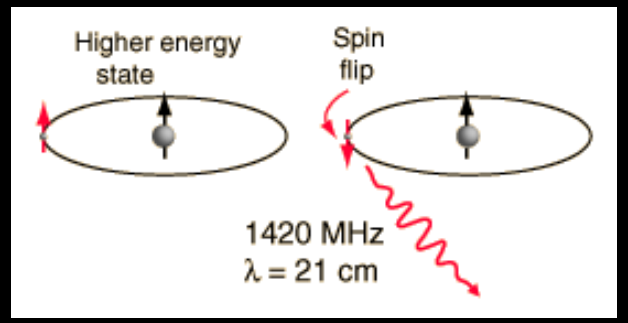
Design Example
Design Assignment

The design example used in this course (and for the bonus assignments)



Our Customer: Low Frequency Radio Astronomers



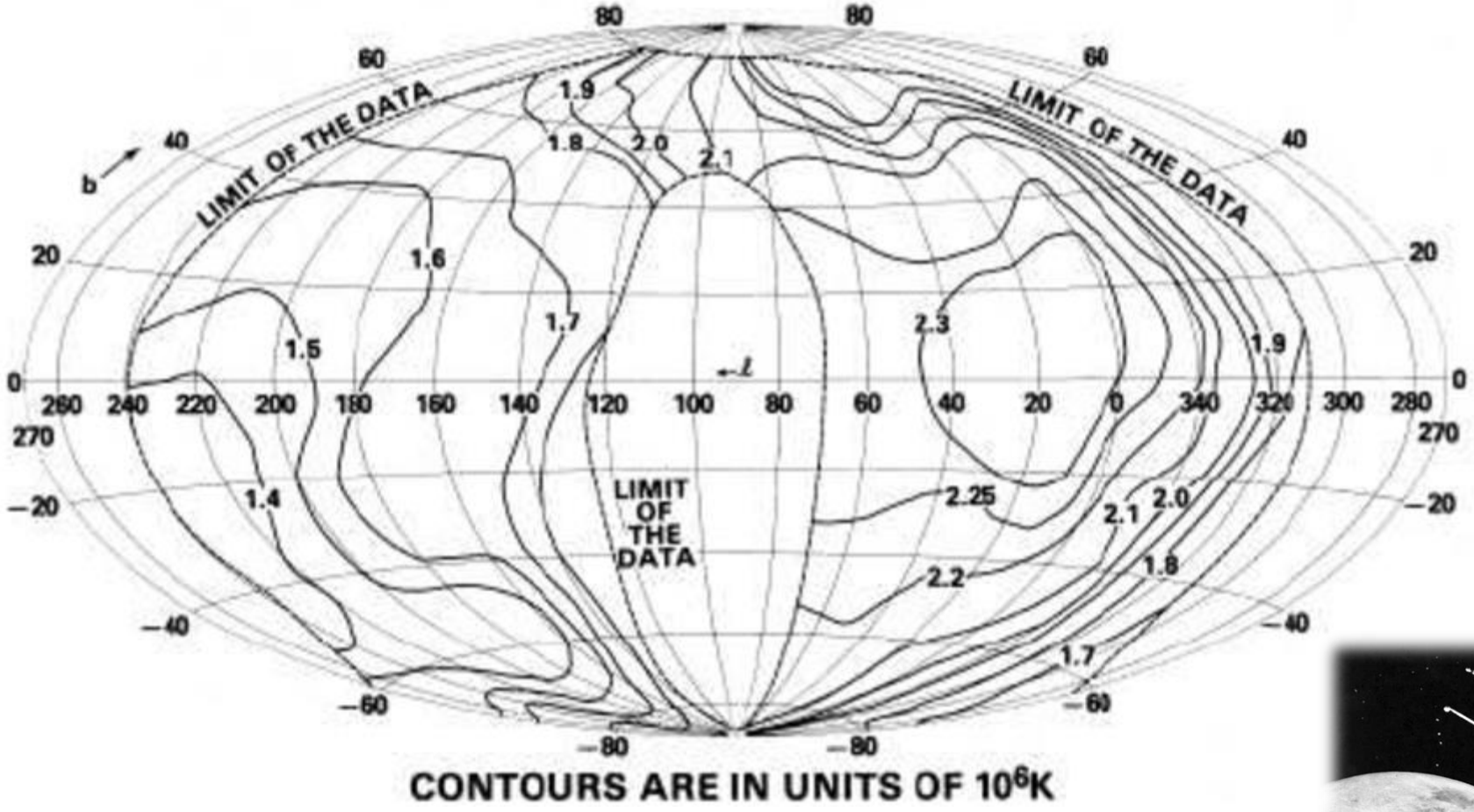


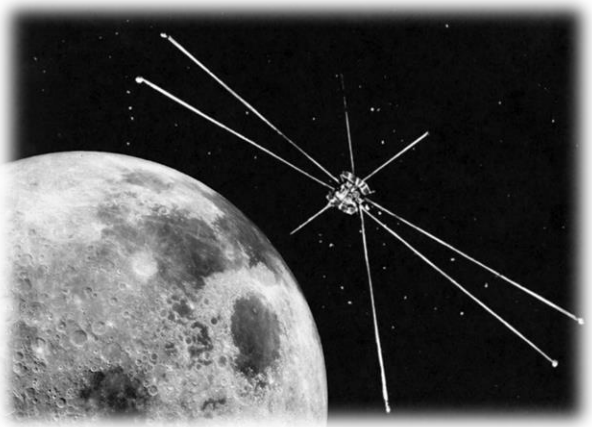
“Hydrogen line” at 1420MHz
Expanding universe:
Objects move away
Red-shift: frequency goes down

Looking deeper in space
and deeper into the past
means:
Looking for largely redshifted hydrogen lines

OLFAR and LUFAR: 30kHz – 30MHz

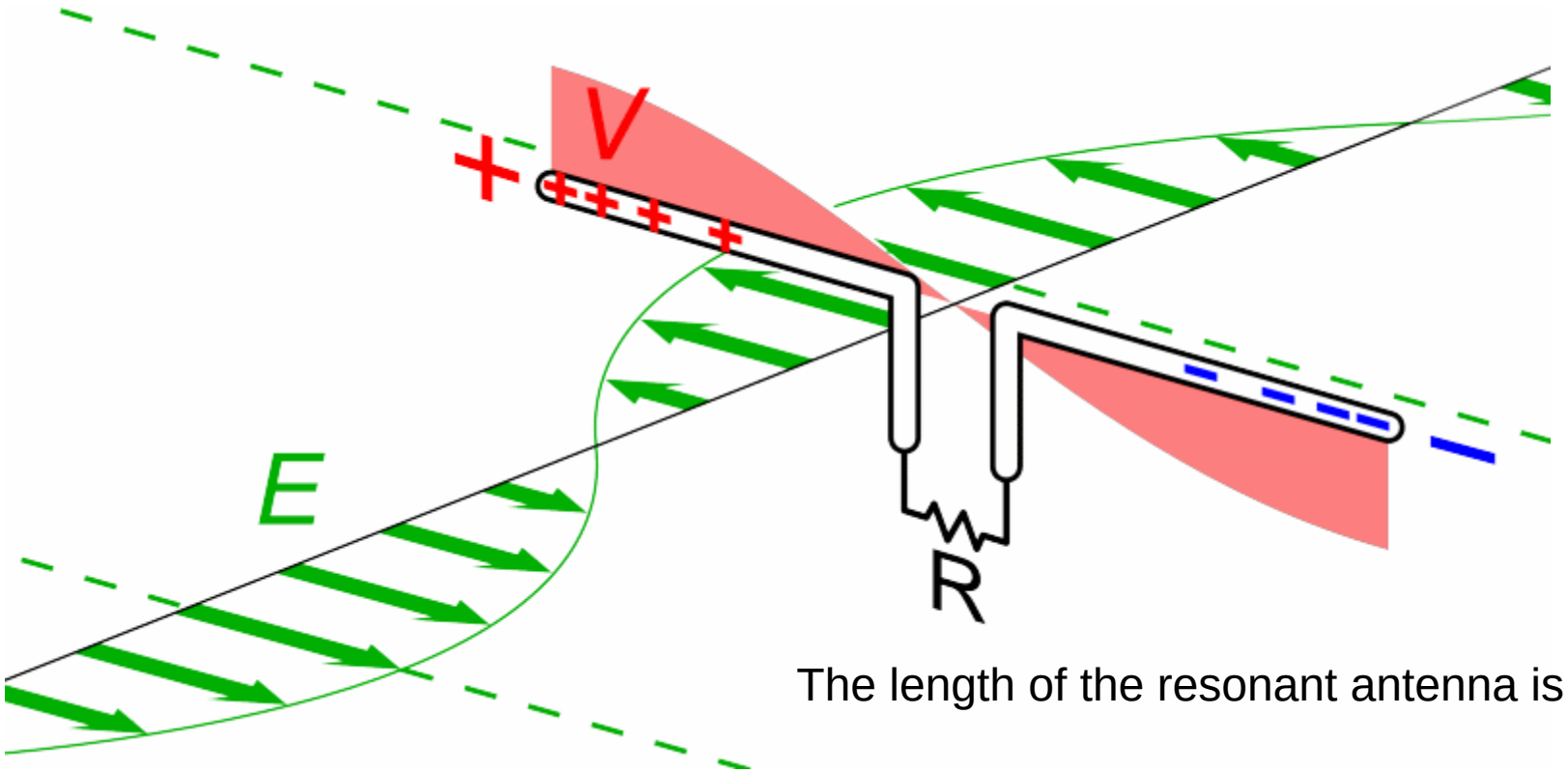
Sky at **4.7MHz**





RAE-2 all-sky map of the galaxy at 4.70 MHz by J. C. Novaco & L. W. Brown (1978) [2]

A resonant antenna



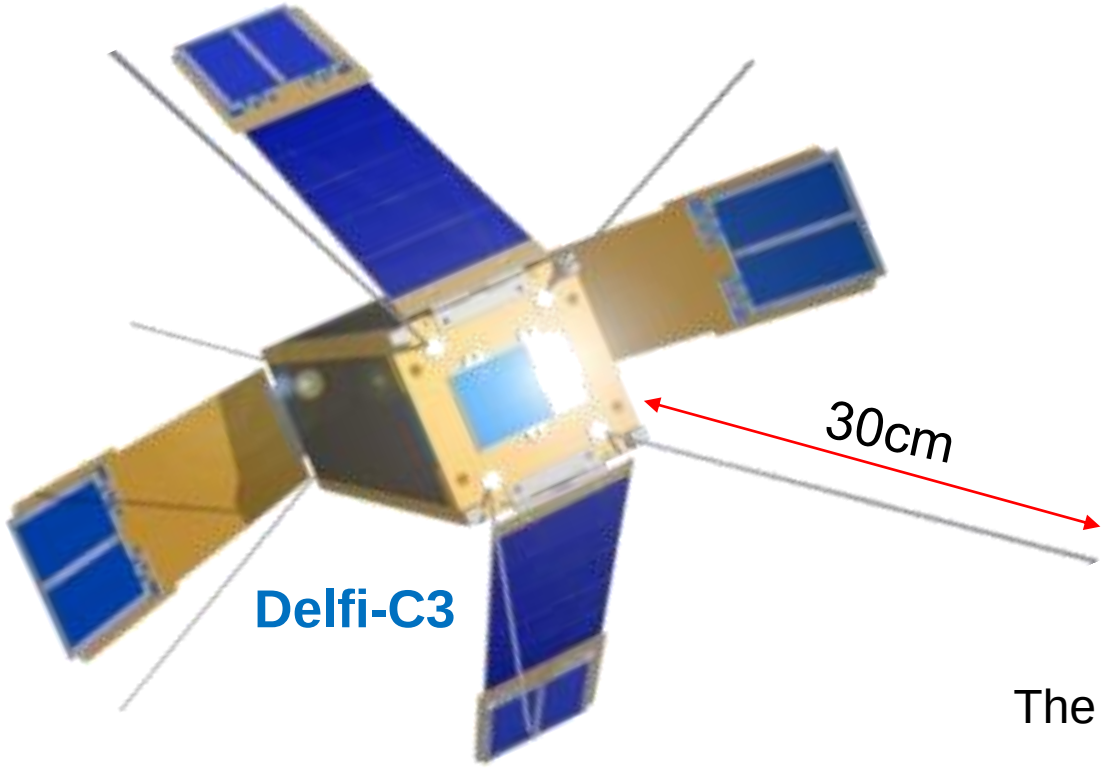
The length of the resonant antenna is ½λ (λ = wavelength)

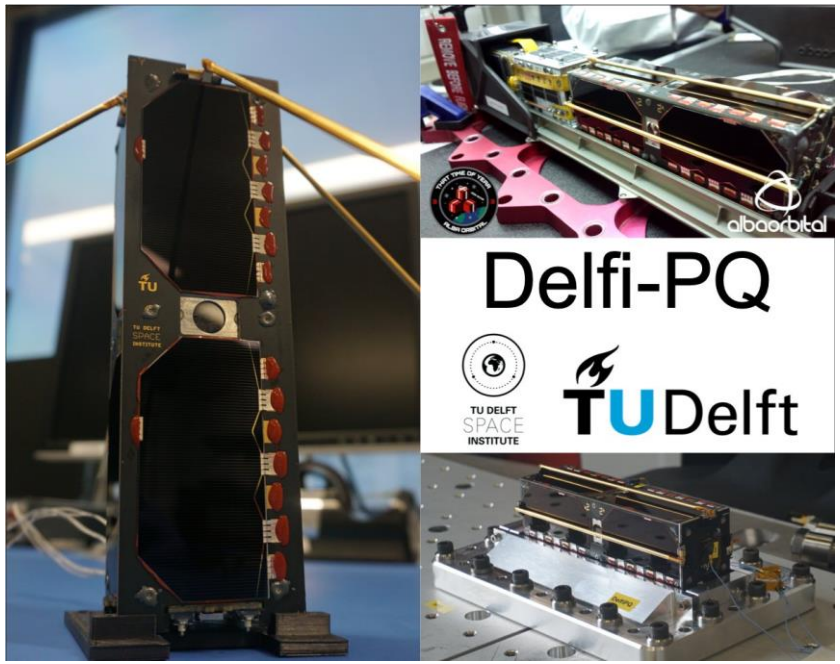
OLFAR and LUFAR: 30kHz – 30MHz

OLFAR and LUFAR: **λ≈10km** – λ≈10m
(RAE1, 4.7MHz: λ≈64m)

https://en.wikipedia.org/wiki/Antenna_(radio)

A short antenna





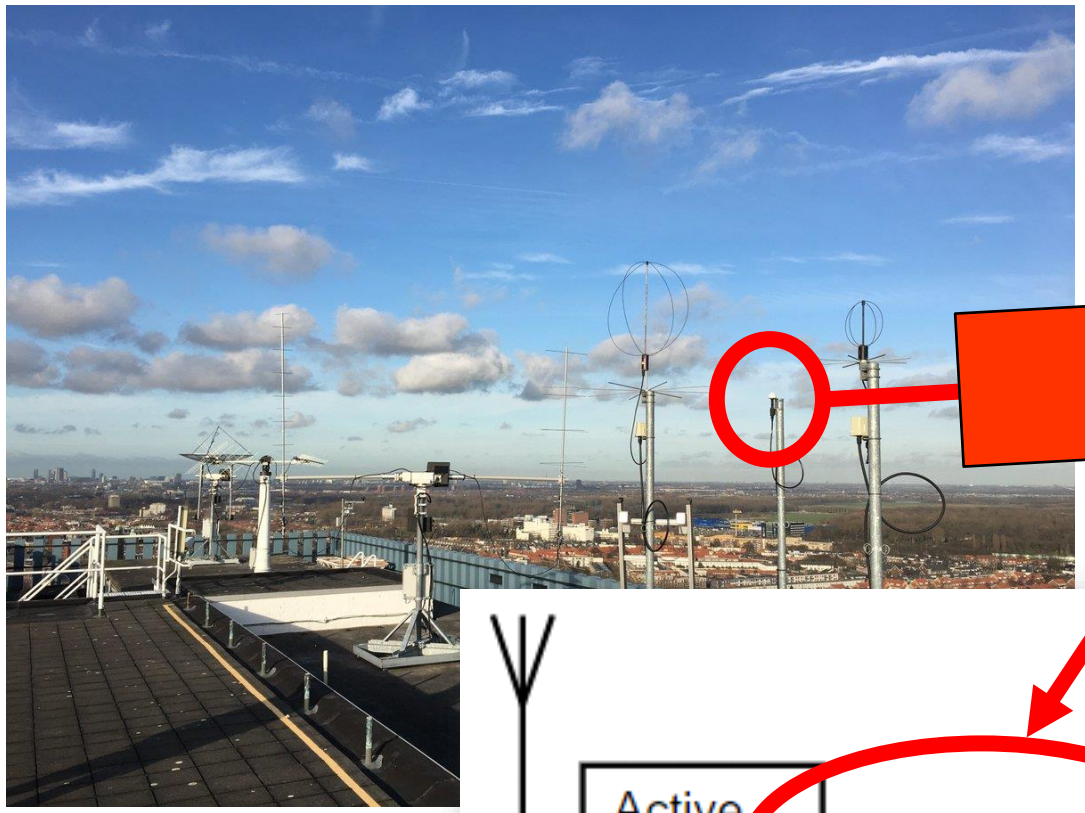
The length of the resonant antenna is ½λ (λ = wavelength)

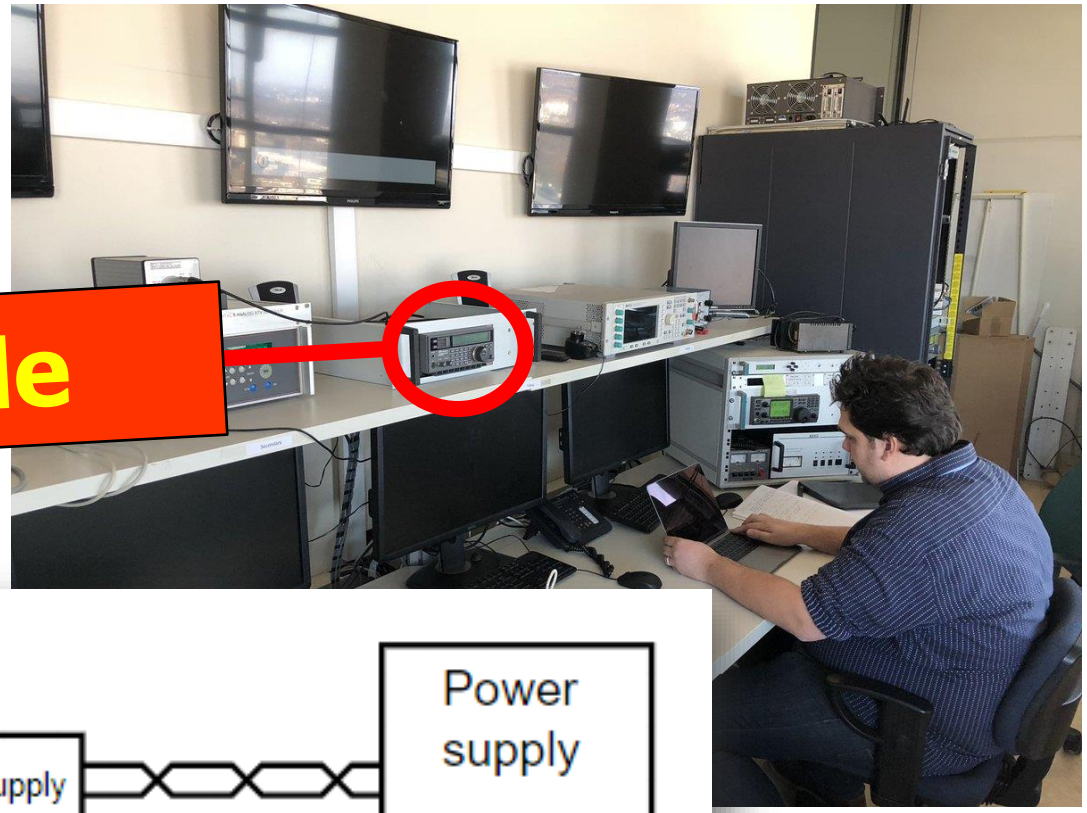
OLFAR and LUFAR: 30kHz – 30MHz

OLFAR and LUFAR: **λ≈10km** – λ≈10m
(RAE1, 4.7MHz: λ≈64m)

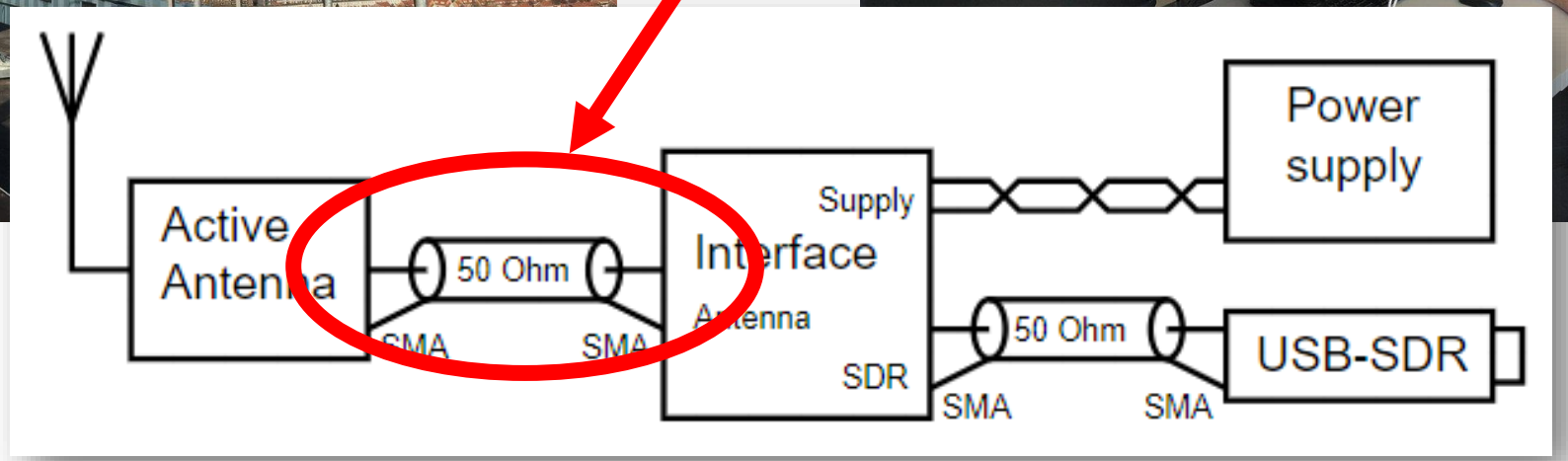
https://www.ru.nl/astrophysics/radboud-radio-lab/projects/netherlands-china-low-frequency-explorer-ncle/

From antenna to radio

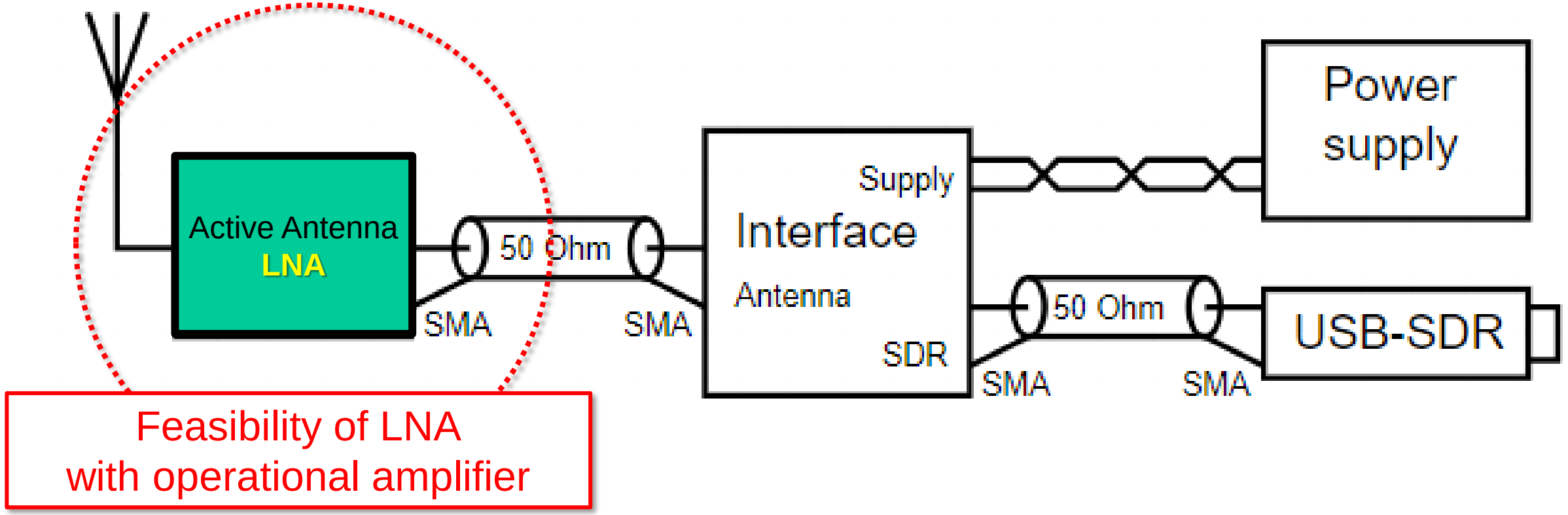




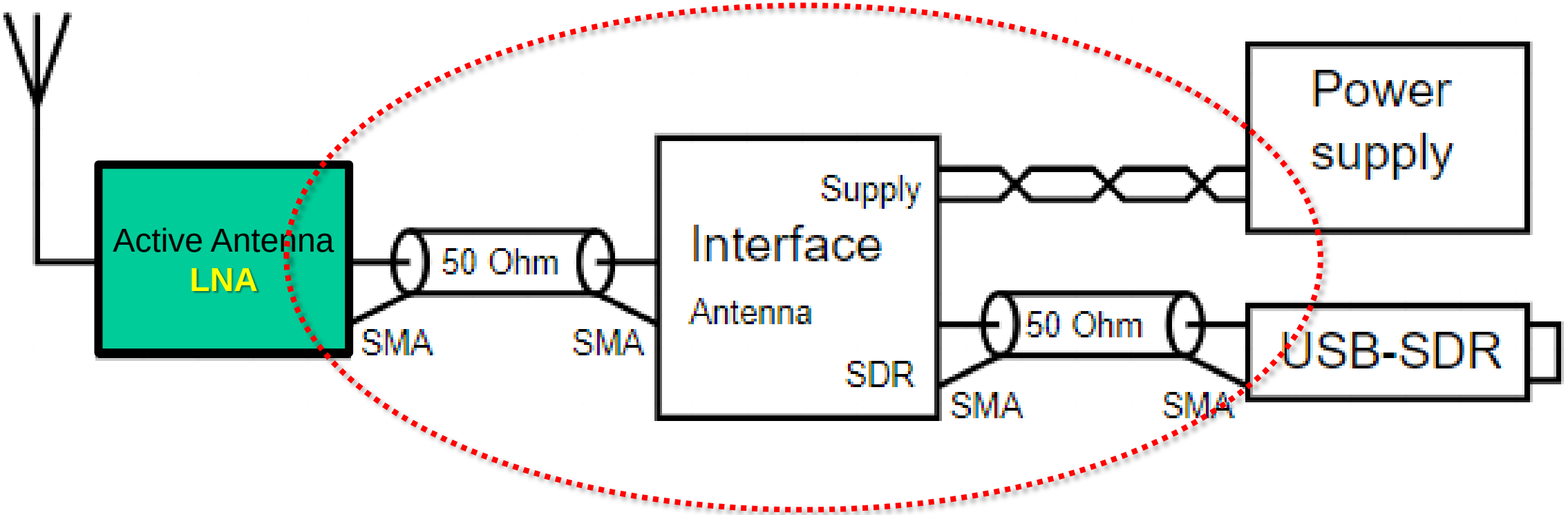
Cable



The design example challenge in this course

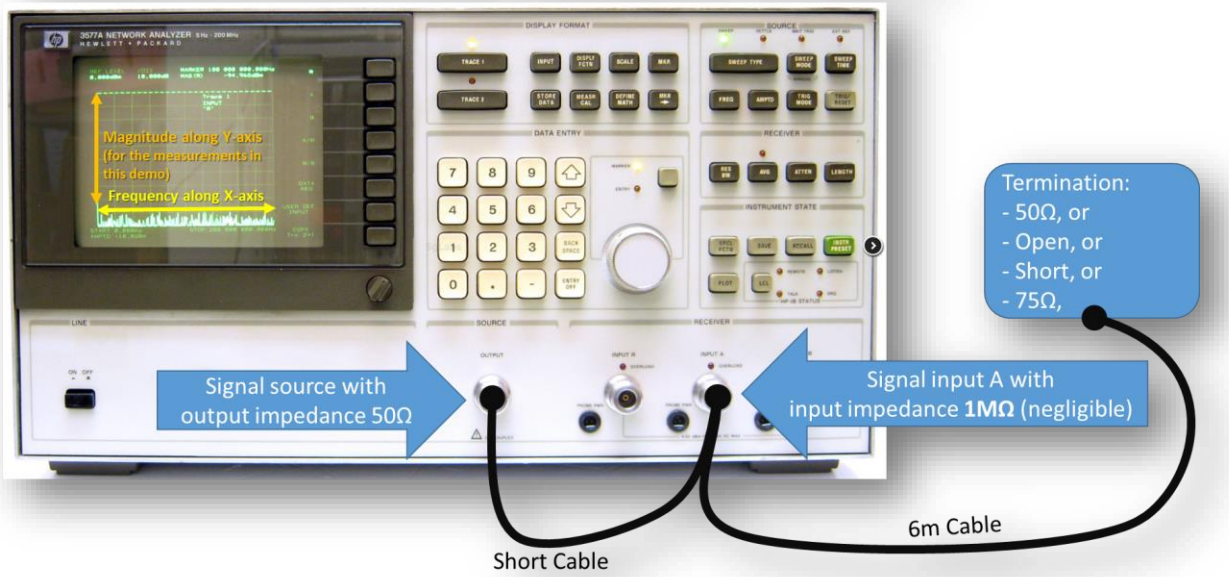


The design example challenge in this course



Demonstration. 50Ω Coax cable, 6m length

Measurements with Network Analyzer



Measurements with oscilloscope

c (speed of light in vacuum)	299792458	m/s
cable reduction of c	0.67	
c in cable	199861639	m/s
cable length	6.1	m
delay cable [ns]	31	ns
return delay [ns]	61	ns
Lowest Resonant frequency at open cable = 0.25 Wavelength		
	8.2	MHz
Lowest Resonant frequency at shorted cable = 0.5 Wavelength		
Lowest Resonant Frequency	16.4	MHz

c (speed of light in vacuum)	299792458	m/s
cable reduction of c	0.67	
c in cable	199861639	m/s
cable length	10.1	m
delay cable [ns]	51	ns
return delay [ns]	101	ns
Lowest Resonant frequency at open cable = 0.25 Wavelength		
	4.9	MHz
Lowest Resonant frequency at shorted cable = 0.5 Wavelength		
Lowest Resonant Frequency	9.9	MHz

c (speed of light in vacuum)	299792458	m/s
cable reduction of c	0.67	
c in cable	199861639	m/s
cable length	16.2	m
delay cable [ns]	81	ns
return delay [ns]	162	ns
Lowest Resonant frequency at open cable = 0.25 Wavelength		
	3.1	MHz
Lowest Resonant frequency at shorted cable = 0.5 Wavelength		
Lowest Resonant Frequency	6.2	MHz

There is a separate file containing much more details about this demo