

# Reconfigurable Receiver Front-Ends for Intelligent Mobile Networks

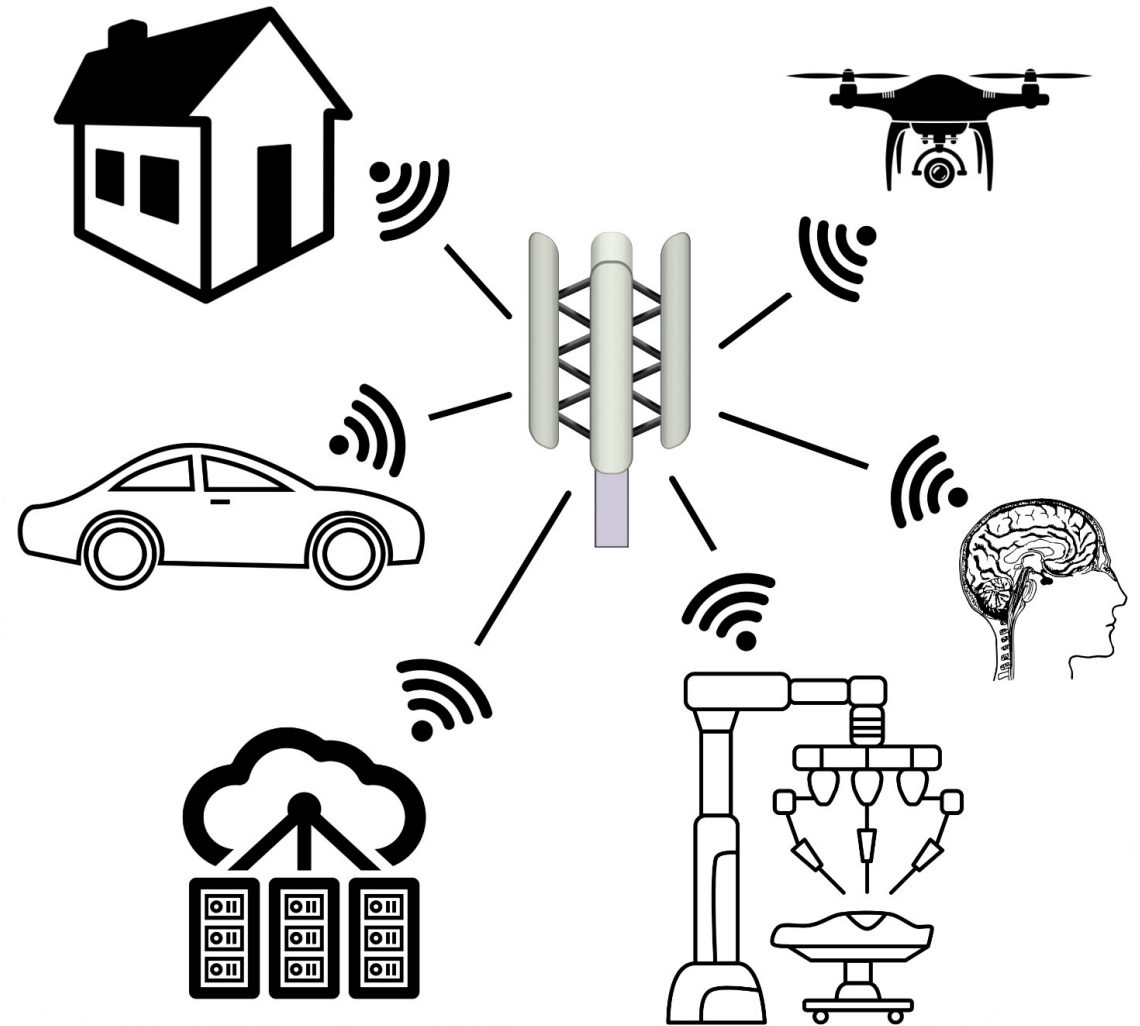
Iman Ghotbi, June 2023

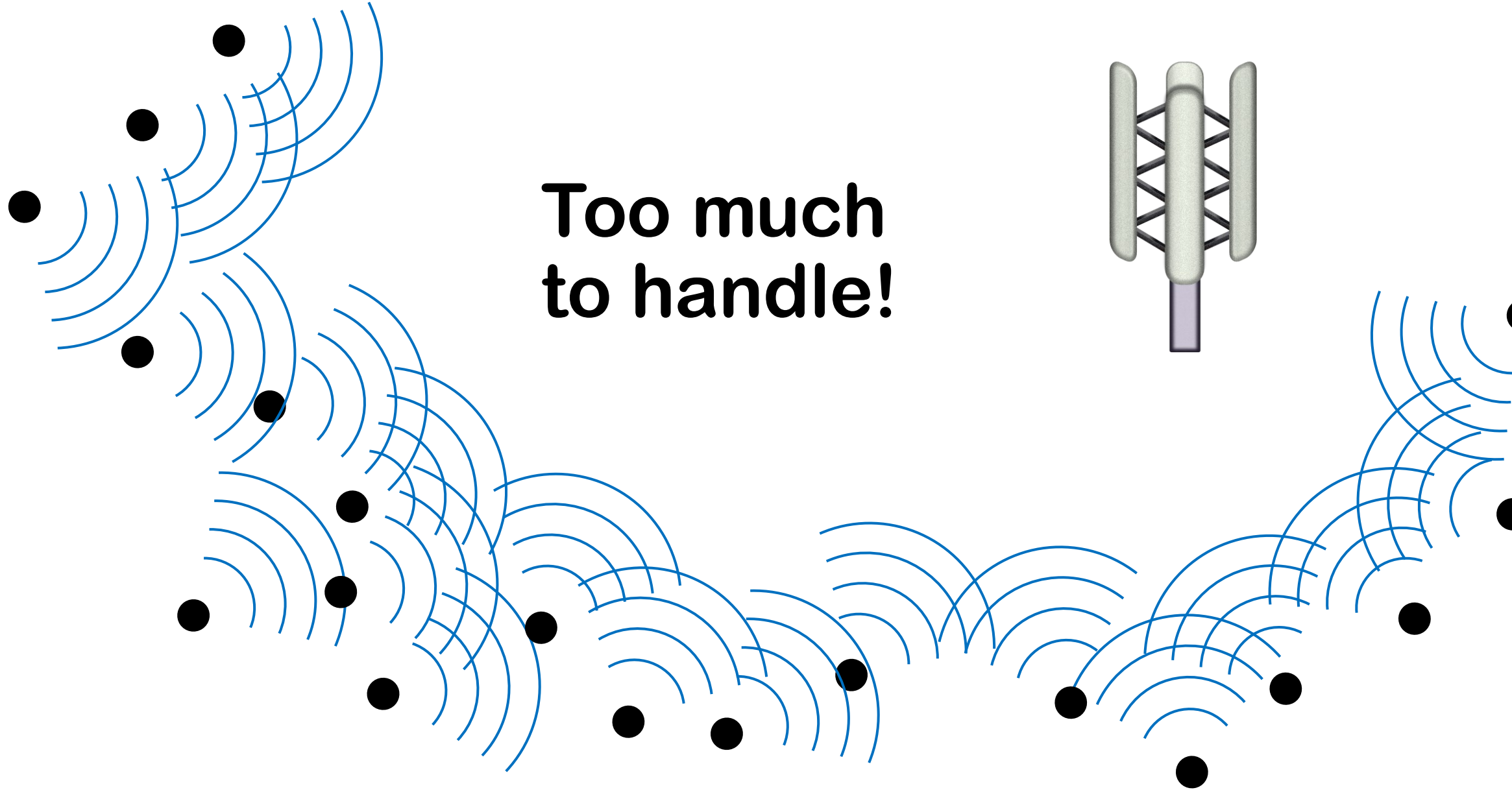


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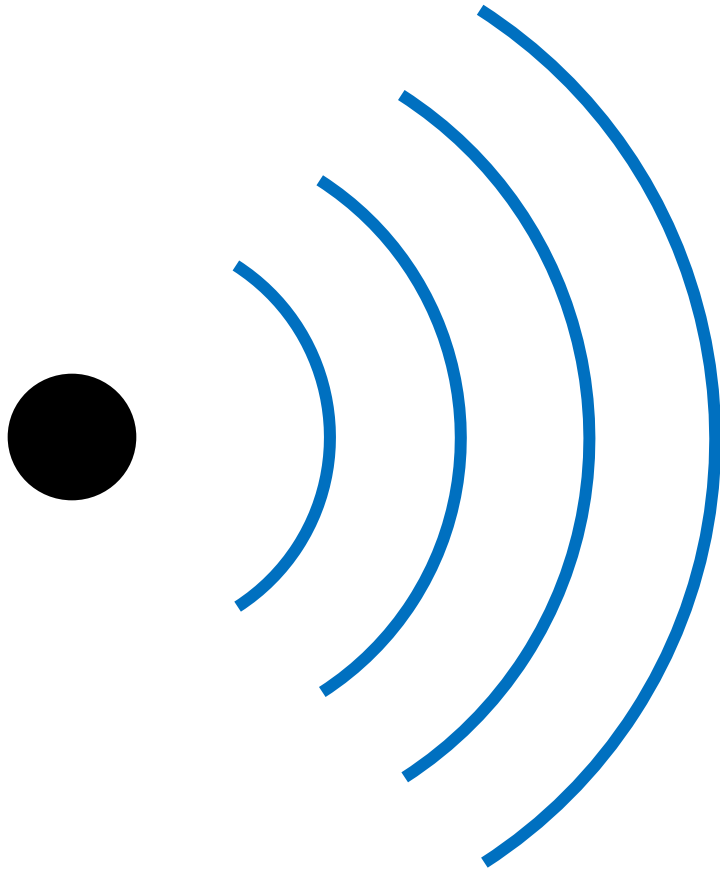
# A World of Connected Systems

- **Internet of Everything (IoE)**
- **Wireless Sensor Networks (WSN)**
- **Autonomous Vehicles**
- **Holographic Artificial Intelligence**
- **Ultimate Global Connectivity**
- **Extreme Multimedia Experience**



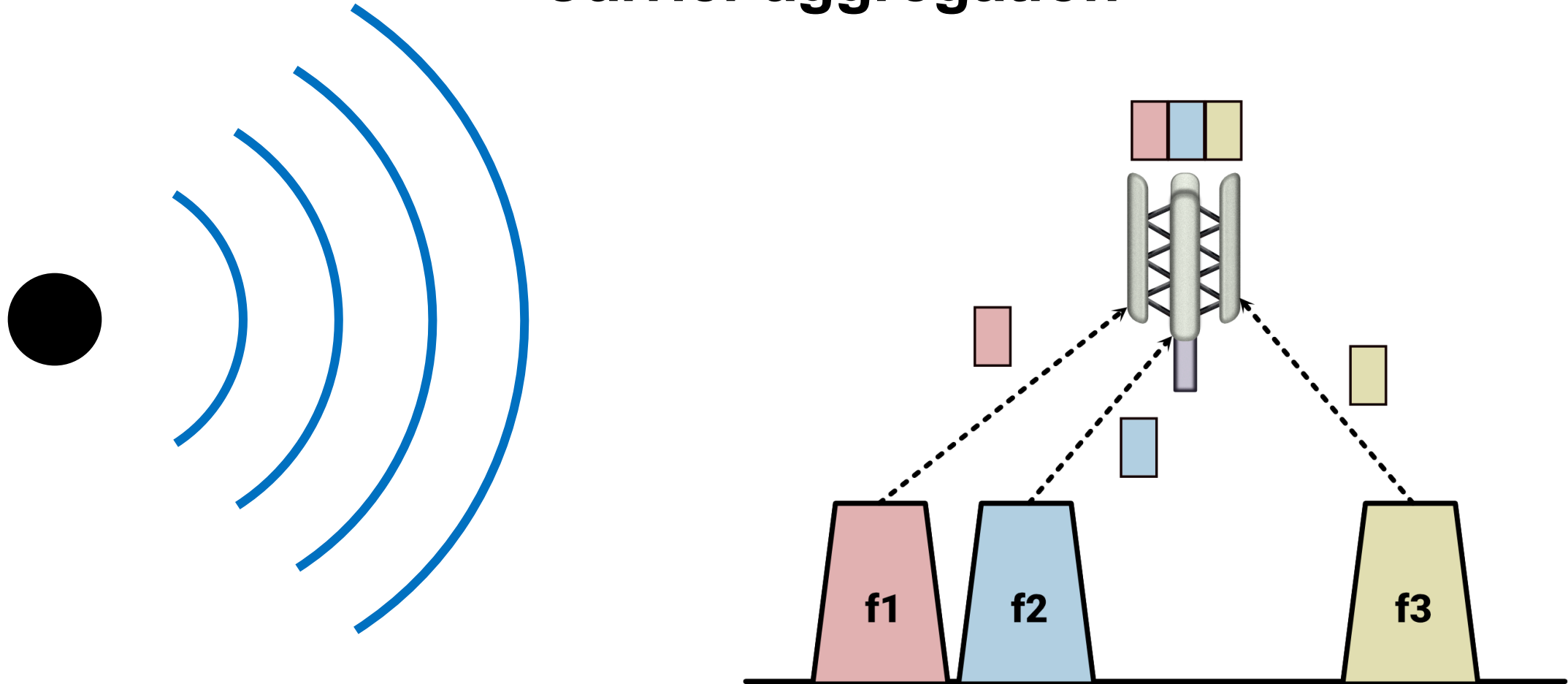


**Too much  
to handle!**

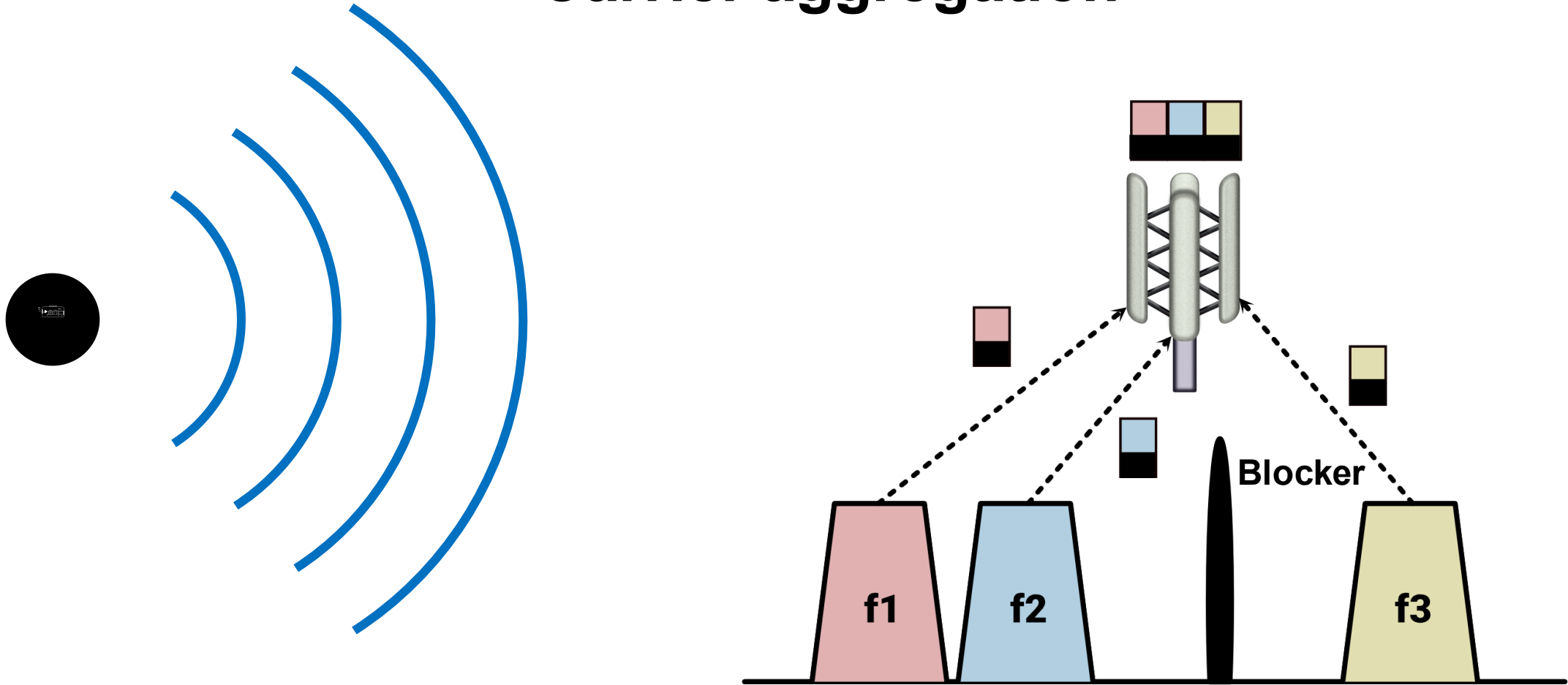


- **Wider channels**
- **Carrier aggregation**
- **Spectrum sharing**
- **Unlicensed frequency bands**
- **More complex modulation schemes**

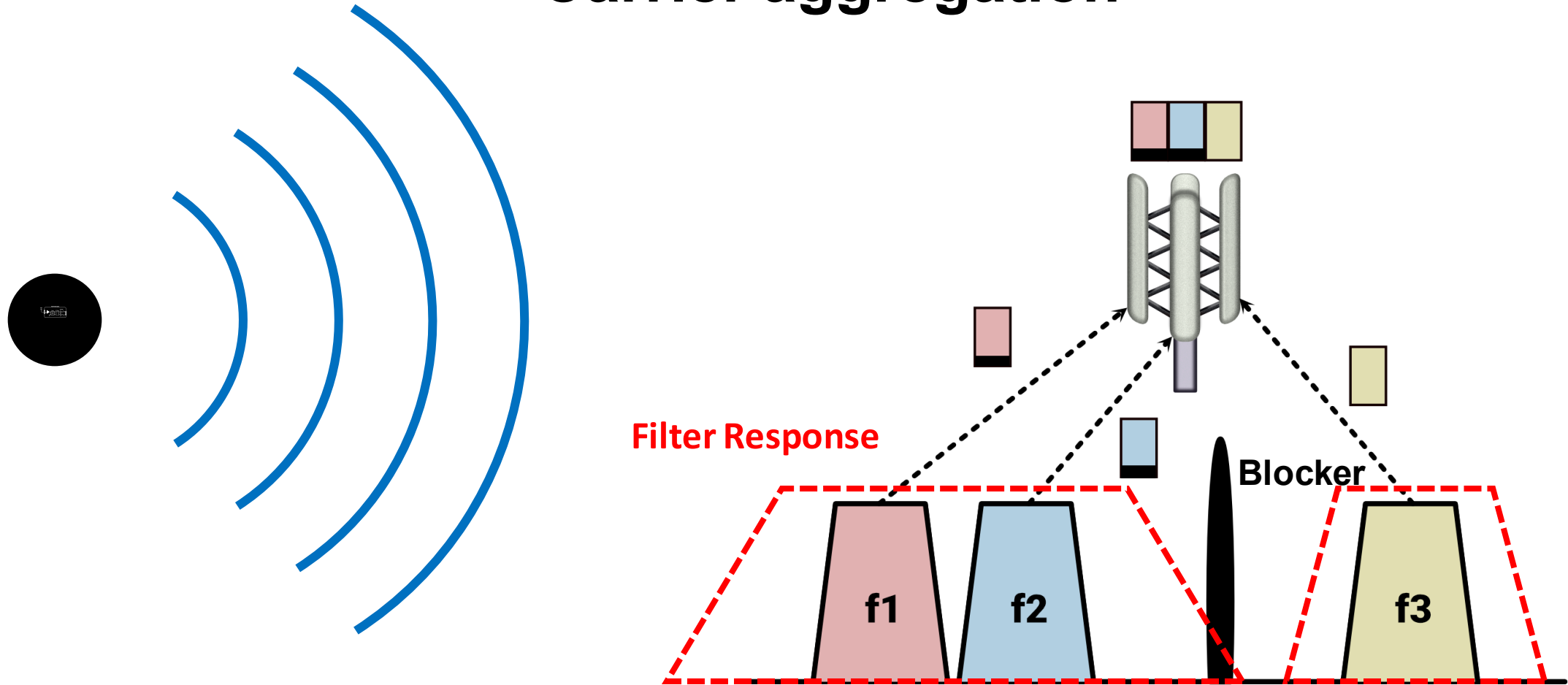
# Carrier aggregation



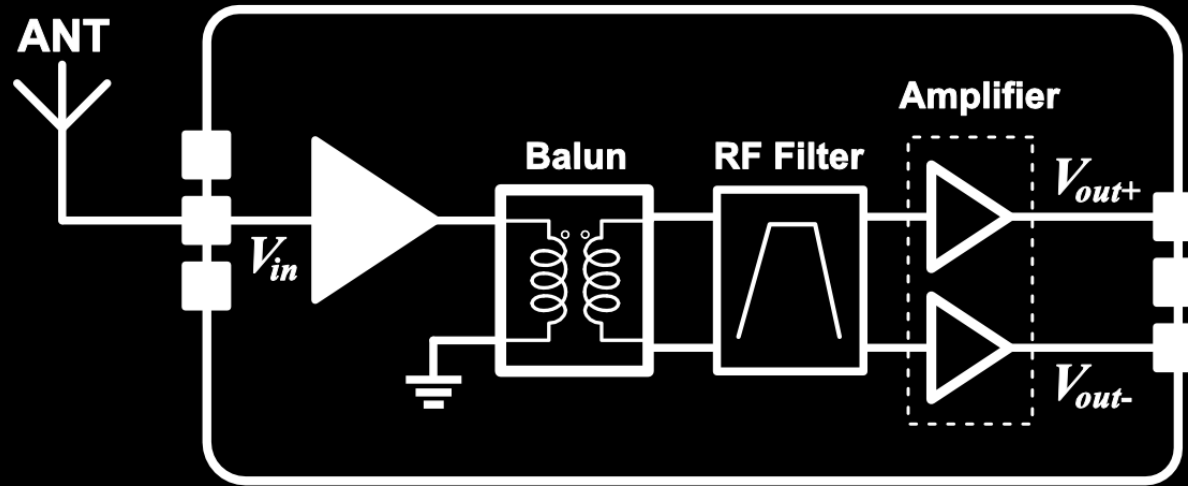
# Carrier aggregation



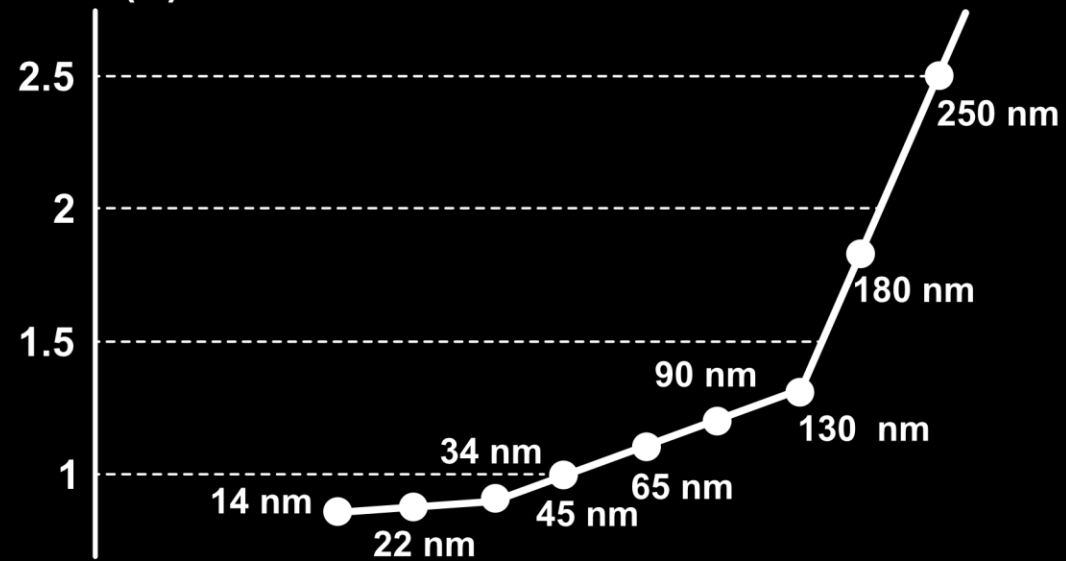
# Carrier aggregation



# RX Front-End

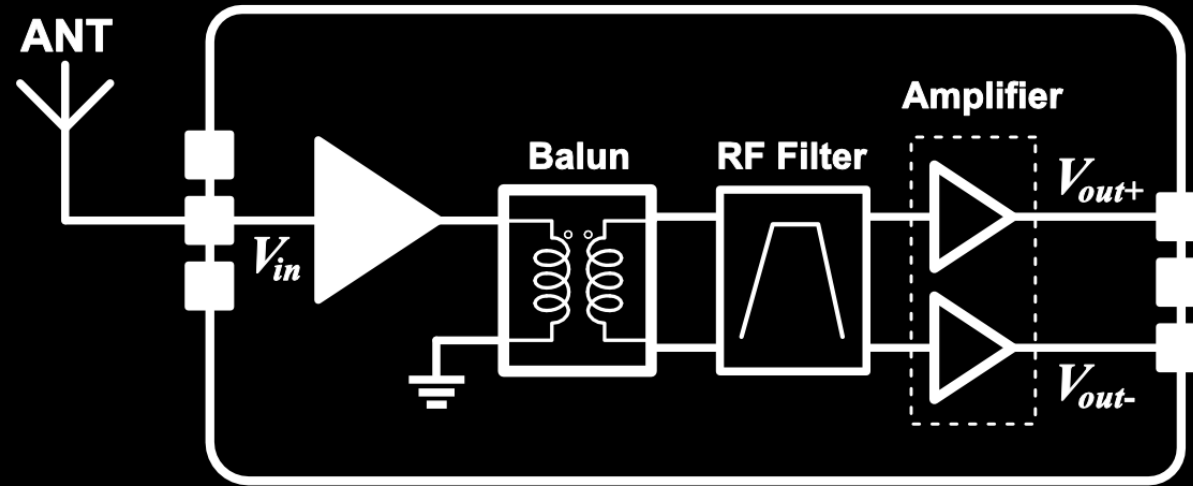


VDD (V)





## RX Front-End



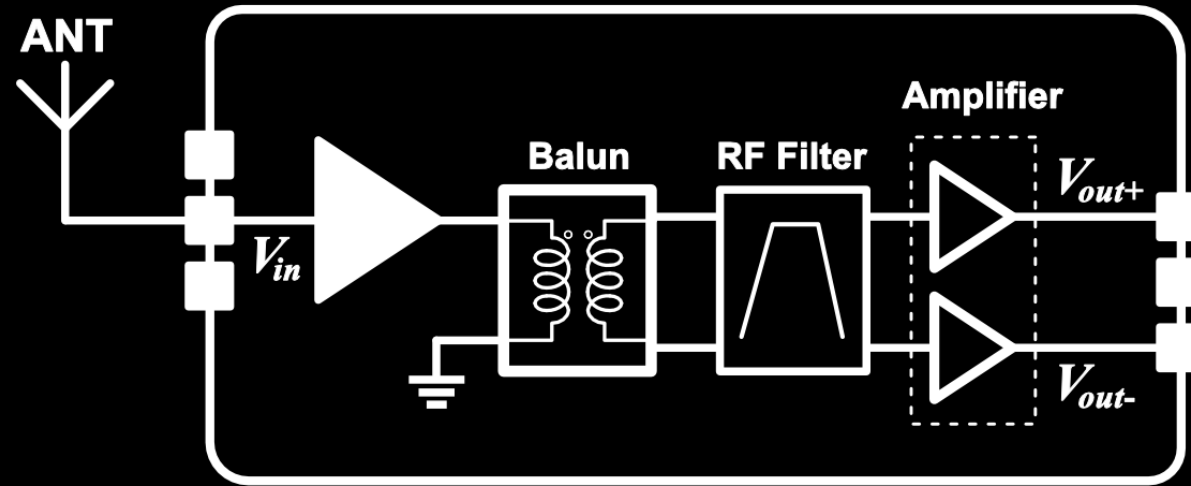
Power Consumption

Blocker Tolerance

Gain Bandwidth

Noise Performance

## RX Front-End



Power Consumption

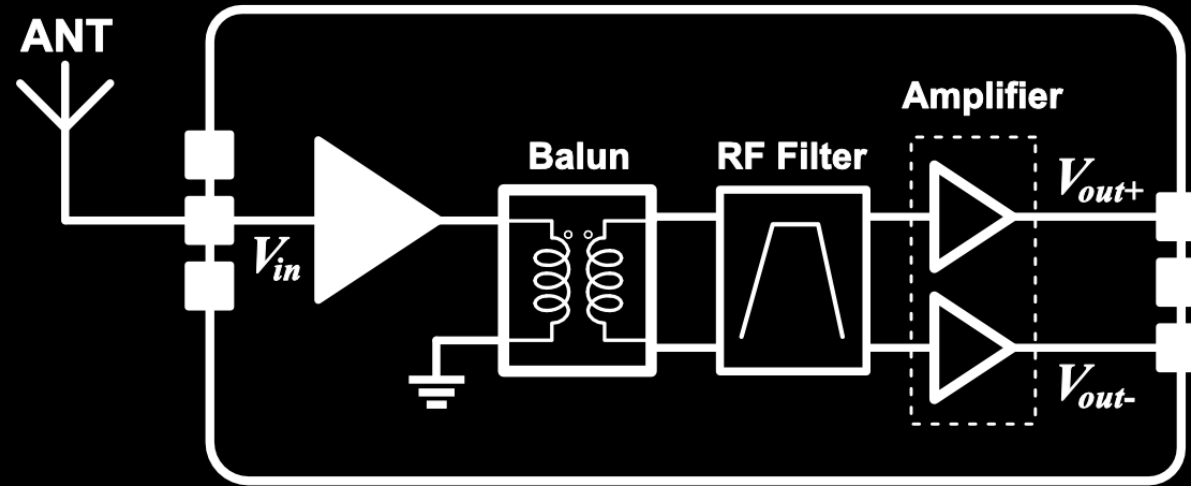
Blocker Tolerance

Reconfigurability

Gain Bandwidth

Noise Performance

## RX Front-End



Power Consumption

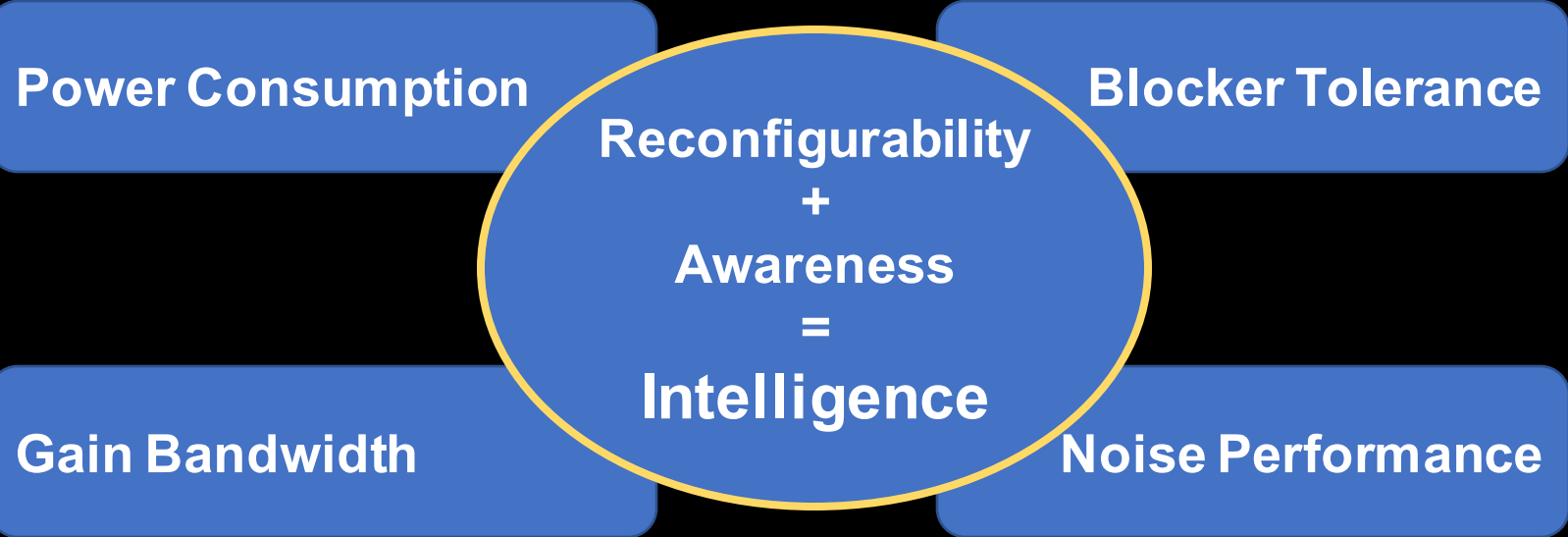
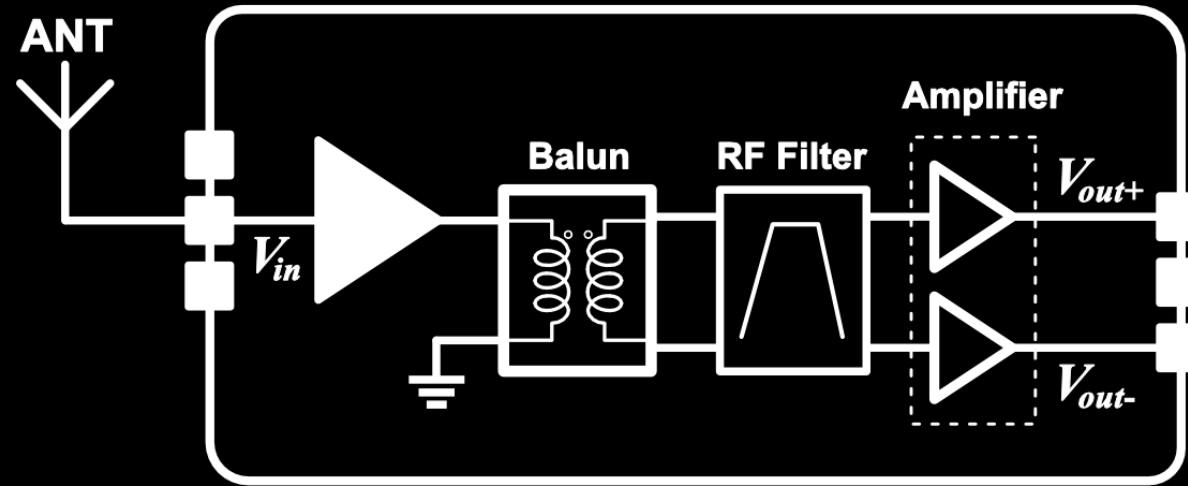
Blocker Tolerance

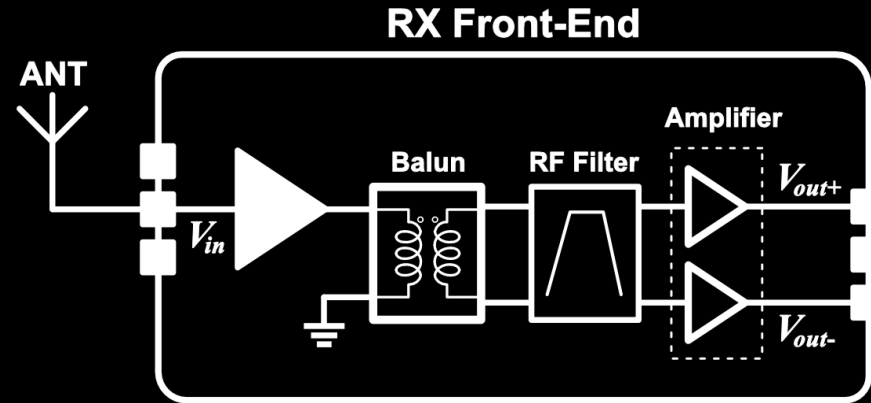
Reconfigurability  
+  
Awareness

Gain Bandwidth

Noise Performance

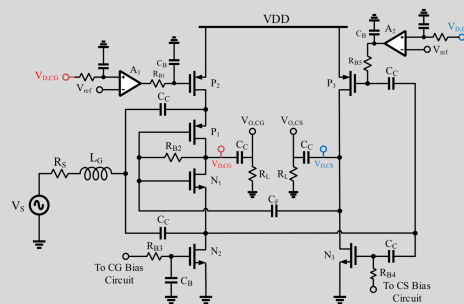
## RX Front-End





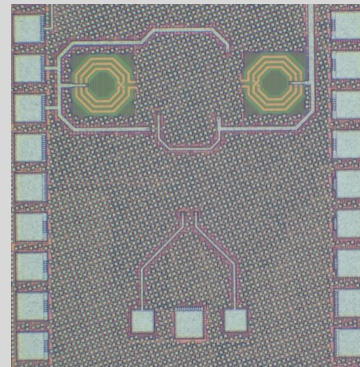
### 5G FR1 LNA

HP and HT Modes

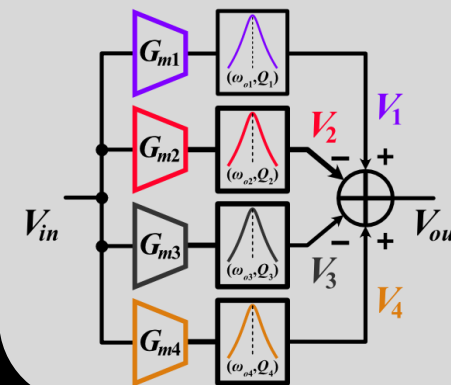


### 5G FR1 Front-End

BW, Power, OOB

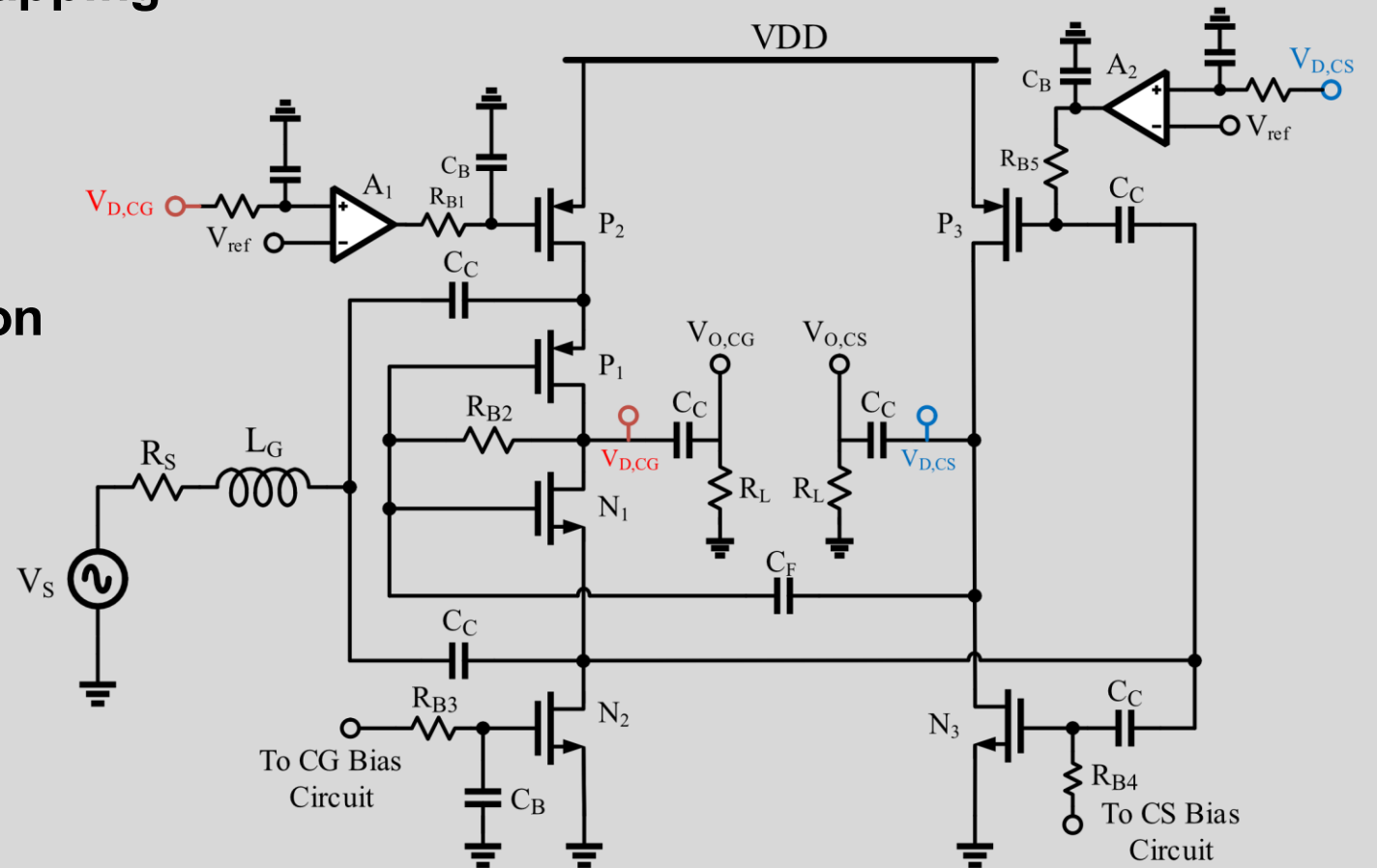


### 6G Upper Mid-Band RFFE



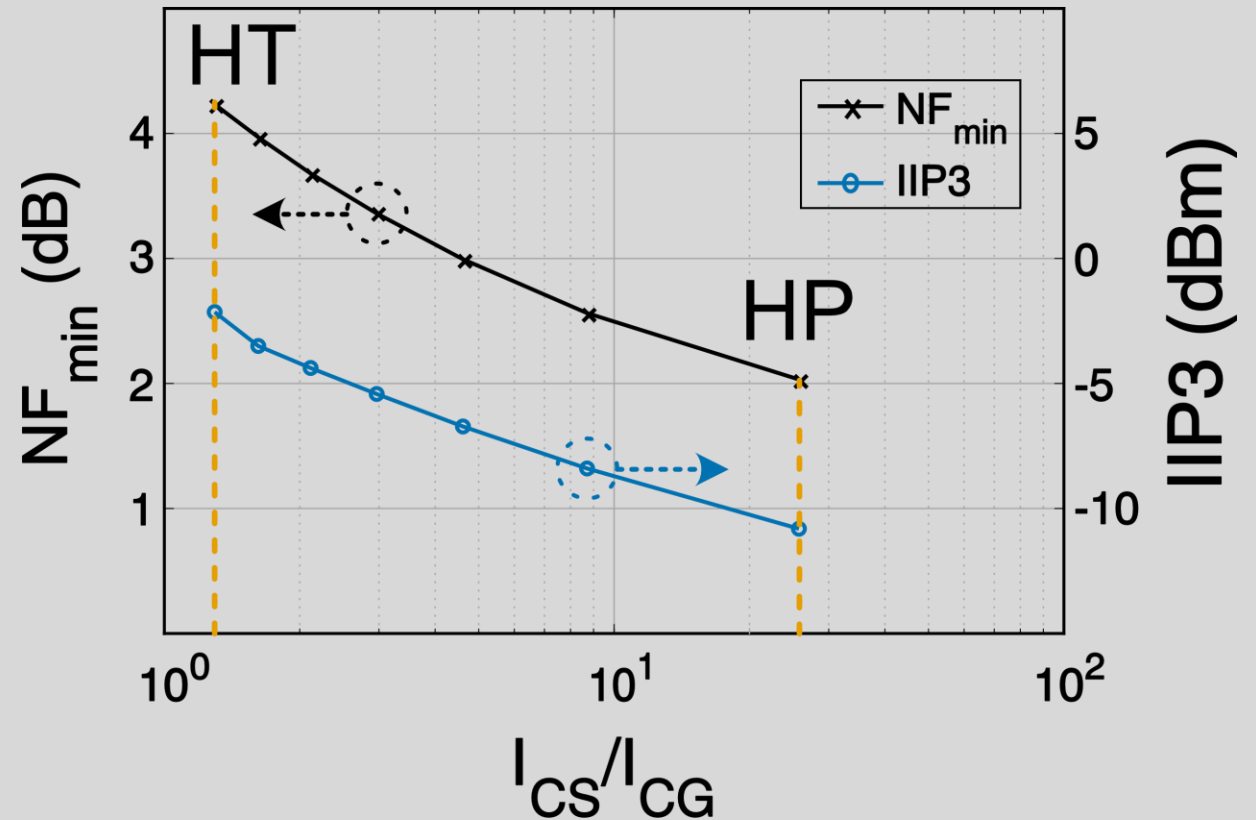
# Wideband Balun-LNA for 5G FR1

- Reconfigurability via current swapping
- 22 nm FDSOI
- 0.8 to 7.3 GHz
- 0.7 to 1.8 mW power consumption
- Forward body biasing (FBB)

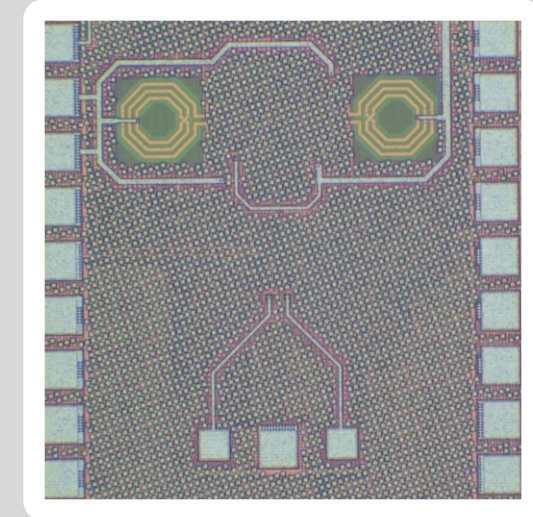
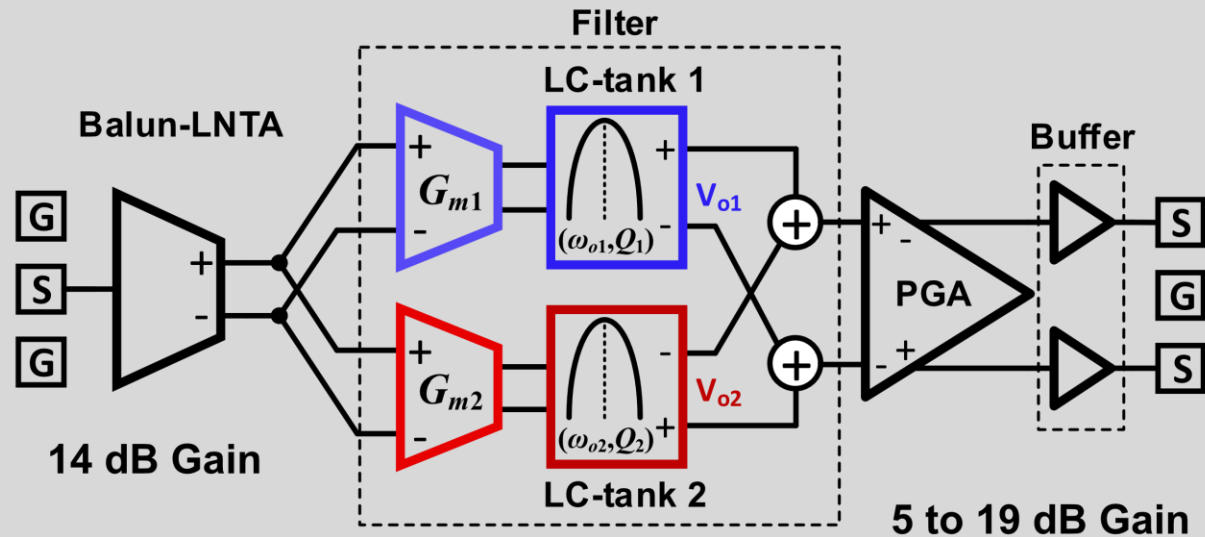


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# Filtering RF Front-End for 5G FR1 Direct Sampling Receivers

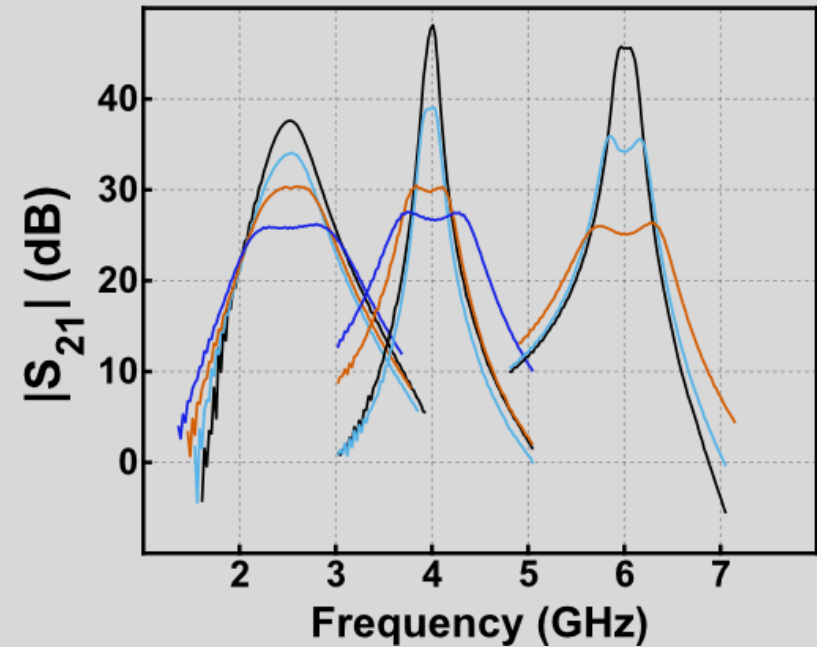


- A **4th-order** Q-enhanced RF filter in 22-nm FDSOI
- Covering the frequency range of **1.7 to 6.4 GHz**
- **1% to 40% FBW** adjustability (50 to 1200 MHz)
- Fulfilling both **sensitivity** and **linearity** requirements

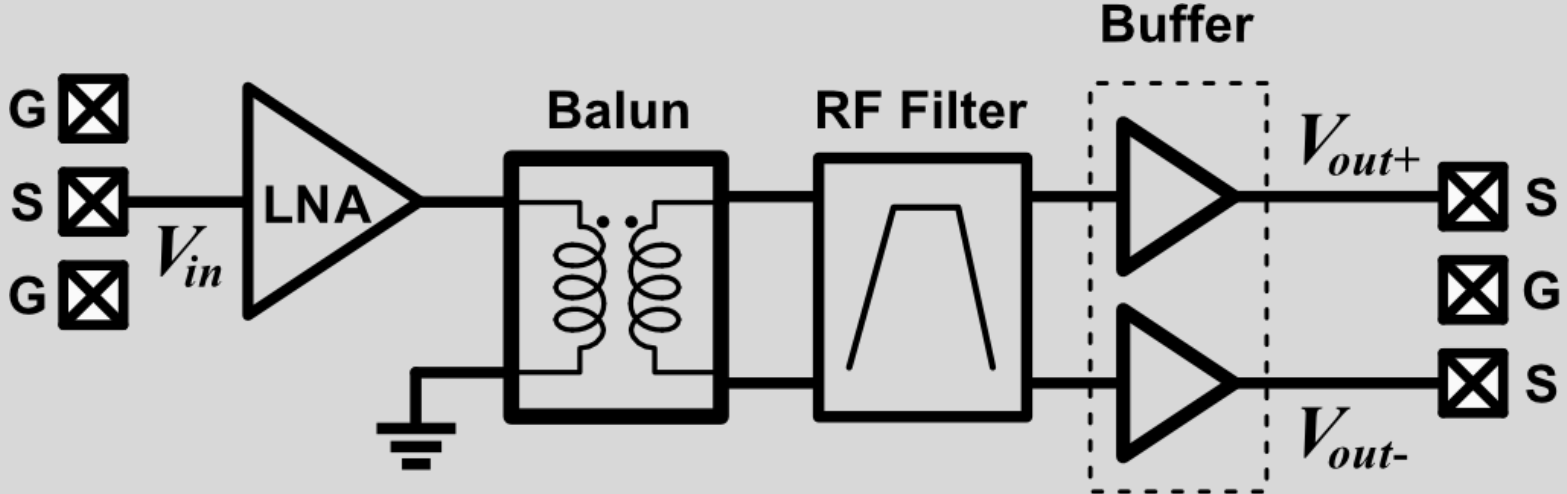
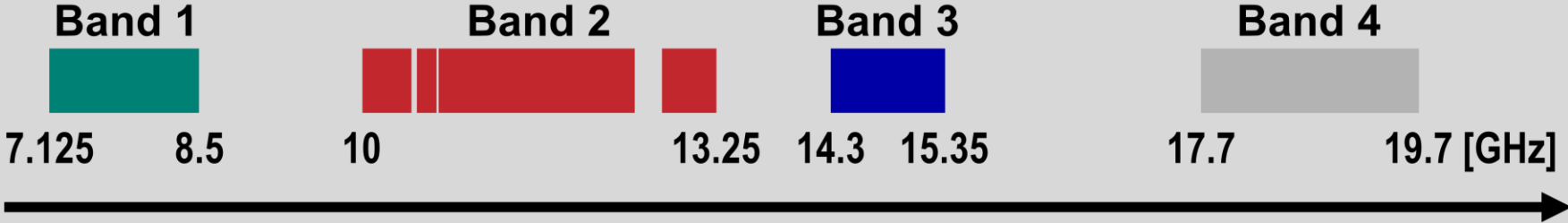


# Filtering RF Front-End for 5G FR1 Direct Sampling Receivers

- Core circuit area: 0.11 mm<sup>2</sup>
- 24 to 45 mW power consumption
- **A low-power, low-voltage, and area-efficient** solution for direct RF-sampling receivers and software defined radios



# Broadband RF Front-End for Upper Mid-Band 6G Receivers





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