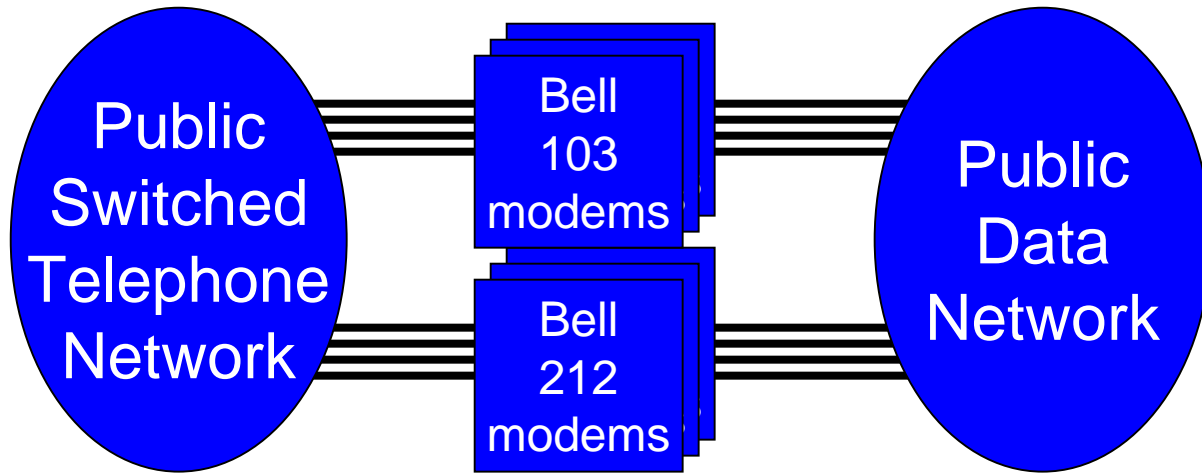# Software Radio –
The Commercial Perspective

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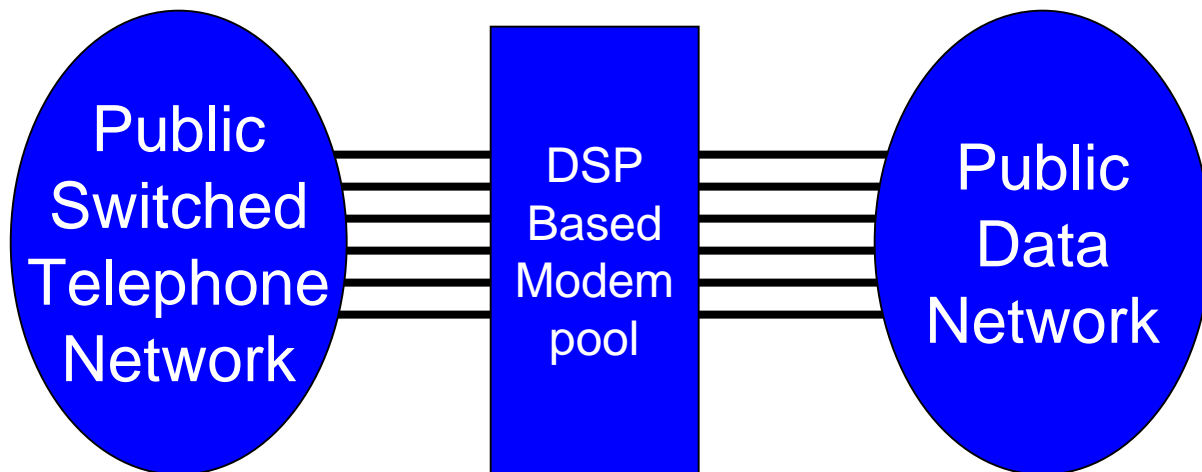
Historical 'Analogue'
of Software Defined Radio

Public Switched Telephone Network

Bell 103 modems

Bell 212 modems

Public Data Network

Circa 1979

- **Under utilized ports**
- **Higher blocking**
- **Susceptible to change**

versus

Public Switched Telephone Network

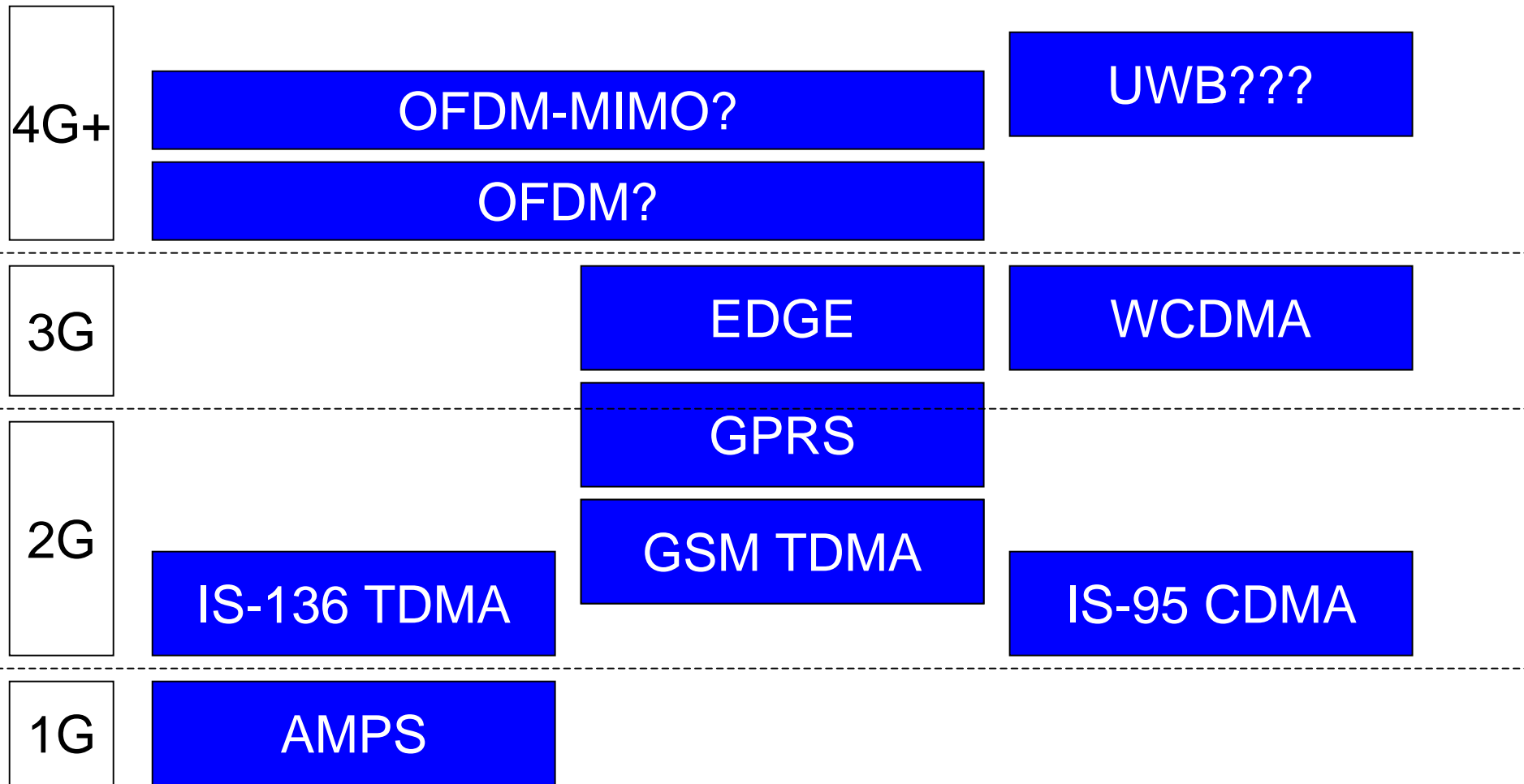**DSP Based Modem pool**
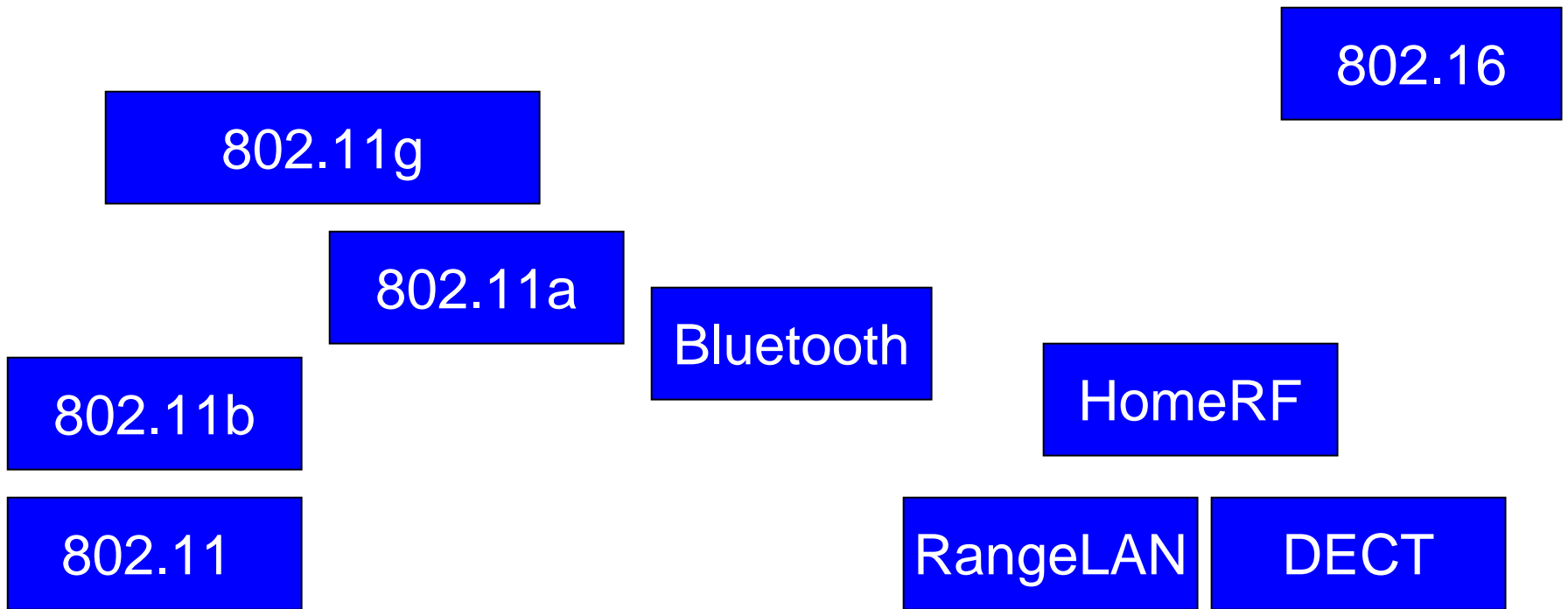
Public Data Network

But:
- **Modems advanced faster than expected**
- **Backwards compatibility was standardized**

- **This is basically where dial-up access has evolved**

Background – Wide Area Systems Evolution

4G+	OFDM-MIMO?	UWB???
	OFDM?	
3G	EDGE	WCDMA
	GPRS	
2G	GSM TDMA	
	IS-136 TDMA	IS-95 CDMA
1G	AMPS	

• **Evolving standards are getting more diverse, not less**

Background – WLAN⁺ Systems Evolution

802.16

802.11g

802.11a

Bluetooth

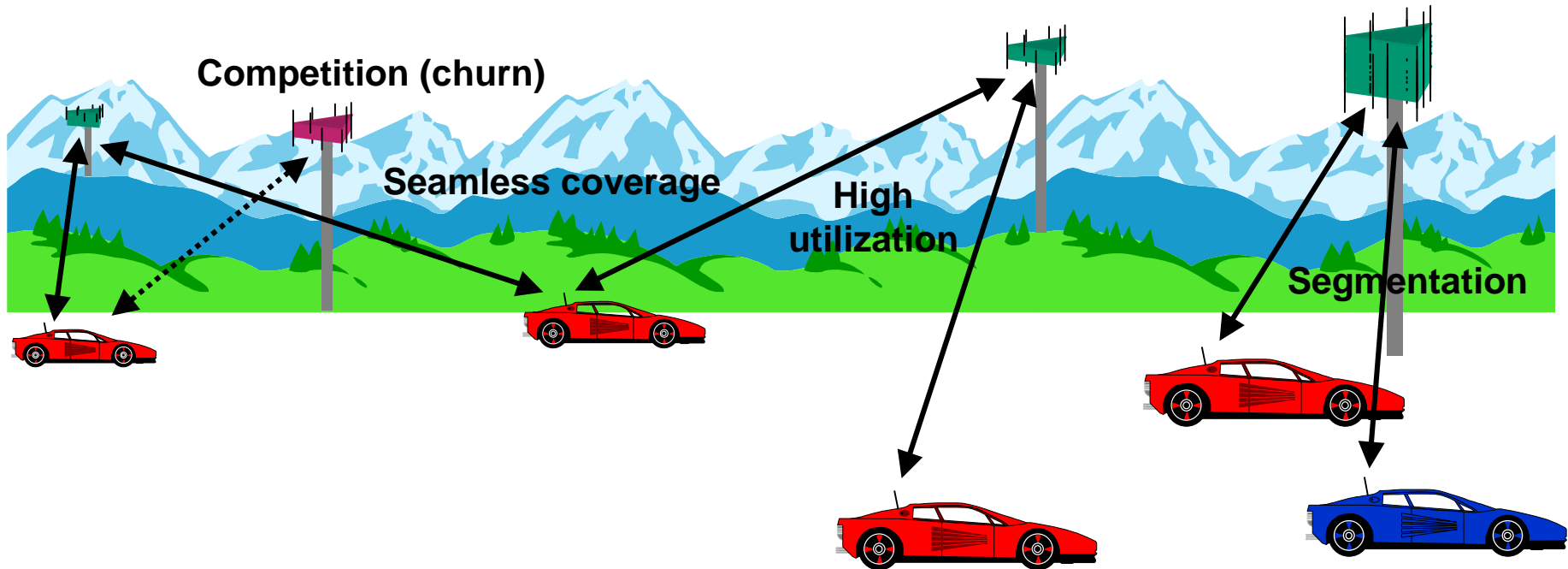802.11b

HomeRF

802.11

RangeLAN

DECT

- **Evolving standards are getting more diverse, not less**

WLAN

vs

Cellular?

Service Infrastructure Provider's Perspective

Competition (churn)

Seamless coverage

High utilization

Segmentation

- **Competition drives down service provider margins**
- **Service evolution complicates network planning**
- **The ability to respond to changing user needs reduces churn**

Base Station/Access Point Supplier's Perspective

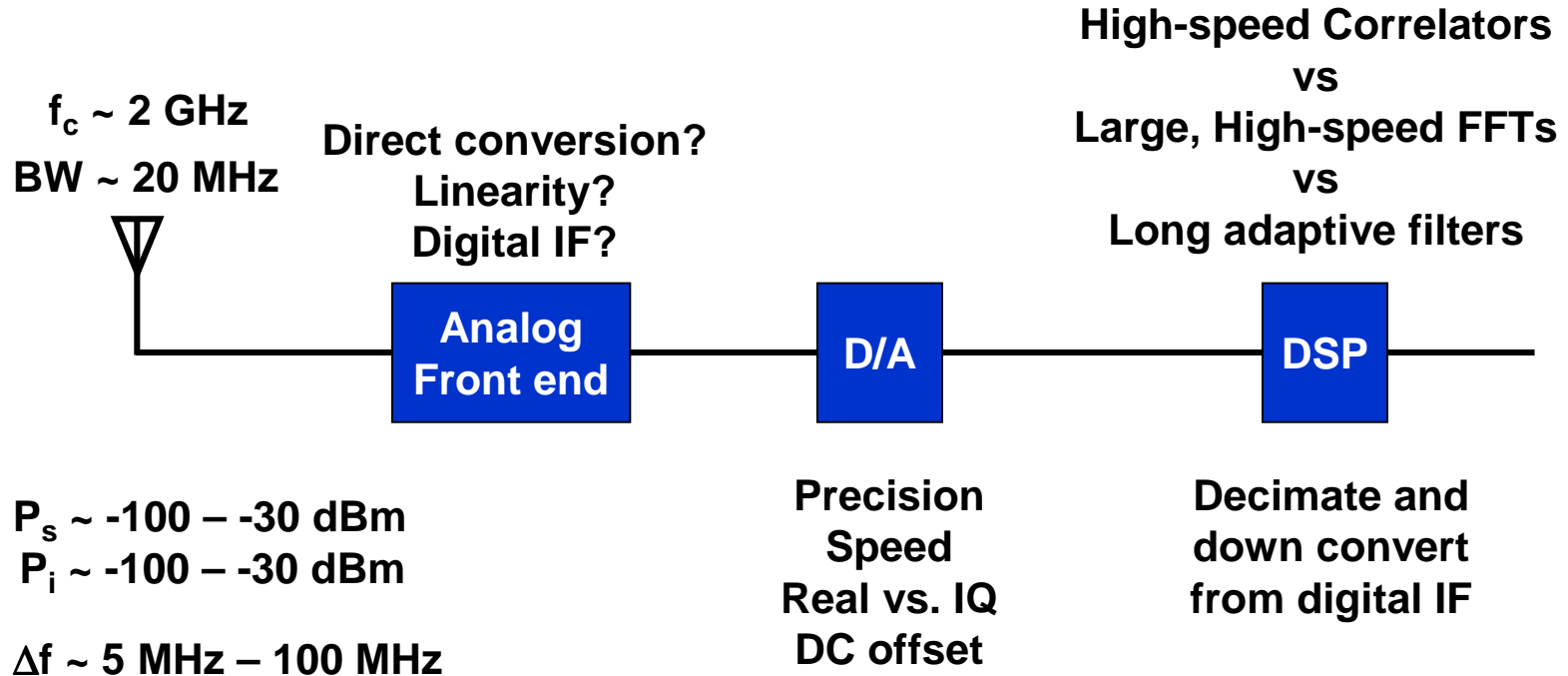
Centralized costs

Design complexity
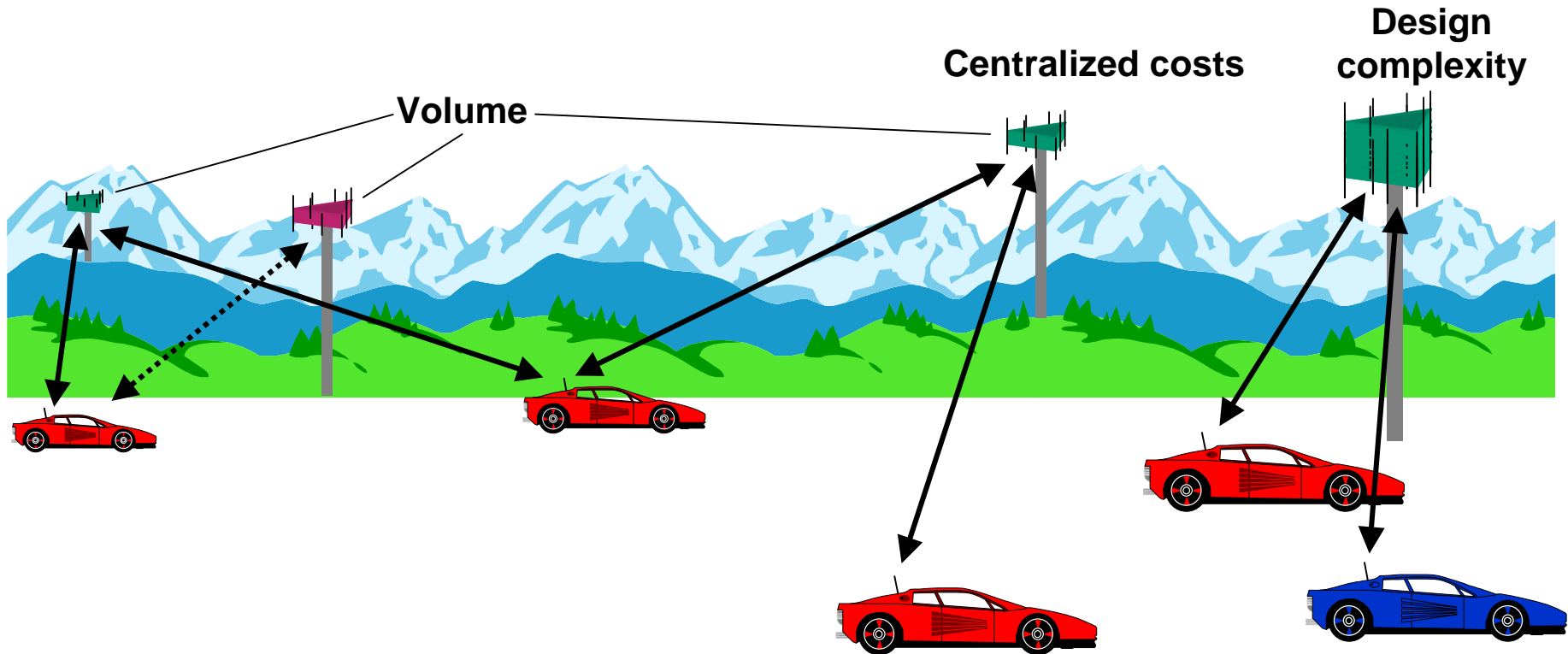
Volume

- Open standards increase competion
- Service provider volumes squeeze equipment providers

Terminal Equipment Supplier's Perspective

Per user costs

complexity

Volume

Size, weight, power
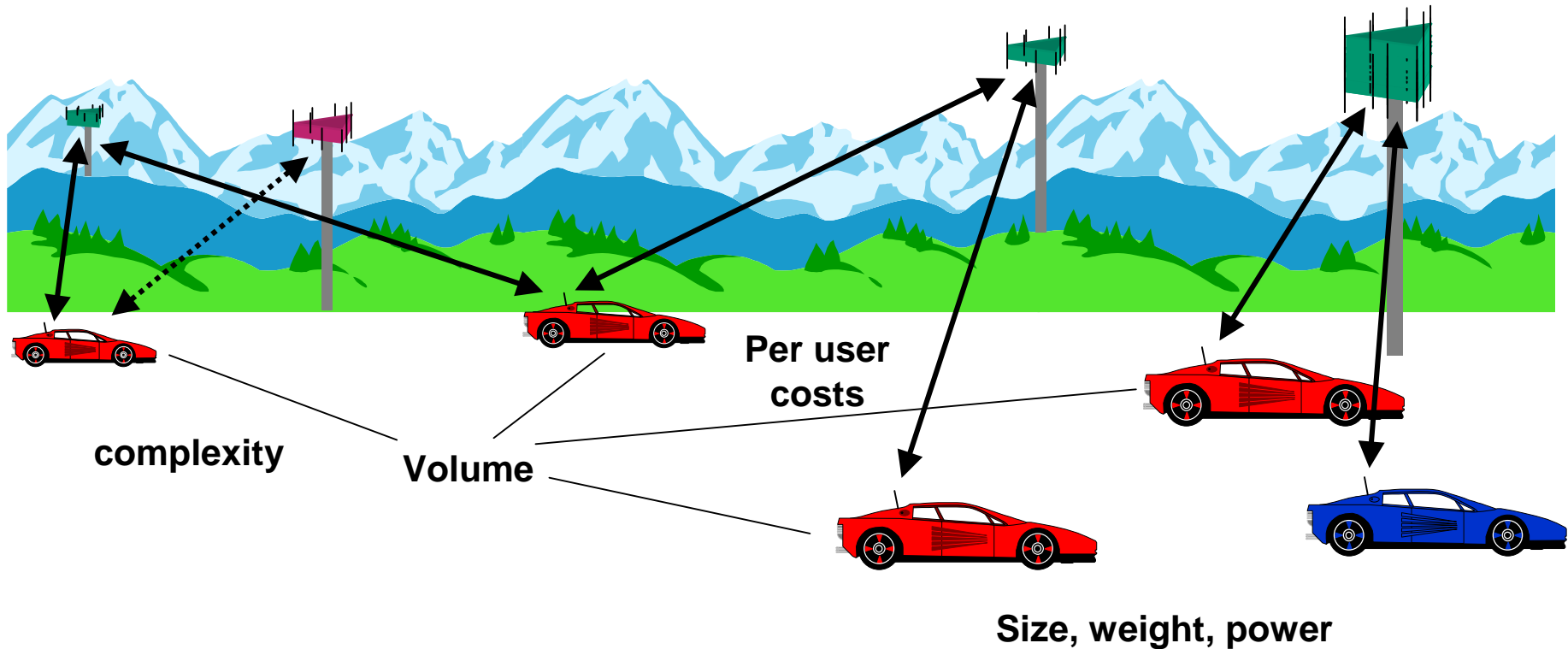
- Service provider rebates are history
- Multivendor competition, little brand loyalty
- Terminal equipment is becoming a commodity

Considerations for a Commercial Software Defined Radio

High-speed Correlators
vs
Large, High-speed FFTs
vs
Long adaptive filters

f_c ~ 2 GHz
BW ~ 20 MHz

Direct conversion?
Linearity?
Digital IF?

Analog Front end

D/A

DSP

P_s ~ -100 – -30 dBm
P_i ~ -100 – -30 dBm

Δf ~ 5 MHz – 100 MHz

Precision
Speed
Real vs. IQ
DC offset

Decimate and down convert from digital IF

Low (average) power consumption for terminal equipment
vs
Duty cycle

Challenges Facing a Commercial Software Defined Radio

- Moving the technology to the terminal
- Making a general purpose terminal as inexpensively as a single function terminal
- Addressing terminal needs beyond the voice-only terminal
  - multimode data transport in PDAs,
  - wireless LAN cards (Bluetooth+802.11b+802.11g)

Conclusion

- Initial Software Radio technology is evolving in base station equipment
- Leading edge chip development houses are starting to apply Software Radio techniques in limited terminal designs
- Will wireless technology:
    - follow top down path – like voice networks (3G…4G)
        - SDR basestations
    - or bottom up deployment – like Internet (WLAN)?
        - multifunction chipsets in PCMCIA cards