Towards 10GHz amplifier design in CMOS

- The effect upon CMOS design due nanometer scaling
- Narrowband versus UWB
- Interesting UWB architectures

Towards 10GHz amplifier design in CMOS

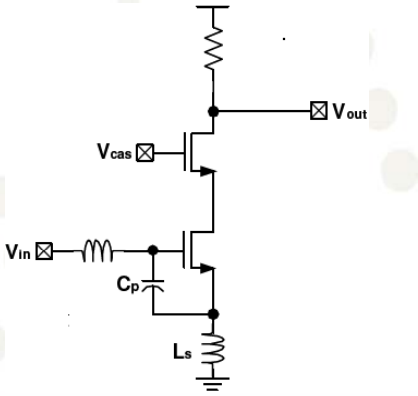
- The effect upon CMOS design due nanometer scaling
  - Higher speed and lower power consumption
  - Decreasing channel length → Lower supply voltage
  - Lower supply voltage → Fewer topologies

Towards 10GHz amplifier design in CMOS

- The effect upon CMOS design due nanometer scaling
- **Narrowband versus UWB**
  - Typical narrowband design approach
  - Typical UWB design approach
- Interesting UWB architectures

Towards 10GHz amplifier design in CMOS

- Typical narrowband design approach
  - Narrowband input matching network
  - Cascoded stage with resistive load



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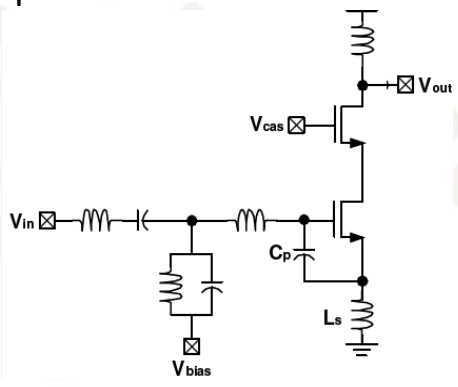
Towards 10GHz amplifier design in CMOS

- Typical UWB design approach
  - Extended input matching filter
  - Inductor load compensates for drop in gain at higher frequencies.



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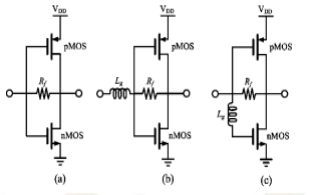
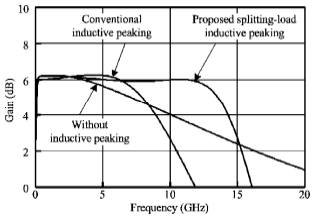
Towards 10GHz amplifier design in CMOS

- The effect upon CMOS design due nanometer scaling
- Narrowband versus UWB
- **Interesting UWB architectures**
  - Inverter architecture
  - Distributed architecture

Towards 10GHz amplifier design in CMOS

- Inverter architecture
  - Simple&good amplifier
  - Relative large gain

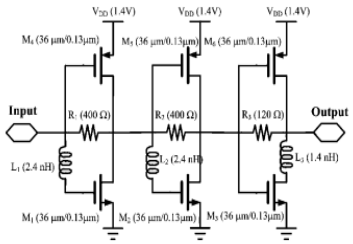




S-F. Chao, J-J Kuo, C-L. Lin, M-D- Tsai and H. Wang (2008) 8

Towards 10GHz amplifier design in CMOS

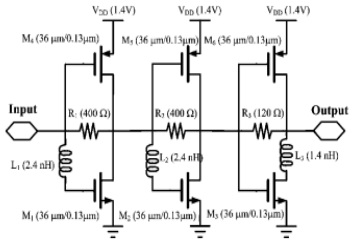
- Splitting-Load Inductive Peaking Technique Chao, Kuo, Lin, Tsai and Wang (2008)
  - Gain: 13.2±1 dB form DC to 11.5GHz
  - NF < 5.6dB



S-F. Chao, J-J Kuo, C-L. Lin, M-D- Tsai and H. Wang (2008)

Towards 10GHz amplifier design in CMOS

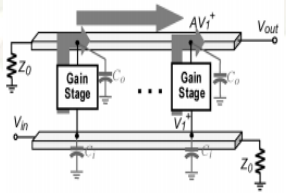
- Splitting-Load Inductive Peaking Technique Chao, Kuo, Lin, Tsai and Wang (2008)
- Possible improvements:
  - Adjustable gain
  - Lower the NF
  - Pseudo differential



S-F. Chao, J-J Kuo, C-L. Lin, M-D- Tsai and H. Wang (2008)

Towards 10GHz amplifier design in CMOS

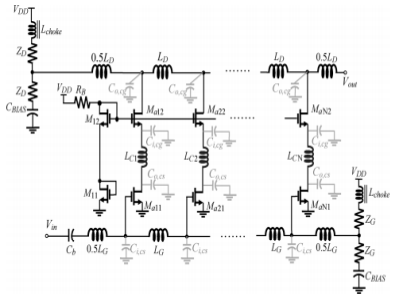
- Distributed amplifiers
  - Introduced in 1936 by William S. Percival
  - Amplifier cells connected together with TL →Greater GBW than a single cell
  - Suitable technology for IC design



P. Heydari (2007)

Towards 10GHz amplifier design in CMOS

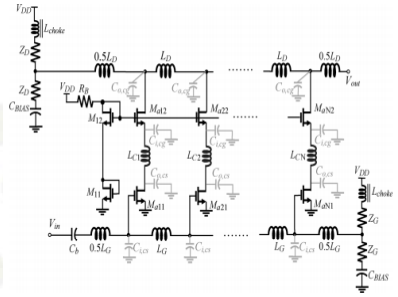
- UWB Distributed LNA, Payam Heydari (2007)
  - Coupling inductor and parasitic capacitance create artificial TL
  - Gain: 8dB from 0.1GHz to 10.6GHz
  - NF: 2.9dB



P. Heydari (2007)

Towards 10GHz amplifier design in CMOS

- UWB Distributed LNA, Payam Heydari (2007)
  - Coupling inductor and parasitic capacitance create artificial TL
- Possible improvements:
  - Adjustable gain
  - Different inter stage network



P. Heydari (2007)

Towards 10GHz amplifier design in CMOS

- Summary:
  - Technology scaling introduces new design challenges in CMOS
  - The GBW required from UWB LNA's opens for new (and some old recycled) and novel design techniques.

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- References:

- S-F. Chao, J-J Kuo, C-L. Lin, M-D- Tsai and H. Wang, "A DC-11.5 GHz Low-Power, Wideband Amplifier Using Splitting-Load Inductive Peaking Technique," in *IEEE Microwave and Wireless Components Letters*, Vol 18, NO 7, July 2008
- P. Heydari, "Design and Analysis of a Performance-Optimized CMOS UWB Distributed LNA," in *IEEE Journal of Solid-State Circuits*, Vol 42, No 9, September 2007
- S.B-T. Wang, *Design of Ultra-Wideband RF Front-End,* Berkeley: PhD dissertation, University Of California, Berkeley, 2005
- W. Sansen, *Analog Design Essentials*, Springer, 2006