

The Future of Wireless Communications – a Glimpse Beyond the Horizon

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CohdaWirelessTM
Mobile Broadband



ACoRN
ARC Communications Research Network

(Mobile) Wireless Broadband Battle

- Muni-Wireless
 - Is wireless broadband a human right?
- 3G/4G, Wi-Fi, WiMax
- *Wi and WiNot - The Dirty Little Secret*
 - David against Goliath



CohdaWireless™
Mobile Broadband

Can we make giant leaps by evolving systems designed to avoid hard problems?

Hard Mobile Wireless Challenges

Physical Layer Challenges???

- Limited bandwidth
 - High user data rate
 - Multiple access
 - Mobile user population
 - Coverage
- Harsh environment
 - Fading due to mobility
 - Interference
 - Power

Avoid these problems through system design?

OR

Solve the problems where they occur?

Physical Layer Invasion

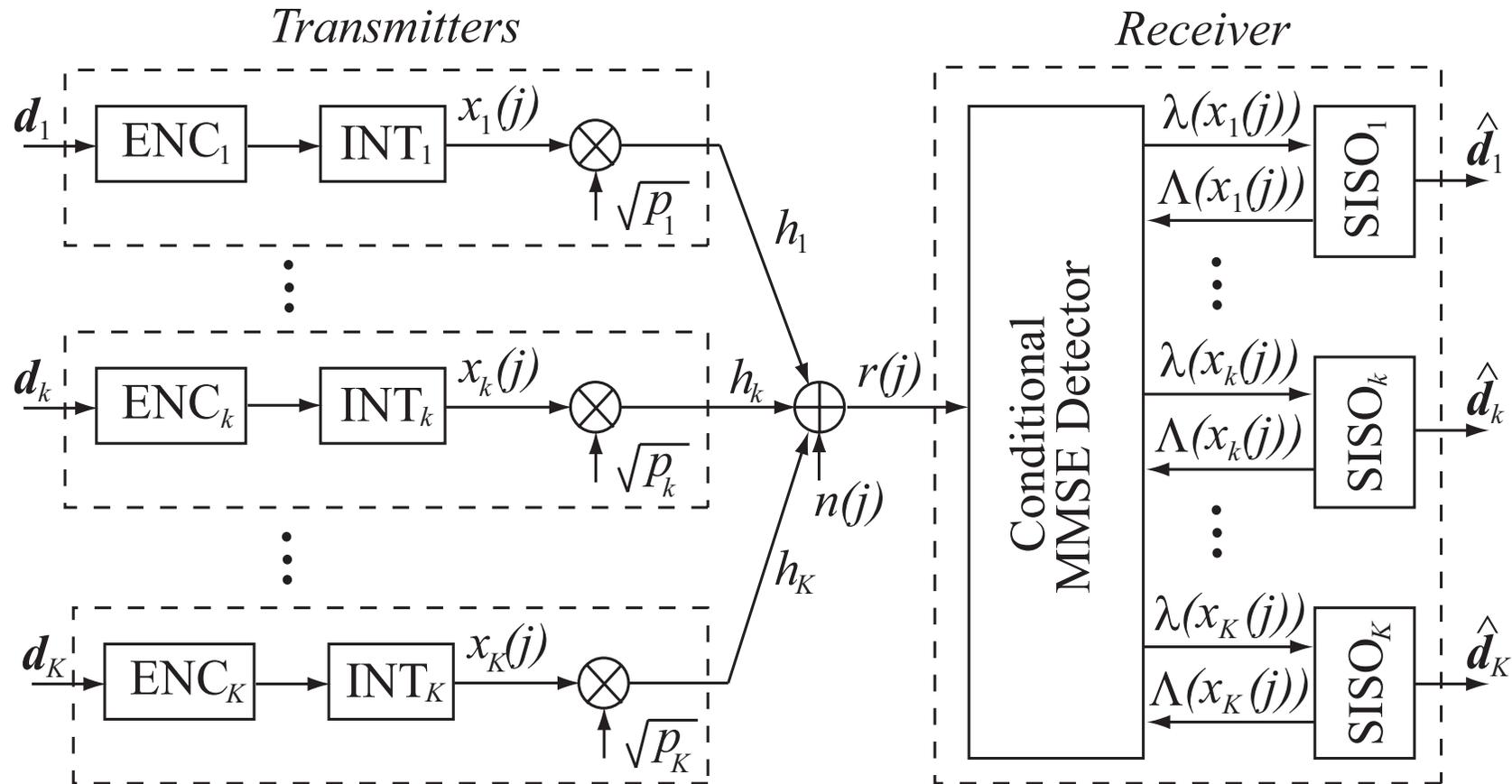
Moving from point-to-point bit pipes to *multi-terminal network bit flows*

- P2P bit pipes
 - MIMO
 - MIMO-ARQ
 - LDPC/Turbo
 - OFDM
- Network bit flows
 - Multiuser detection
 - Cooperative communications
 - Multiuser-ARQ
 - Peer-to-peer communications
 - Network coding

Is a unifying physical layer framework required for successful joint exploitation of emerging technologies?

Strong Candidate for Unifying PHY Technique

- Multiple access, high data rate, space-time, MIMO, ARQ



- [MaLiP04] X. Ma and Li Ping, "Coded modulation using superimposed binary codes", *IEEE Trans. Inform. Theory*, vol. 50, pp. 3331–3343, Dec. 2004.
- [LiPLiu06] Li Ping, L. Liu, K. Y. Wu, and W. K. Leung, "Interleave-division multiple-access", to appear in *IEEE Trans. Wireless Commun.*

Where Could We Be Heading?

- Technologies knocking on the door
 - Selective cross-layer design
 - Exploiting *all diversity*
 - **Controlled peer-to-peer communications**
- Beyond the Horizon
 - *Solving physical layer problems at physical layer*
 - **Merging layer design**



Evolution or Revolution?

Cross-Layer Design or Merging Layer Design?