Proposal for generic channel model in 802.16m

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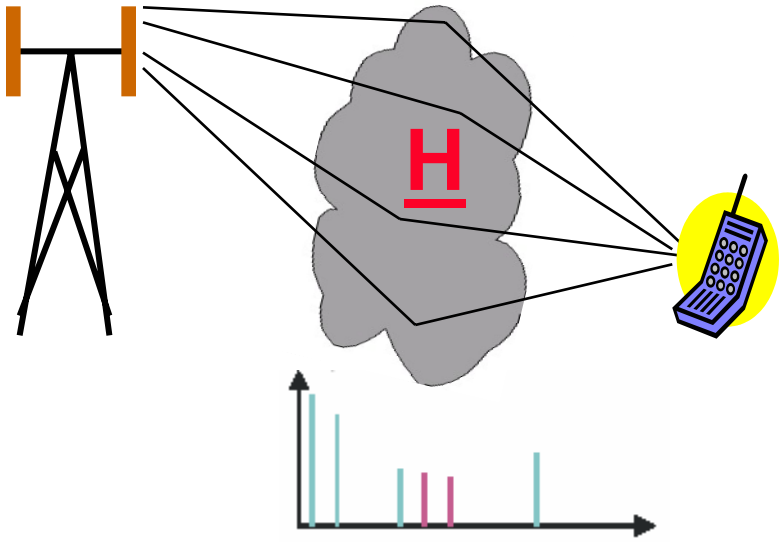
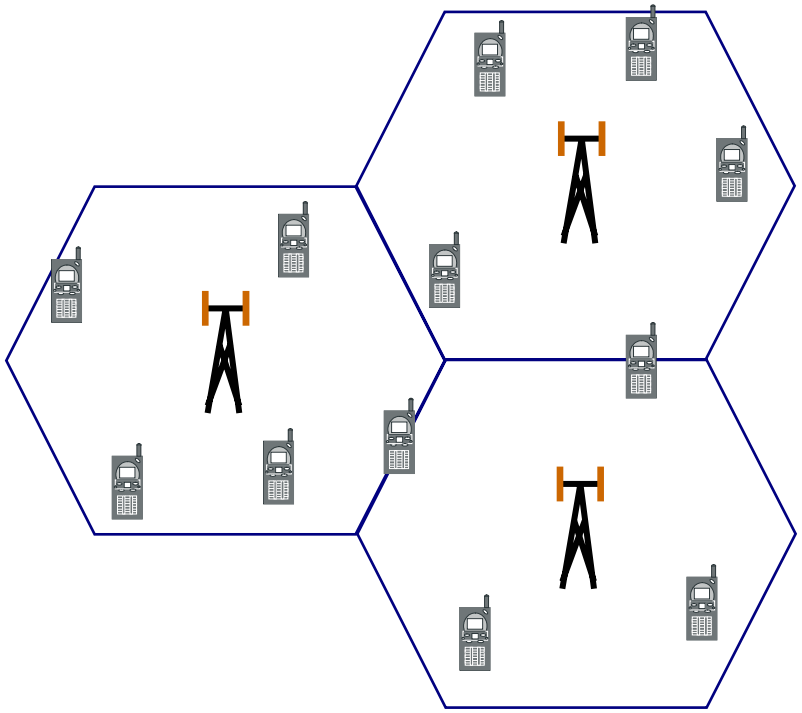
Channel Model Requirements: Link level vs. system level

Link level



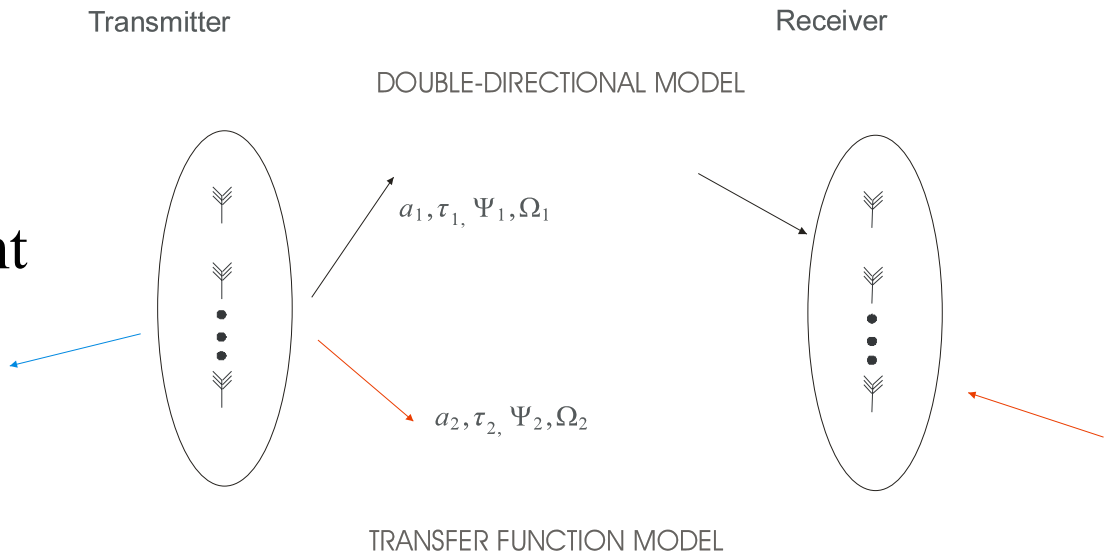
System level



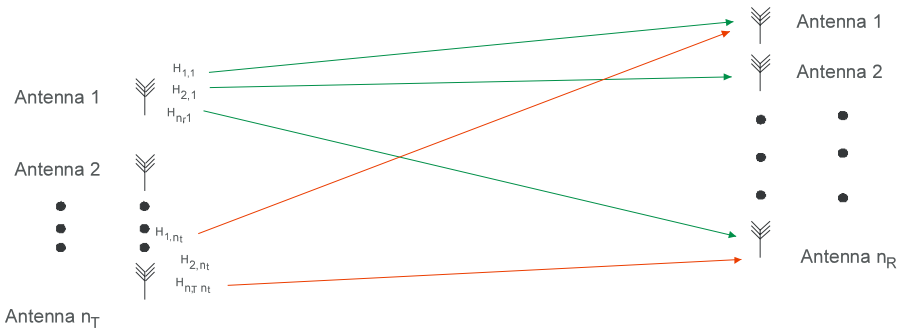
Impulse responses for all antenna combinations

Types of description methods

- Double-directional
  - Channel-centric
  - Array-independent



- Transfer functions
  - Antenna centric
  - Array-dependent



Comparison of description methods

- **Double-directional model**
  - Describe amplitude, delay, DOA, DOD of MPCs
  - Independent of antenna configuration
  - Equivalent to scatter location

$$h(\tau,\Omega_R,\Omega_T) = \sum_{i=1}^{N} h(\tau_i,\Omega_{R,i},\Omega_{T,i}) = \sum_{i=1}^{N} a_i e^{j\phi_i}\delta(\tau-\tau_i)\cdot\ \delta(\Omega_R-\Omega_{R,i})\ \delta(\Omega_T-\Omega_{T,i}).$$

- **Transfer function matrix**
  - From each transmit to each receive antenna element
  - Depends on antenna configuration

$$h(\tau,x_R,x_T) = \sum_{i=1}^{N} h(\tau_i,\Omega_{R,i},\Omega_{T,i})\cdot g_R(\Omega_R)g_T(\Omega_T)\cdot\ e^{j\left\langle\vec{k}(\varphi_{R,i})\vec{x}_R\right\rangle} e^{j\left\langle\vec{k}(\varphi_{T,i})\vec{x}_T\right\rangle}$$

- **Conversion:**
  - can always get from DD to transfer matrix, but not vice versa.
  - Transfer function cannot be generalized to different antenna configuration

Types of models

- Deterministic
- Purely stochastic
- Geometry-based stochastic

Deterministic models

- Stored measured impulse response or ray tracing
- Advantages:
  - good agreement with physically existing results (site-specific)
  - reproducible
- Problems:
  - need not be typical
  - large data bases required
  - expensive to produce
  - parameters cannot be changed easily
- Conclusion:

  suitable for site-specific modeling, but not system development

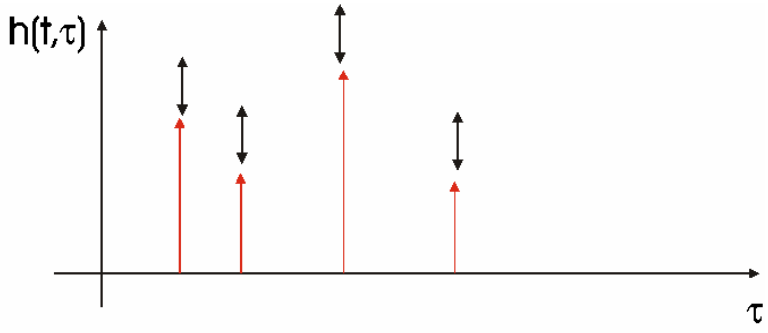
Stochastic channel models

- Multidimensional probability density function of CIR
- Advantage:

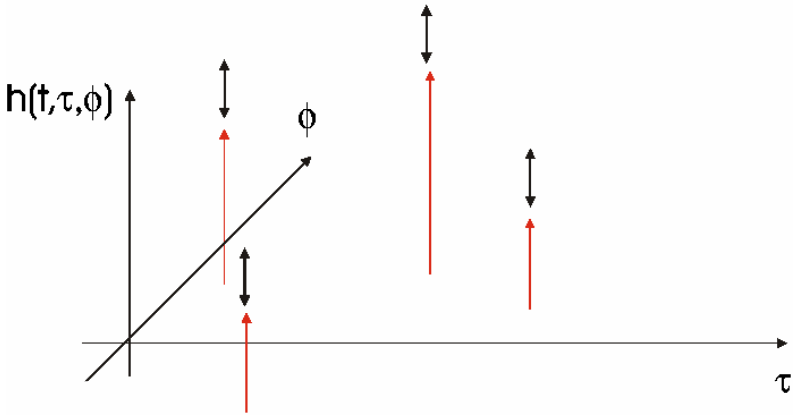
  fast
- Problem:

  difficult to parametrize over large areas

Standard WSSUS model – tapped delay line realization



Generalization to spatial dimension

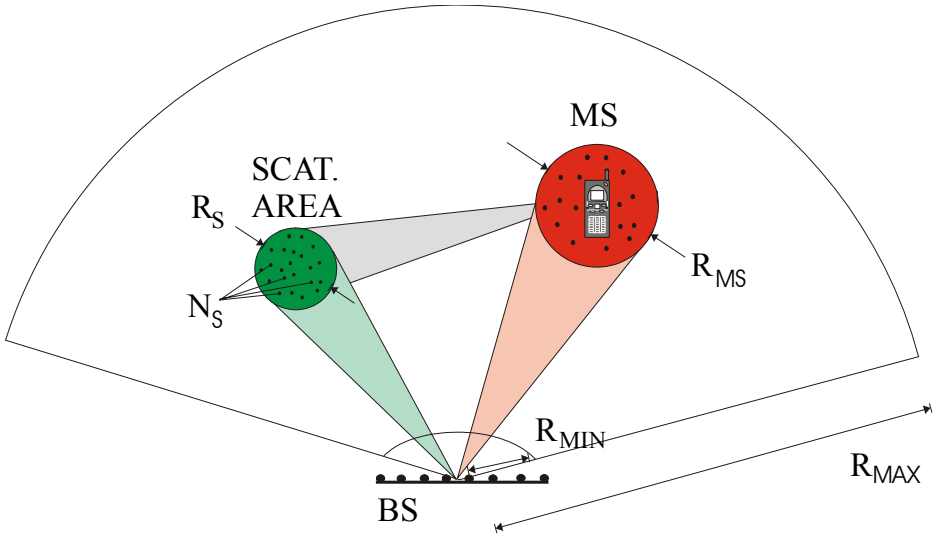


Geometry-based stochastic channel model (GSCM)

- Prescribe probability density function of scatterers
- Specular reflection
- Simple ray tracing
- High-rise building groups (urban) or mountains (rural)
  - Increase of temporal and angular dispersion
  - Far scatterers fixed in space
- Advantage:

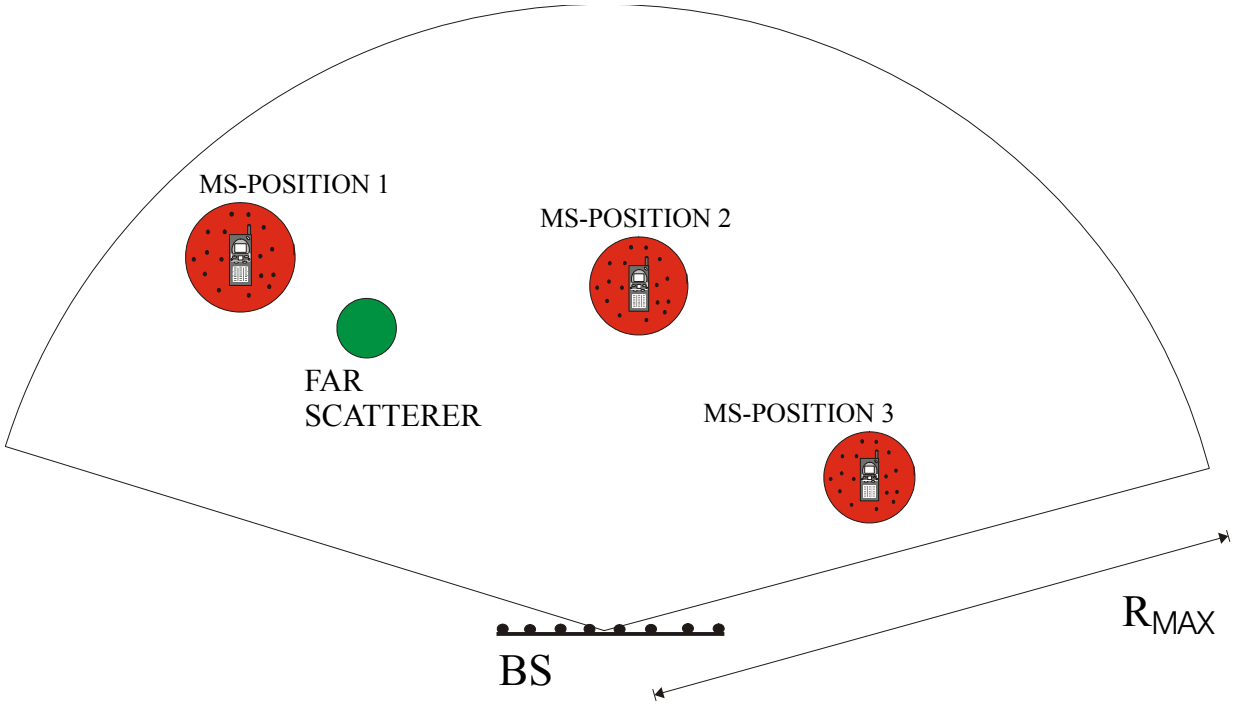
  Better for large areas
- Problem:

  Slightly slower for small-scale computations



Temporal evolution - GSCM

- Temporal evolution of channel easily implemented
- Correlation between changes of DOAs, delays, etc. implicit; Correlation between signals at antenna elements also implicit



Existing models

- COST 259: good basis
- 3GPP: widely accepted subset of COST 259, only small number of environments
- 802.11n: for indoor, but no elevation, no polarization
- COST 273: parameterization not complete
- Winner: good 100 MHz MIMO measurements, but some extracted parameters are questionable

Suggested model and model parameters

- Use cluster-based model
  - Easier to parameterize
  - Follows model of 3GPP, COST 259, COST 273
- Define environments of interest
  - Should include peer-to-peer, outdoor-to-indoor, …
- Set of parameters
  - See MS-Word document

Summary and conclusion

- Recommend to use model that is
  - Stochastic (with geometric component)
  - Double-directional (with possible example realization of transfer function)
  - Cluster-based
- Define all environments of interest
- Parameterization in the environments should be done by concerted effort until May

THANK YOU !