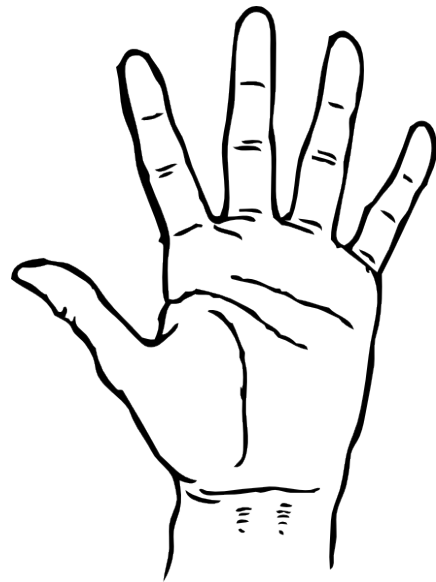


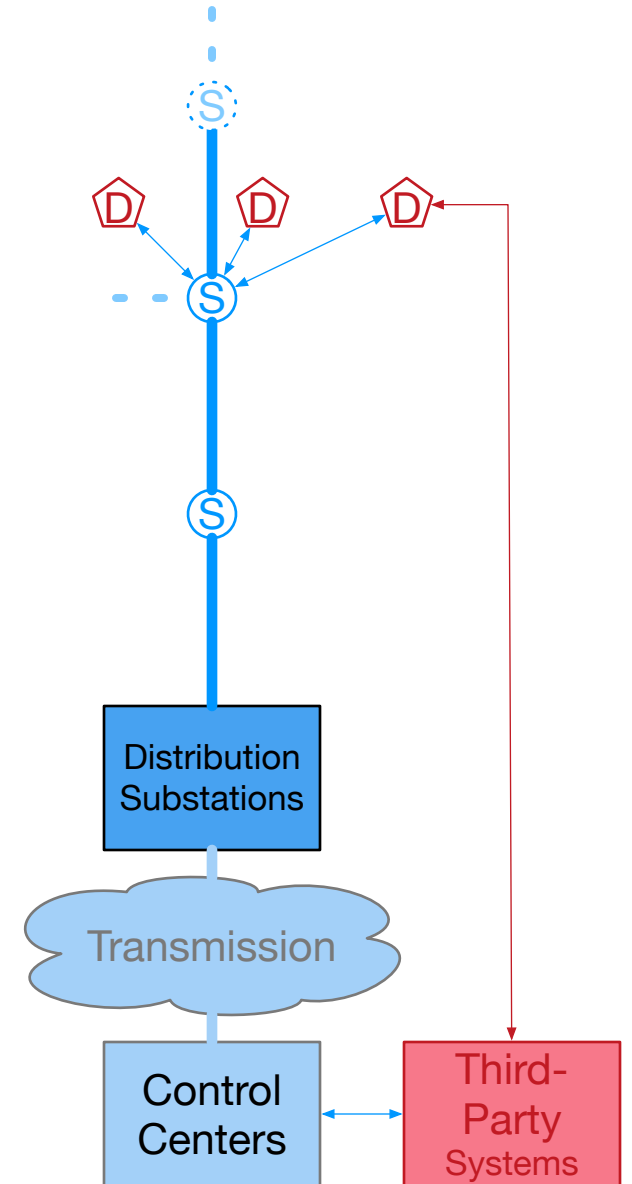
Michael B Robinson

Business Architect
Digital Transformation Group














Principles for Addressing Distribution Grid Needs

- 1** **Modularize** the distribution grid in terms of electric operation, communication, security and information flows. Seek harmony between autonomy and federation.
- 2** Maximize reliability through **systematic diversification** of resources. (Supply, connectivity, control)
- 3** Balance operational, financial, and innovation risk by **maintaining private and public** infrastructure elements and support
- 4** Innovate distribution grid operations by using **edge-, substation-, control center- and third-party- compute** systems
- 5** Design for both **legacy** and foreseeable (industry standard) **new applications**
- 6** Optimize business cost structure (CAPEX+OPEX) and business flexibility through **virtualization** with appropriate performance and quality service levels. (Multi-service grid devices, multi-service communication networks, virtual computing)

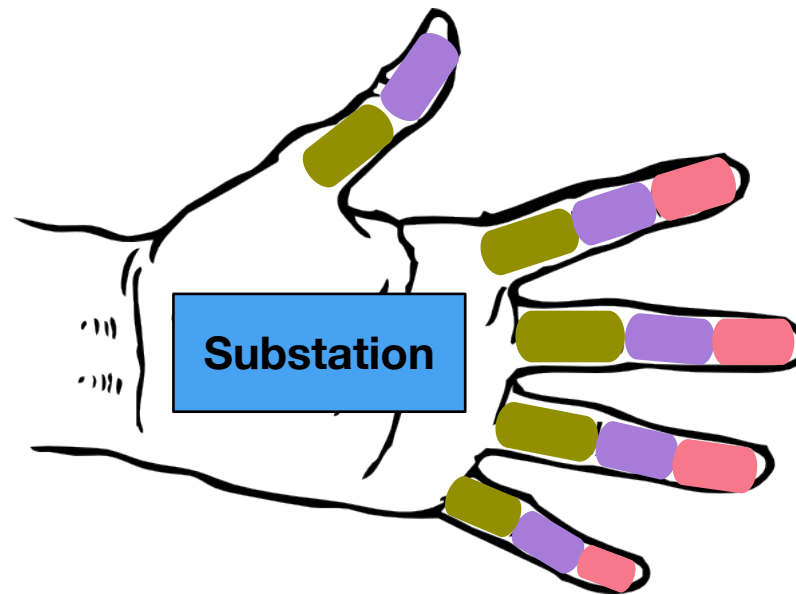







Characterizing and Forecasting What We Are Solving For

Distribution Grid Application											
Device Type	Meter Collector	AMI Meter	Sectionalizer	Fault Location	CapBank Control	Street Light	Voltage Regulator	DER Ext Comms	DER Int Comms	Charging Station	Mobile Worker
Quantity	900	462,600	3,600	8,100	900	50,000	900	27,000	243,900	??	??
Low Latency	8 hour cycle		< 3 sec		< 3 sec		< 3 sec	< 3 sec	15 sec control	< 3 sec	< 50 msec
Non-Low-Latency	8 hour read cycle	15 min read cycle		5 min read cycle	> 3 sec	1 hour	> 3 sec	15 min read cycle	15 min read cycle	> 3 sec	
Bandwidth	400 kbps / collector	9.6 kbps / meter	128 kbps / device	19.2 kbps / FLISR	9.6 kbps / CBC	9.6 kbps / StreetLight	9.6 kbps / VRC	128 kbps / LDER	128 kbps / SDER	19.2 kbps / Charging Sta	400 kbps / Vehicle

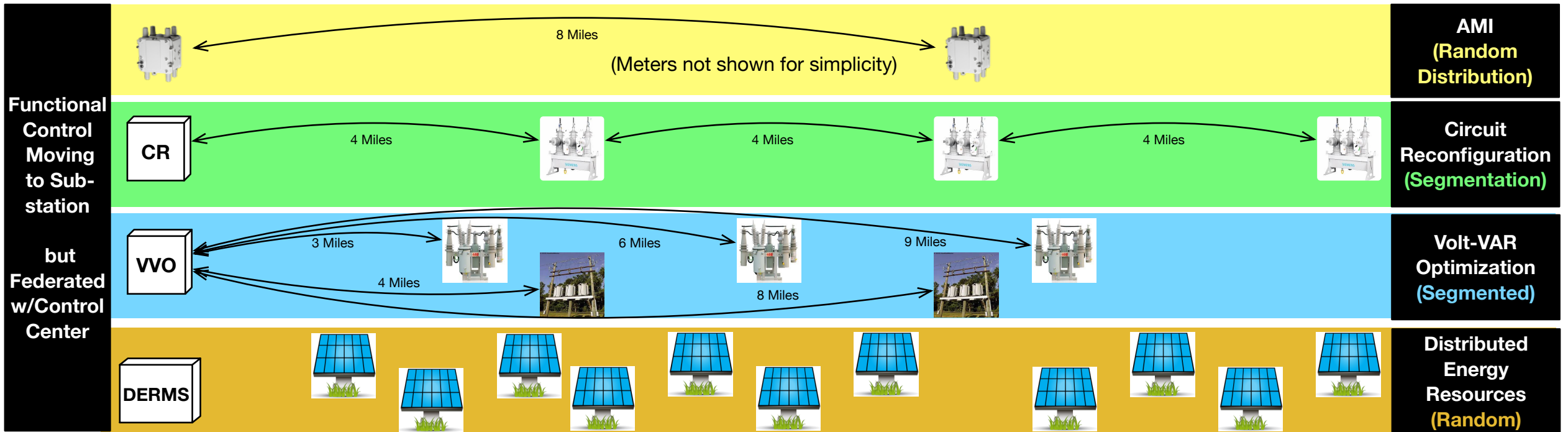
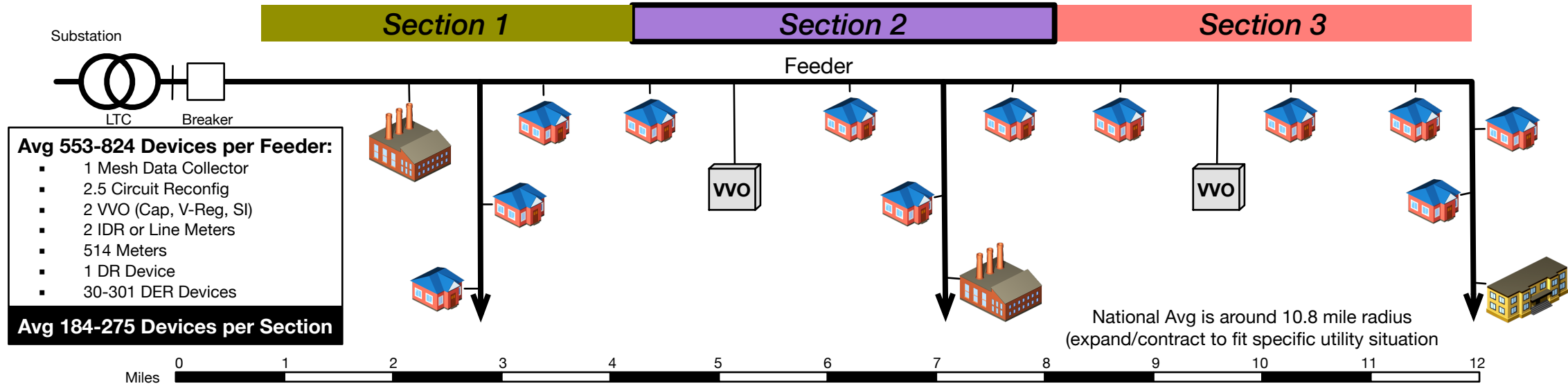
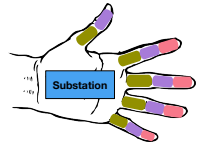
3 Operating Regions
~300 Substations
~900 Feeders
~2700 Sections
~741,600 Devices

The concept of sections is used herein to describe modular areas of electric and communications infrastructure in terms of functional sub-systems, communities of interest, performance and reliability.
(i.e. power profiles, SAIFI, sub-networks, latency, restoration)

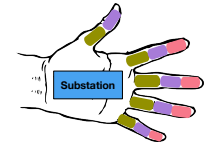
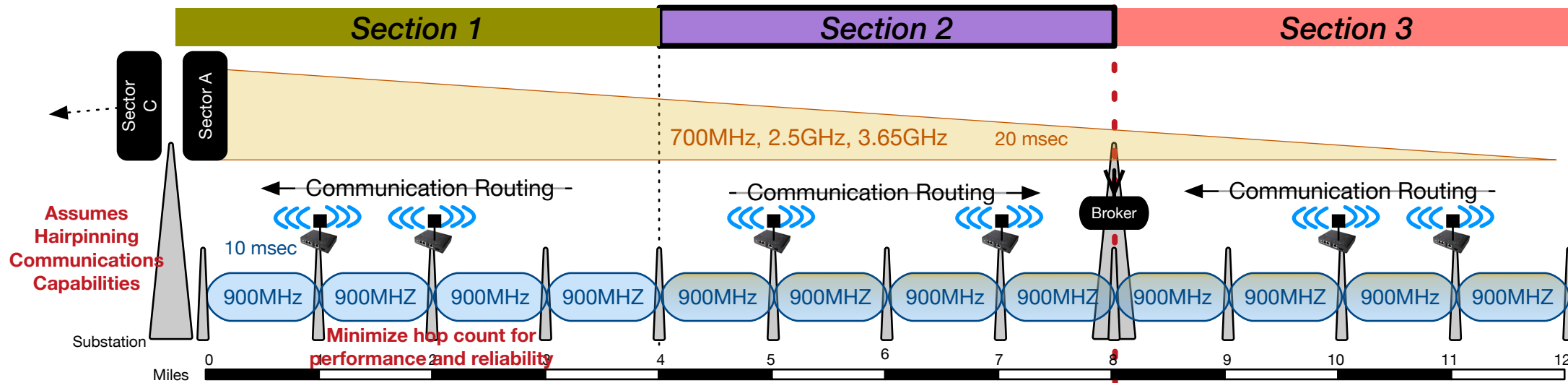


Section 1	Section 2	Section 3
Adjacent to Substation	Middle Area	End of Feeder
< 4 miles	4 to 8 miles	> 8 miles
100 msec range*	> 100 msec range**	> 100 msec range**
Direct Tier-1	Direct Tier-1 or Tier-2 assisted	Tier-2 assisted
	 	 

Spatial Layout of Electric Distribution Grid Elements



Spatial Layout of Information Sub-Systems Supporting Distribution Grid Functions



TCP not favorable on lossy networks

