Name	Steve Zoromsky												
Company	Lower Colorado River Authority (LCRA)												
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				Estimated Number of Communications Nodes to be Deployed for Each Application (e.g. thousands of collectors)	Estimated Number of End Point Devices to be Deployed for Each Application (e.g. millions of meters)	Functional Requirements (See Definitions Below)						Functional Requi	
						AC Independence	Bandwidth Throughput Estimated	Coverage	Latency	Reliability	Security	AC Independence	Bandwidth Throughput Estimated
						Quantified Estimates						Ranking of Relative Importa	
Applications	Customer	Advanced Metering	Remote Meter Reading (based on hourly reads)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
			Direct Load Control	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
			Real time pricing	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Distributed Generation Management		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		PHEV Integration	At the customer premises	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
			At charging stations	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Pricing Signals to Smart Appliances		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		in-Home Display of Customer Usage		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Distribution	Automated Feeder Switching		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Capacitor Bank Control		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Fault Current Indicator		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Transformer Monitoring		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Voltage and Current Monitoring		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Renewable Energy/Distributed Generation		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Network Protection Monitoring		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
				n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operations	AMI Network Management		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Remote Connect/Disconnect		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Meter Data Management		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Outage Management		450	9,000	72 hrs	1,000,000 kbps	90%	500 ms	99.9999%	5	6	3
		Distribution Asset Management		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Distribution Network Management		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Demand Response		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Transmission	Wide Area Situational Awareness (PMUs)		450	9,000	72 hrs	1,000,000 kbps	90%	500 ms	99.9999%	5	6	3
		Line Protection and Control		450	450	72 hrs	1,000,000 kbps	50%	8 ms	99.9999%	5	6	3
	Service Provider	Billing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Customer Information Management		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Consumer Web Portal		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	er	Emergency Response		570	12,000	72 hrs	19,200 kbps	95%	250 ms	99.9999%	5	6	4

	Othe	Routine Dispatch		570	12,000	72 hrs	19,200 kbps	95%	250 ms	99.9999%	5	6	4
		Workforce Automation		570	8,000	72 hrs	19,200 kbps	95%	250 ms	99.9999%	5	6	4
		Comments (explain your answers below)											
		LCRA is a G&T (Generation and Transmission). We do not have distribution but we have 44 electric wholesale customers who are municipals and cooperatives. As such, LCRA is not directly involved in smart grid activities.											
		Definitions (please report your data based on the definitions below)											
	Functional Requirements	AC Independence	After the loss of electric service what applications need backup power to provide restoration and for how long (measured in minimum hours)?										
		Bandwidth	Estimated or tested data rates are required to support this application during normal and emergency conditions (measured in kilobits per second (kbps))										
		Coverage	Geographic areas that these networks are required to operate (estimated percentage of service territory).										
		Latency	How quickly does field data need to be updated (measured in milliseconds (ms) from endpoint-to-endpoint (i.e. not roundtrip))?										
		Reliability	How many service interuptions are tolerated and how well must this network provide accurate data (as a percentage of overall traffic (e.g. 99.999%)?										
		Security	How secure must the network be from cyber and physical attacks (one a scale of 1-5 with 1 being low and 5 being high)?										
	Smart Grid Communications Framework												
		Tier 1 – Core Backbone											
		The core communications network is the primary path to the utility data center and data processing infrastructure. The core may also be the transport for enterprise applications and will typically be architected in a self-healing ring topol											
		Tier 2 – Backhaul Distribution											
		The distribution tier will aggregate the field area network including collectors, RF access points, data concentrators, etc. from the field access tier of the network and provide a delivery transport bridge to the core backbone tier.											
		Tier 3 – Access											
		At this tier end-point devices will gain access to the network. It is commonly referred to as the last mile communication or Field Area Network and will be relatively low bandwidth for hand off to the Backhaul Distribution Tier.											
		Tier 4 – Home Area Network (HAN)											
		In home devices will typically communicate with the Access tier through various technologies. The HAN has not yet converged on a standard but is likely to consist of technologies like ZigBee or Home Plug which may connect directly with											
	Technology Options	Licensed Wireless Radio				Private licensed wireless radio networks operating under Part 90 of the FCC rules							
		Licensed Wireless Microwave				Private licensed wireless microwave networks operating under Part 101 of the FCC rules							
		Unlicensed Wireless				Private unlicensed wireless radio networks operating under Part 15 of the FCC rules (e.g. Wi-Fi, WiMAX, Zigbee)							
		Fiber				Private fiber networks owned or controlled by a utility							
		Other Private Network				Private networks that are neither fiber nor wireless, such as powerline carrier							
		Commercial Wireless Network (Licensed)				Commercial networks that operate using licensed radio under Part 22 of the FCC rules (e.g. Verizon, AT&T, Sprint, etc.)							
		Commercial Wireless Network (Unlicensed)				Commercial networks that operate using unlicensed radio under Part 15 of the FCC rules (e.g. wireless internet service providers (WISPs))							
		Commercial Wireline Network				Commercial networks that use any wireline technology, including fiber, DSL, coax or traditional twisted pair copper circuits)							

	🟦	Satellite				Satellite includes all types of fixed and mobile satellite services, including Very Small Aperture Terminals (VSATs)	

rements (See Definitions Below)				Technology Options (Rank preference 1-8 for each below)									Technology Options (Rank preference 1-8 for each					
Coverage	Latency	Reliability	Security	Licensed Wireless Radio	Licensed Wireless Microwave	Unlicensed Wireless	Fiber	Other Private Network	Commercial Wireless Network (Licensed)	Commercial Wireless Network (Unlicensed)	Commercial Wireline Network	Satellite	Licensed Wireless Radio	Licensed Wireless Microwave	Unlicensed Wireless	Fiber	Other Private Network	Commercial Wireless Network (Licensed)
nce of Each Functional Requirement (1-6)				Tier 1									Tier 2					
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5	4	1	2	3	2	5	1	6	7	8	4	9	2	1	5	3	6	7
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5	4	1	2	3	2	5	1	6	7	8	4	9	2	1	5	3	6	7
5	4	1	2	3	2	5	1	6	7	8	4	9	2	1	5	3	6	7
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1	5	2	3	3	2	5	1	6	7	8	4	9	2	1	5	3	6	7

1	5	2	3	3	2	5	1	6	7	8	4	9	2	1	5	3	6	7
1	5	2	3	3	2	5	1	6	7	8	4	9	2	1	5	3	6	7
ogy or point-to-point with backup circuit redundancy. The core may have points-of-presence in substations and other company facilities.																		
communication Tier 3, Tier 2 or Tier 1.																		

below)			Technology Options (Rank preference 1-8 for each below)									Technology Options (Rank prefer				
Commercial Wireless Network (Unlicensed)	Commercial Wireline Network	Satellite	Licensed Wireless Radio	Licensed Wireless Microwave	Unlicensed Wireless	Fiber	Other Private Network	Commercial Wireless Network (Licensed)	Commercial Wireless Network (Unlicensed)	Commercial Wireline Network	Satellite	Licensed Wireless Radio	Licensed Wireless Microwave	Unlicensed Wireless	Fiber	Other Private Network
			Tier 3									Tier 4				
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8	4	9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8	4	9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8	4	9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8	4	9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

8	4	9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8	4	9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

ence 1-8 for each below)			
Commercial Wireless Network (Licensed)	Commercial Wireless Network (Unlicensed)	Commercial Wireline Network	Satellite
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a

n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a