This is a checklist of features to consider when evaluating network design tools, and an indication of how typical each feature might be.

Table – consists of three groups of columns – Feature, Audience, and Prevalence; e.g.:

Feature	Audience				Prevalence of feature
	S	M	D	R	
User interface					
Intuitive CAD-like graphical interface	x	x	x	x	C
Etc.					

Feature – features were gleaned from about 10 modeling and simulation toolkits that I was familiar with in 2002. I think we might update and expand this based on feature sets in more recent tools.

The features are also grouped by major categories – e.g., user interface, modeling paradigm, etc. Those groups also need updating.

Audience – the article in which this table appeared compared features for different users of modeling and simulation tools. This is very subjective!

Code		
R	Research and Development Professionals	R&D
D	Network Designers	Design/Deployment
M	Network Managers and Network Engineers	Operations
S	Sales/Field Staff	Other

Prevalence – how typical the feature is; this is also very subjective!

Code	
C	Common
U	Uncommon
R	Rare

Definitions of the four audience categories (draft):

Researchers and *developers* want to reduce development costs and risks by testing the effects of new or modified protocols, devices, architectures, component designs, and traffic models in the lab or on the workbench. They need complete control of simulated behavior at the programming language level, and want the language to provide a rich set of special-purpose modeling functions. They usually simulate discrete events (packets transiting a router, protocol retransmissions, *etc.*), and must often simulate billions of events in order to mimic actual behavior. They want accuracy over speed.

Network designers specify and build new networks, or overhaul existing ones. They want to reduce design time and improve design accuracy, ensure that designs meet performance requirements without overbuilding, and identify potential bottlenecks and overloads. They need an extensive

library of link technologies, devices, architectures, and protocols to build or upgrade the network, and tools to accurately predict its performance.

Network managers and *network engineers* operate networks, troubleshoot and solve performance problems, and make sure that service-level agreements are met. They want to gauge the effects of changes on cost, performance, capacity, and availability before the changes are made. Changes typically include introducing new routing protocols, adding new devices and links, supporting new applications (*e.g.*, an ERP or enterprise-wide e-mail application), upgrading servers, and changing service level agreements. If the existing network is large, they need to import topology and traffic data from other tools. The set of alternatives is usually enormous, so they want to evaluate scenarios in tens of minutes rather than hours.

Sales and field staff want to show customers reasonably accurate representations of how a product, service or technology will improve the customer's network and support the customer's business case. They want an intuitive tool that runs on a laptop computer and can be mastered in 1-2 days. They need fast execution speed (tens of seconds per scenario rather than tens of minutes), and extensive presentation features such as traffic animation, graphical indications of service-level performance, reports, diagrams, charts and graphs.

First draft of table:

Feature	Audience				Prevalence of feature
	S	M	D	R	
User interface					
Intuitive CAD-like graphical interface	x	x	x	x	C
Drag-and-drop tool palette for building or modifying models	x	x	x	x	C
Network topology overlays map, grid, descriptive background	x	x	x		C
Standard and custom maps, grids, backgrounds	x	x	x		C
Model behavior accurately reflects map distances and grid scales		x	x	x	U
Modeling paradigm					
Hierarchical representation (network, sub-network, device, *etc*.) with ability to drill down	x	x	x	x	C
Standard object-oriented constructs (inheritance, specialization)		x	x	x	C
Multiple levels of detail and/or abstraction	x	x	x	x	C
Model individual devices and links	x	x	x	x	C
Create custom device and link models		x	x	x	C
Library of models for links, media, devices, architectures, protocols, applications, packet types, etc.	x	x	x	x	C
Database of voice/video/data devices with attributes and prices	x	x	x		U
Represent sub-networks in terms of aggregate behavior	x	x	x	x	C
Accurately model large networks (1000-10,000 elements)		x	x		R
Confirm connectivity based on device and media attributes	x	x	x		U
Network topology					
Create topology via tool palette	x	x	x	x	C
Create topology via rapid configuration tool		x	x	x	U
Discover/import topology from network management tools (e.g., HP OpenView)		x	x	x	C
Discover/map/import topology via SNMP-based tools		x	x	x	C
Import user-specified subset topology (LAN, WAN, access network, etc.)		x	x	x	U
Import topology from external file or drawing/presentation tool (e.g., Visio)	x	x			U
Types of networks supported					
Wireline (point-to-point, multipoint, broadcast, switched, routed, etc.)	x	x	x	x	C
Optical (including optical layer protocols)			x	x	R
Wireless (fixed and mobile nodes, satellite, radio, cellular, microwave, etc.)	x	x	x	x	C
Mobile nodes' positions change as simulation progresses		x	x	x	U

Feature	Audience				Prevalence of feature
	S	M	D	R	
Wireless models reflect terrain, fading, multipath effects		x	x	x	R
Traffic models, traces, profiles					
Generate traffic via common models (constant and variable bit rate, bursty, etc.)	x	x	x	x	C
Generate traffic by application characteristics (voice, email, web browsing, etc.)	x	x	x	x	C
Create custom flows based on user-defined traffic profiles	x	x	x	x	C
Import packet traces from network monitors and sniffers		x	x	x	U
Import traffic profiles from monitors and sniffers		x	x	x	U
Import traffic traces or profiles from text files		x	x	x	U
Define load via traffic matrix representing flows between end-systems		x	x	x	C
Specify background traffic as a baseline load on network	x	x	x	x	U
Model traffic as aggregate flow from LAN or WAN "clouds"	x	x	x	x	C
Solution methods					
Integration of design tool with simulation or analytical tool	x	x	x	x	C
Analytical solution methods (queuing theory, mathematical modeling, etc.)	x	x	x		U
Discrete event simulation		x	x	x	C
Hybrid analytical/simulation methods		x	x	x	U
Parallel simulations over multiple CPUs				x	R
Ability to vary simulation granularity (e.g., simulate every packet, aggregates, flows)		x	x	x	C
Vary speed of solution method		x	x		R
Simulation output					
Real-time graphical indications of performance (delay, throughput, packet loss, link utilization, load, etc.)	x	x	x	x	C
Display traffic flows via real-time animation	x	x	x	x	C
Graphical output (diagrams, charts, graphs)	x	x	x	x	C
Reports	x	x	x	x	C
Export results to spreadsheets, files, other tools		x	x	x	C
Generate bill of materials and estimate materials' costs	x	x	x		R
Estimate tariffs for communications links	x	x	x		R
Presentation tools for non-technical audience	x				U
Analysis tools					
Customized plots (time series, histograms, etc.)		x	x	x	C
Probability functions, parametric curves, confidence intervals		x	x	x	C
Compute descriptive statistics (mean, variance, minimum, maximum, quantiles)	x	x	x	x	C
Analyze output via filters (e.g., moving average)		x	x	x	U
Overlay plots, charts, graphs		x	x	x	U
Level of customization					
Support user-defined protocols and devices		x	x	x	C
Simulate any required behavior at the programming language level				x	R
Language-level functions for special-purpose modeling features				x	R
Source code provided for models		x	x	x	U
Integrated debugging tool				x	R
Ability to import existing code into simulation				x	R
Ability to export simulation code				x	R
Functions					
Represent resource capacity and bandwidth	x	x	x	x	C
Measure/estimate/report utilization, network congestion, load, delay, lost packets, response time, device latency, availability, etc.	x	x	x	x	C
Identify bottlenecks	x	x	x	x	C
Support exploration of alternatives	x	x	x	x	C
Perform sensitivity analysis	x	x	x	x	U
Specify traffic and server workloads	x	x	x	x	C
Distribute load across a complex topology		x	x	x	U
Handle high-load and other stress tests		x	x	x	U
Model failure and error conditions		x	x	x	C
Predict when/where network will develop performance problems	x	x	x	x	C
Predict which device/link/sub-network will reach capacity first	x	x	x	x	C

Feature	Audience				Prevalence of feature
	S	M	D	R	
Identify applications/protocols causing congestion	x	x	x	x	C
Assure service level conformance	x	x	x		U
Identify nodes/links close to exceeding user-defined thresholds	x	x	x		U
Identify under-utilized resources	x	x	x		U
Predict how many users an application can support	x	x	x		U
Other factors					
Computing requirements (hardware, operating system)	x	x	x	x	
Ease of use, learning curve	x	x	x		
Training, technical support, documentation	x	x	x	x	C
Availability of less-expensive run-time version or viewer	x	x			U
Availability and cost of special-purpose add-on modules and features			x	x	C
Annual maintenance fees			x	x	C
Tiered versions (developer, IT staff, sales/field force)	x	x			C
Degree of integration with vendor's other products	x	x	x	x	C

Questions for the team:

1. Shall we build upon this table?
2. Is the structure acceptable?
3. How shall we update it?
4. Do we need an editor? Are there volunteers?
5. The publisher of the original article (IEEE Computer Society) is interested in publishing an updated table. Shall we add that as a goal for this work task?