

A Web-based Automated Fault Location System

by

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Grid Sentinel
www.gridsentinel.com

Grid Sentinel

- Industry depth
 - Over 15 years experience in the power field
 - Incorporated in 2003 w/patent pending
 - Technology excellence award
- Focus on
 - Web-based solutions and professional services for fault location and disturbance analysis



Background Information

System operators

- Restore services quickly and safely
- Locate faults automatically and accurately
- Dispatch crews to fix the fault

Protection engineers

- Review and verify protection system operations
- Analyze and understand faults
- Uncover hidden relay setting issues



WebFL™

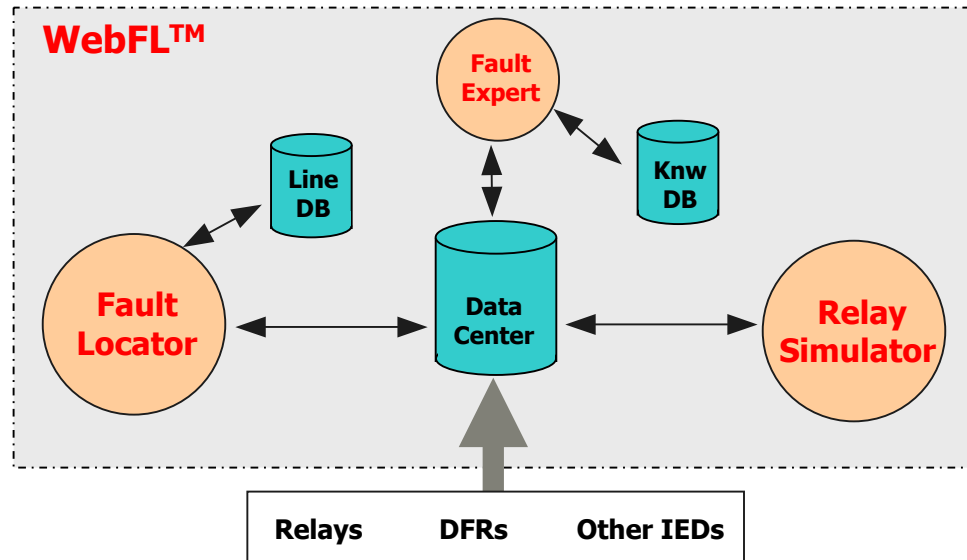
The web-based automated fault location system for

- Finding faults automatically and more accurately
- Speeding up service restorations
- Improving service reliability
- Reducing operation costs



WebFL™ System Architecture

- Complete web-based solutions
- Built with Microsoft .NET technology



WebFL™

- Innovative algorithms
- Error less than 0.5%

Covering:

Multi-terminal lines

Two-terminal lines

Transposed lines

Un-transposed lines

Tapped lines



Fault Locator

Innovative Technologies for Power Grid Challenges - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media Print

Address <http://www.gridsentinel.com> Go Links

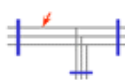
S1
[3T-line](#)

S2
[3T-line](#)

S3
[3T-line](#)

Sub 0
[line-1](#)
[line-2 untrans](#)

Sub 1
[line-1](#)
[line-2 untrans](#)



FaultLocator

[Upload Files](#) | [View Files](#) | [Delete Files](#)

Line **line-2 untrans**; Type **Un-transposed**; Terminals [term1](#) | [term2](#)

Valid Faults [All Faults](#)

Index	Distance to term1 (mi)	Distance to term2 (mi)	Fault Type	Date & Time	Data at term1	Data at term2
<u>0</u>	49.59	50.41	AG	01/12/1997 16:32:35.67391	F2L_16.dat	F2R_16.dat
<u>1</u>	78.89	21.11	AG	02/12/1997 11:11:21.17391	F3L_16.dat	F3R_16.dat
<u>2</u>	89.78	10.22	BG	02/12/1997 11:51:39.73913	F4L_16.dat	F4R_16.dat

[Phasor Entry](#) | [Phasor Records](#) | [Disturbance Records](#) | [Line Parameters](#)

[Delete lines](#) | [Welcome](#) | [Help](#) | [Home](#)

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Internet



Fault Locator

The screenshot shows a Microsoft Internet Explorer browser window displaying the website http://www.gridsentinel.com/m_term. The main heading is "Untransposed Line Fault Location".

Line

- Name: [un-trans](#)
- Length: 100 miles

Phasors

Name: F3

@ Line terminals

- [Fault phasors](#)

@ Fault location

- [Phasors](#)

Fault Location	79.07 miles from s 20.93 miles from r
Fault Type	AG
Fault Resistance	Rag = 3.36 Ohms
r Delaying	20.23 degrees

The diagram illustrates a fault on a three-phase transmission line. A fault is indicated by a green dot on the top phase. The fault voltage is labeled V_{fa} . The fault current is labeled I_{fa} , and the fault resistance is labeled R_{ag} . The fault is connected to ground.

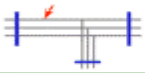


Fault Locator

www.gridsentinel.com - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://www.gridsentinel.com/m_term

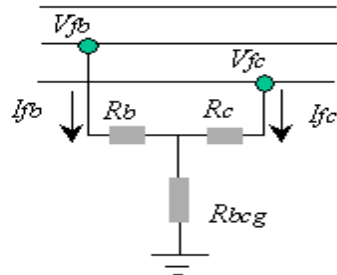


Three-terminal Line Fault Location

Data: R_bcg_80m_500

Line Name	S	R	T	S -- Tap	R -- Tap	T -- Tap
<u>three</u>	s	r	t	100 miles	100 miles	40 miles

Fault Location	Fault Type	Fault Resistance
80.01 miles (from r)	BCG	Rb = 51.26 Ohms Rc = 48.12 Ohms Rbcg = 0.37 Ohms



Internet



Automated event diagnosis & classification

The screenshot shows a Microsoft Internet Explorer browser window with the address bar displaying <https://www.grid sentinel.com>. The page content includes a sidebar with substation links, a main content area with a 'Data Files' section, and a table of relay events for Substation Sub 1.

Sub 0
[SEL-311C](#)
[SEL-321](#)
[SEL-421](#)

Sub 1
[REL350-1](#)
[REL356-1](#)
[REL512](#)
[SEL-121F](#)
[SEL-121G](#)
[SEL221-16](#)
[SEL-2PG10](#)
[SEL-311B](#)
[SEL311C](#)
[SEL321](#)
[SEL-421](#)

Sub 2
[DFR-1](#)
[REL350-2](#)
[REL356-2](#)

Sub 3
[REL352](#)

Sub 4
[MDAR-1](#)
[MDAR-2](#)

Data Files
[Upload files](#) | [View files](#) | [Delete files](#)

Settings: [System](#) | [Fault Location](#) | [Overcurrent](#) | [Voltage](#) | [Distance](#) | [OOS](#)
[Polar Diagram](#)

Relay SEL321 @ Substation Sub 1

Index	Data	Diagnosis	Format	Date Uploaded
0	sel321.eve	Breaker fails to trip (I.F)	SEL321	2/9/2004 5:30:59 PM
1	swingZone1.eve	Relay slow trip	SEL321	3/30/2004 7:23:45 PM

Total File Size: 44 KB; Limit: 5000 KB

[Delete relays](#) | [Welcome](#) | [Feedback](#) | [Help](#) | [Logout](#)
Email: support@grid sentinel.com
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www.grid sentinel.com -- Innovative Technologies for Power Grid Challenges - Microsoft Internet Explorer

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Event Diagnosis Report

Diagnosis result	Relay false trip; Breaker fails to trip (E.F.)
Event site	Station name: Sub 0 Line name: Line-2 Line length: 12.04 miles Relay name: SEL-321 Breaker name: Breaker-2
Fault property	Fault type: CG Fault location: +13.50 miles Fault date: 05/12/04 Fault time: 71.88 ms (21:03:10.892) Fault duration: * Data: SEL-321-Event.eve
Relay and breaker operations	Relay trip time: 134.38 ms (21:03:10.892) Breaker trip time: *

[Help](#)

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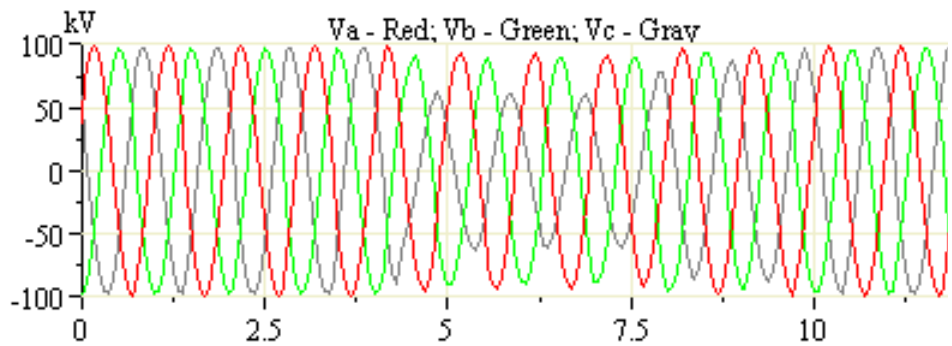
Done Internet



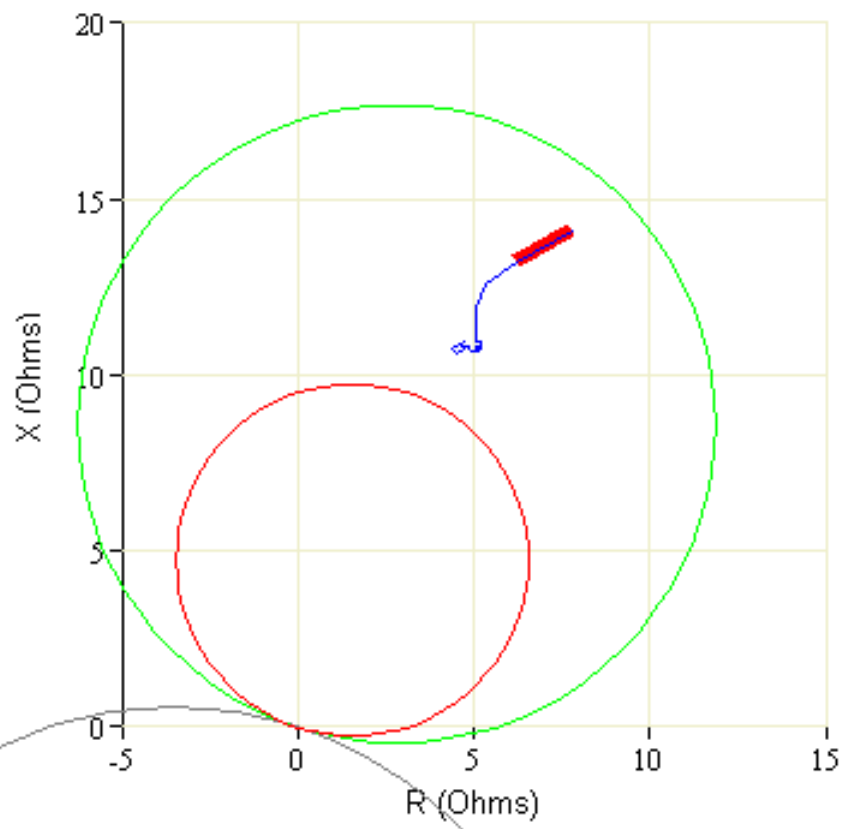
Relay simulator

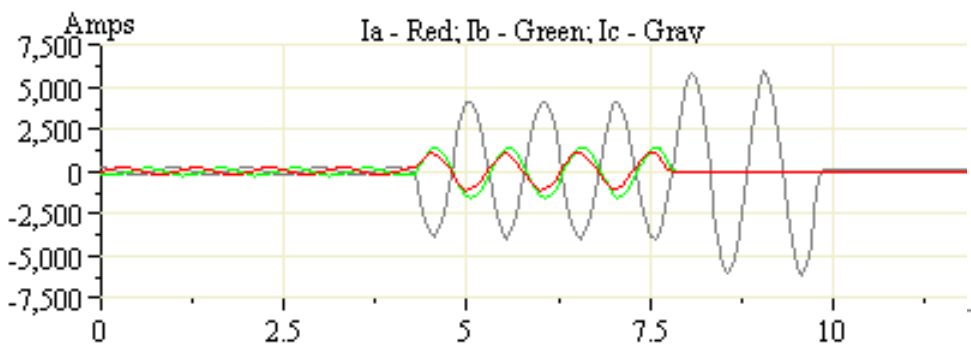
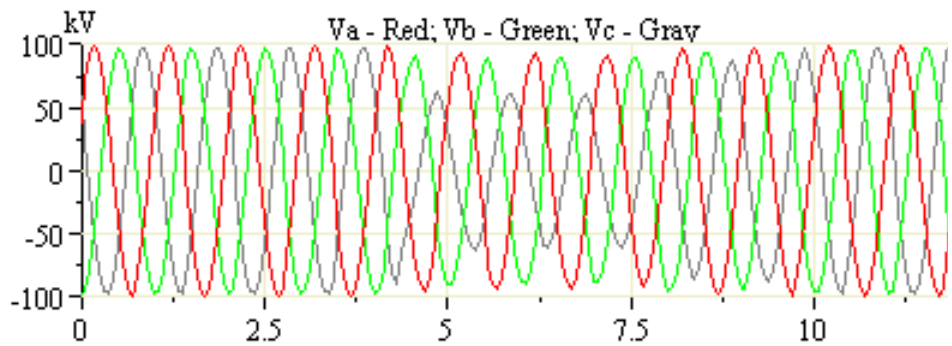
- Overcurrent
- Voltage
- Directional – phase & ground
- Distance – phase & ground
- Current differential
- Phase comparison



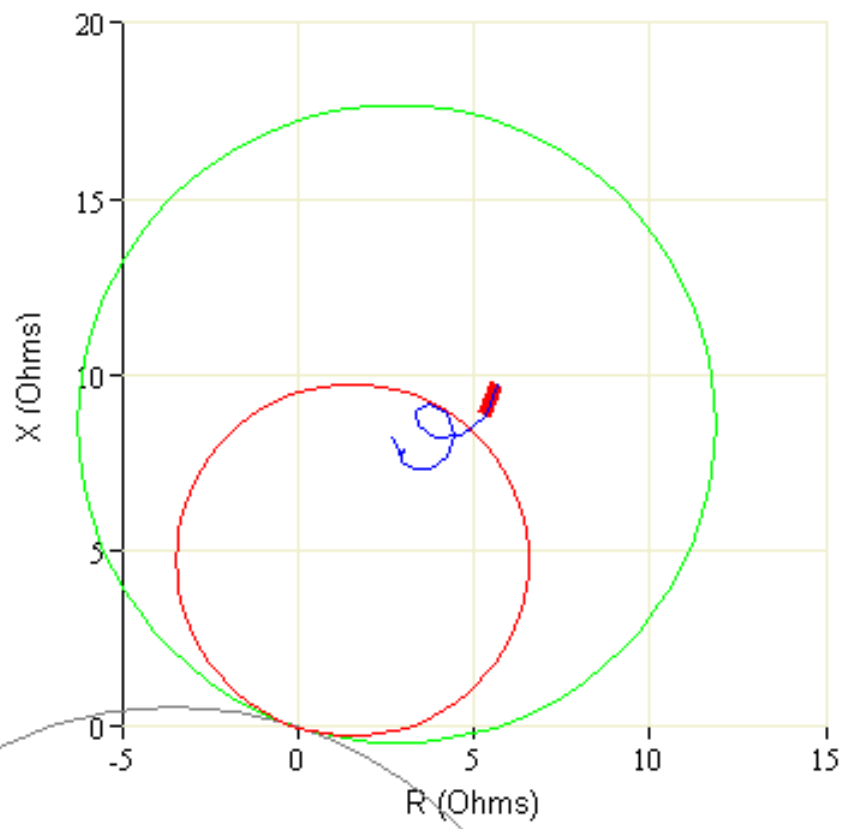


Time (C): 5 to 8; ZCG: 8.01 Ohms @ 65.82 deg.

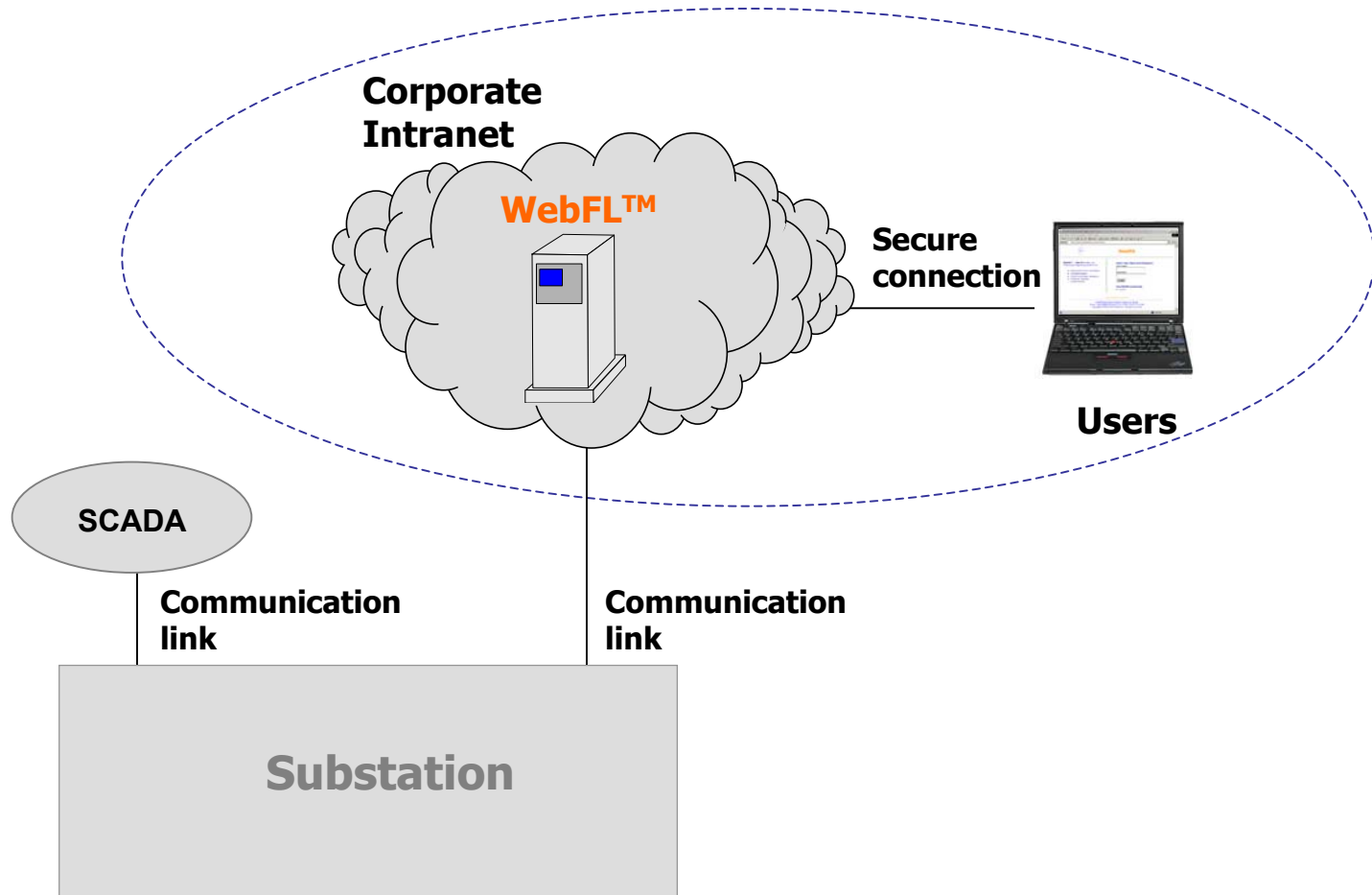




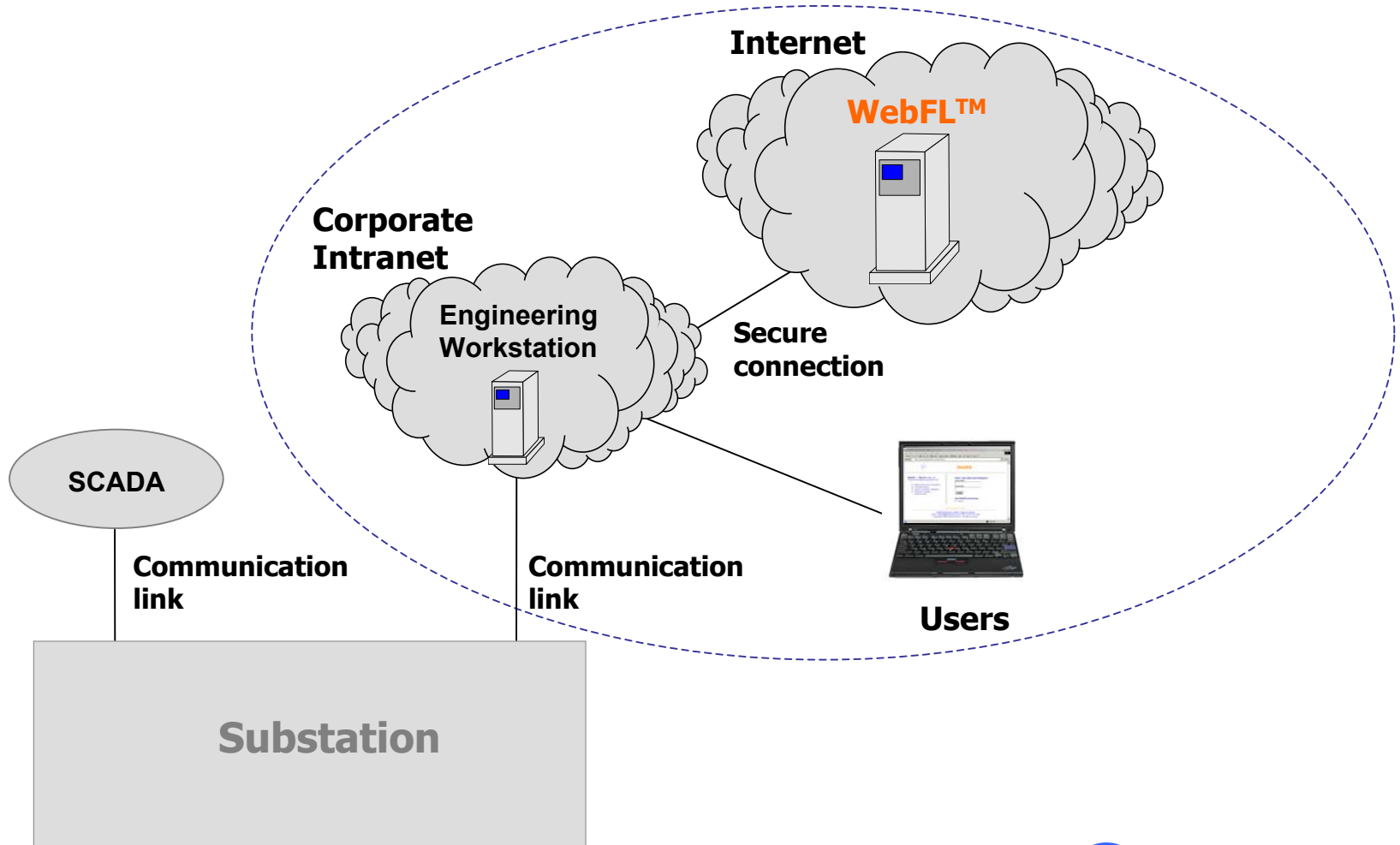
Time (C): 8 to 10; ZCG: 8.01 Ohms @ 65.82 deg.



WebFL™ Enterprise Edition



WebFL™ On-line Edition



WebFL™

Key benefits

- Reduces outage times due to accurate fault locating and quicker repair
- Reduces operation and maintenance costs through dispatching repair personnel effectively and rapidly
- Improves protection reliability through automated fault diagnosis & relay performance evaluation



Questions or Suggestions



See you at

Vendor Expo

5:00 – 8:00 PM

