

# 2014 Georgia Tech Fault Disturbance & Analysis

**The BIG Picture –  
A Comprehensive Look at Automated  
Systems for Disturbance Analytics using  
Open Source Software (OSS)**

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# Overview<sub>1</sub>

- **Value of OSS for Electric Utilities**
- **Existing OSS Components**
- **Gaps Remaining for End-to-end Solutions**

# Overview<sub>2</sub>

- **Existing Data Flow and Human Interaction**
- **Proposed Automated OSS Data System**
- **Getting Started**

# Value of OSS<sub>1</sub>

## OSS is growing rapidly in every segment of society

### Printing prosthetics –

Robohand creates affordable mechanical prosthetics through the use of 3D printers. Not only that, but it has made its **designs open source**...customers can assemble and fit themselves courtesy of a **free open-source manual** available to them.

From a CNNTech article April 15, 2014  
<http://www.cnn.com/2014/04/14/tech/innovation/carpenter-fingers-robohand-3-d/index.html>

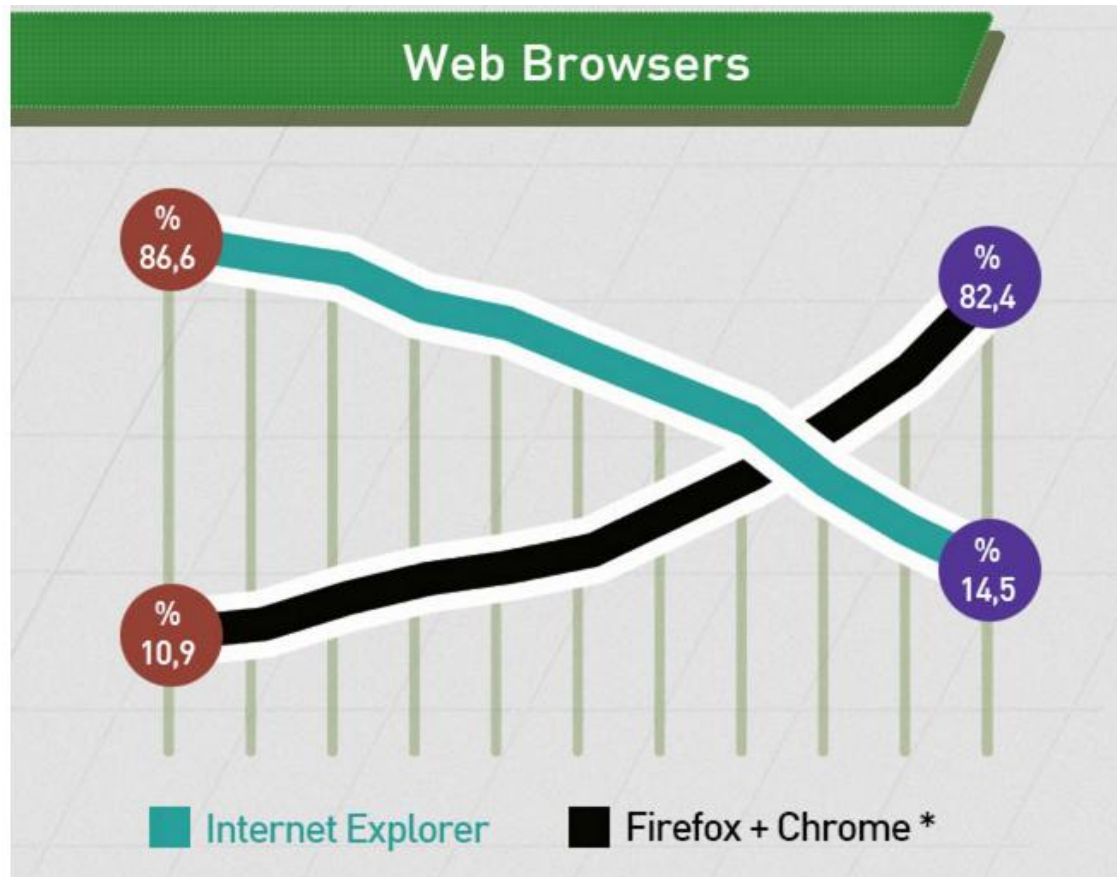


Robohand produces 3-D printed mechanical fingers, hands and arms. The first Robohand ever created was made for five-year-old Liam, who was born with a condition that left him with no fingers on his right hand.

Robohand

HIDE CAPTION

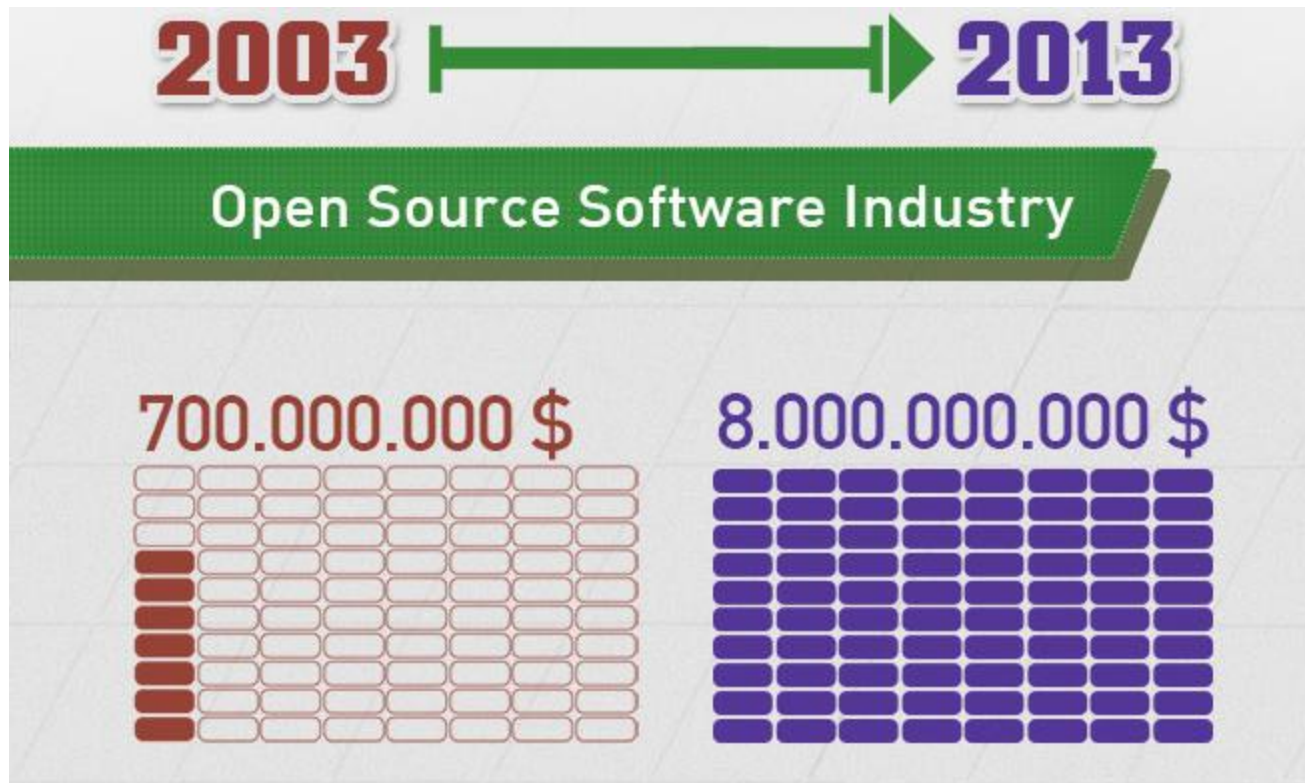
# Value of OSS<sub>2</sub>



\*These clips are taken from an infographic created by [infografik.com.tr](http://visual.ly/10-years-open-source)  
<http://visual.ly/10-years-open-source>

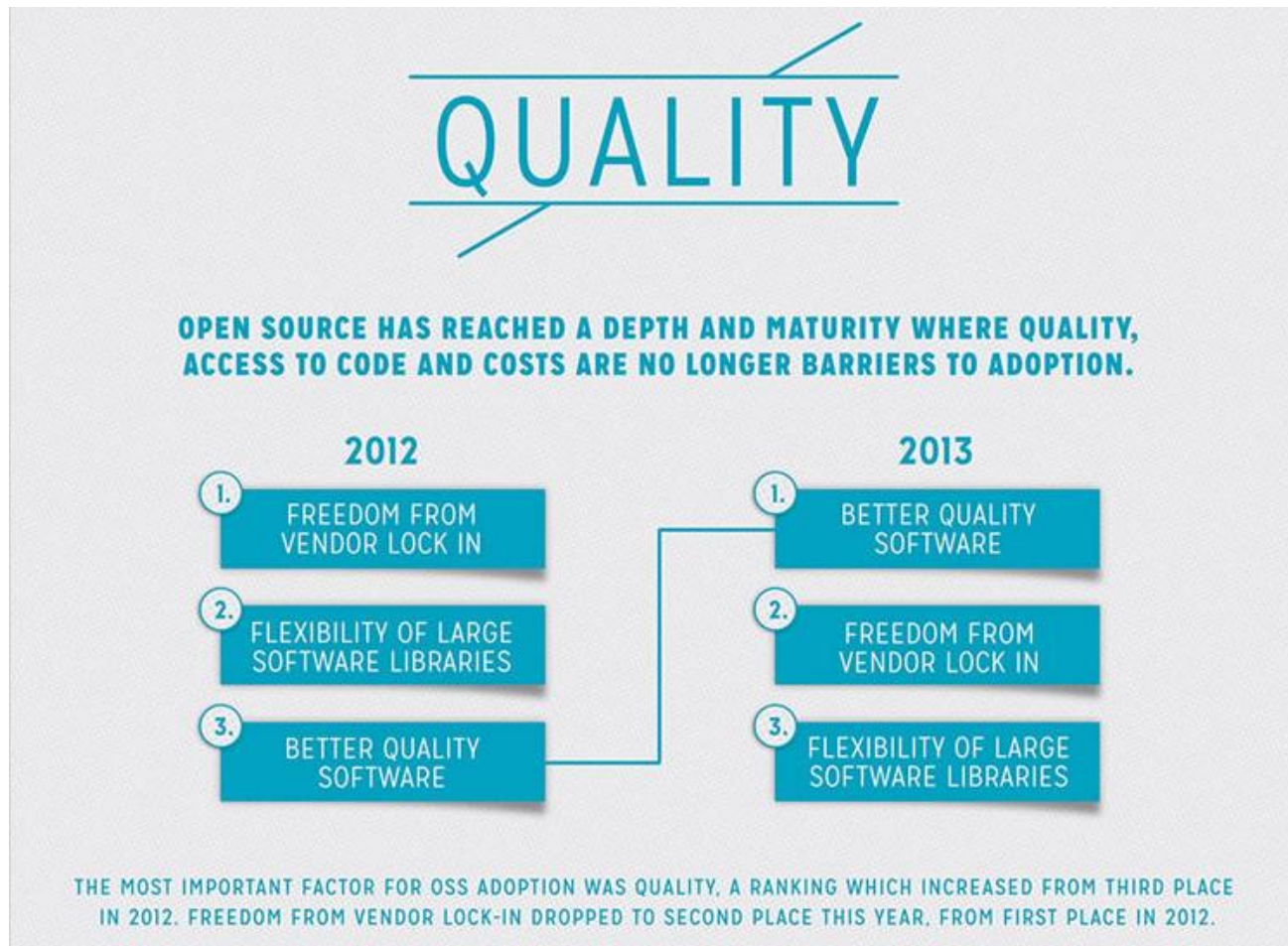


# Value of OSS<sub>3</sub>



\*These clips are taken from an infographic created by [infografik.com.tr](http://visual.ly/10-years-open-source)  
<http://visual.ly/10-years-open-source>

# Value of OSS<sub>4</sub>



<http://www.blackducksoftware.com/resources/infographics/2013-future-open-source-open-revolution>

# Value of OSS<sub>5</sub>

- Current media and publications have many references to the benefits of OSS
  - Tech Crunch, Feb. 13, 2014 - “Many of today’s most successful new companies rely on an ecosystem of standardized OSS...”
  - Forbes, Feb. 4, 2014 - “...business and consumers world-wide will ultimately benefit from the proliferation of “open source” in the form of lower prices...”
  - An industry professional, Jiles Gulp, Feb. 2014 - “Very few companies inside or outside the software industry can afford to do business without depending (heavily) on open source”.



# Value of OSS<sub>6</sub>

**High Quality**

**Facilitates security**

**Competitive features, flexibility**

**Lower total cost of ownership**

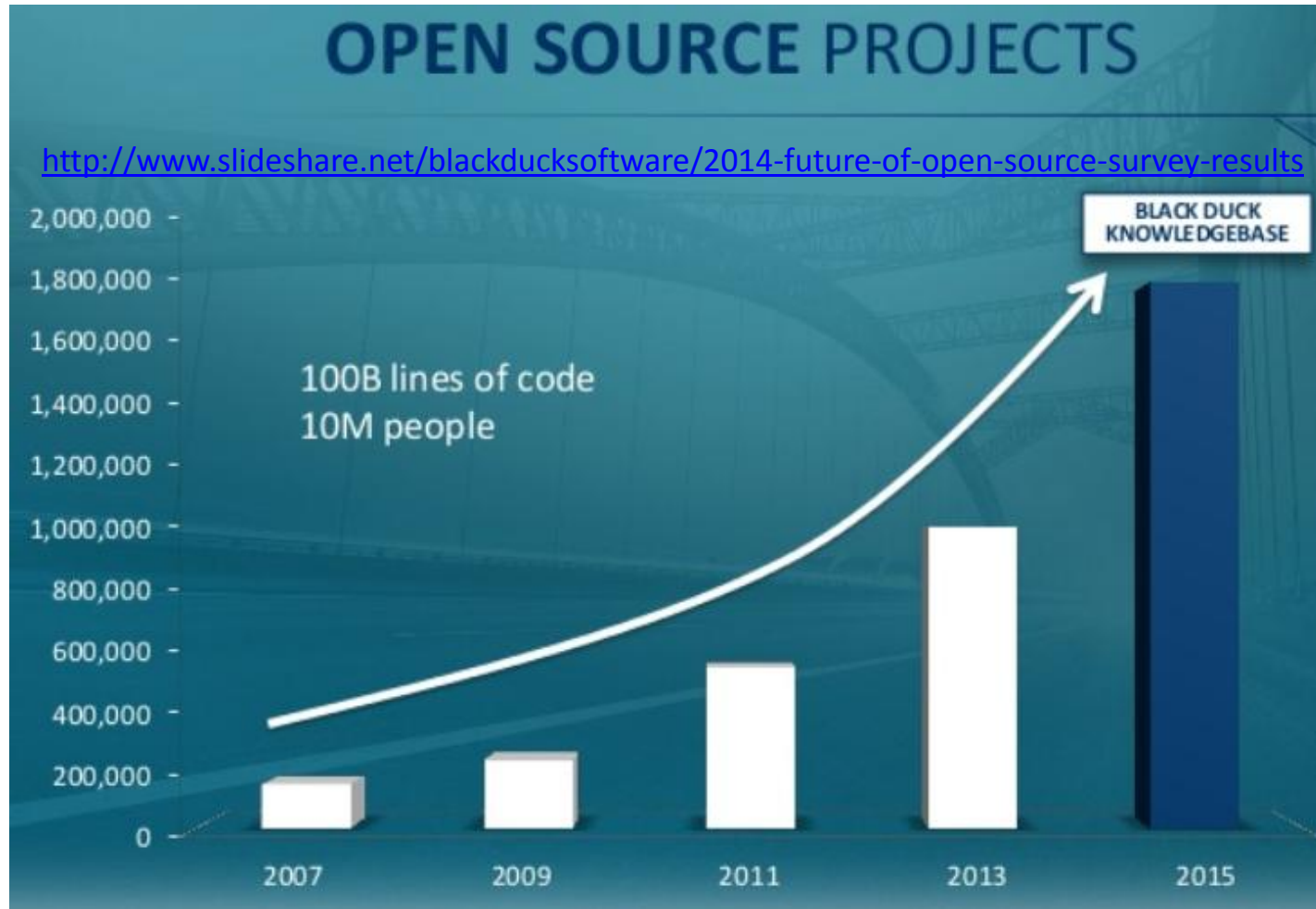
**Stimulates innovation**

**Encourages collaboration**

**Reduces time to deployment**

# Existing OSS Components<sub>1</sub>

Taken from the 2014 Future of Open Source Survey...



# Existing OSS Components<sub>2</sub>

- **openFLE** – a 2012 Electric Power Research Institute (EPRI) project to create an OSS fault location engine
- **PQDIF and COMTRADE** – standard fault record formats that can be read using GSF.PQDIF or GSF.COMTRADE
- **SEL Event records** – vendor specific fault record format, a limited set can be read using GSF.SELEventParser
- **openXDA** – a framework built around openFLE to provide automation and extensibility

# Remaining Gaps<sub>1</sub>

**Data retrieval**

**Data quality**

**Analytics**

**Applications**

# Remaining Gaps<sub>2</sub>

## Data Retrieval

- Typically requires vendor specific software
- May include any or all methods of communication
- Largest source of latency in automated analytics
- Great opportunity for NEW OSS project
  - Single user interface for all remote devices
  - Data retrieval and configuration management
  - All data more valuable through integration



# Remaining Gaps<sub>3</sub>

## Data Quality

- COMM failures
- Device failures
- Device configuration
- Maintenance practices / changes

# Remaining Gaps<sub>4</sub>

## **Analytics**

- 5 single-ended distance methods now, more?
- Double-ended methods
- Steady-state and event records can be analyzed
- Waveform data available in time or frequency domain
- Transient event analytics

# Remaining Gaps<sub>5</sub>

## Applications

- Fault distance reporting enhancements
- Disturbance libraries
- Baseline monitoring and alarms
- Integration with lightning / GIS
- Dashboards (EPRI Beta project this year for PQ)

# Data Flow - Human Interaction

**Data retrieval requires manual initiation / review**

**Unique software for each manufacturer**

**Analysis methods / results may vary**

**Too time consuming to analyze every record**

# Proposed Automated System

**Data retrieval**

**Device configuration management**

**Analytics on every disturbance record**

**Include steady-state data and transients**

**Robust disturbance database / integration**

**Notifications, web pages, dashboards**



# Getting Started<sub>1</sub>

**Accurate device settings**

**Accurate power system parameters**

**Rapid data retrieval**

**Configuring automated system**

**Presenting information effectively**

# Getting Started<sub>2</sub>

## **Accurate device settings**

- Critical to capturing the right data
- Typically manual process
- Great value in automation

# Getting Started<sub>3</sub>

## **Accurate power system parameters**

- Should be obtained from a well maintained source
- Automatic extraction and updates a big plus
- Automated analytics can identify errors

# Getting Started<sub>4</sub>

## Rapid data retrieval

- Analytic cycle time is largely data retrieval
- An OSS based automated data retrieval system could improve performance even with slow communication pathways
- Overall system has value even with slow retrieval

# Getting Started<sub>5</sub>

## Configuring automated system

- Disturbance file repository
- DFR channel mapping for line groups
- Line parameters for each line/monitor
- Output data repository, file structure or database



# Getting Started<sub>6</sub>

## **Presenting information effectively**

- Automated notifications e.g. text, email
- Populating web pages
- Disturbance database for downstream applications
- Integration with lightning / GIS
- Populating an XML file repository

# Getting Started<sub>7</sub>

## Presenting information effectively

### Sample Layout

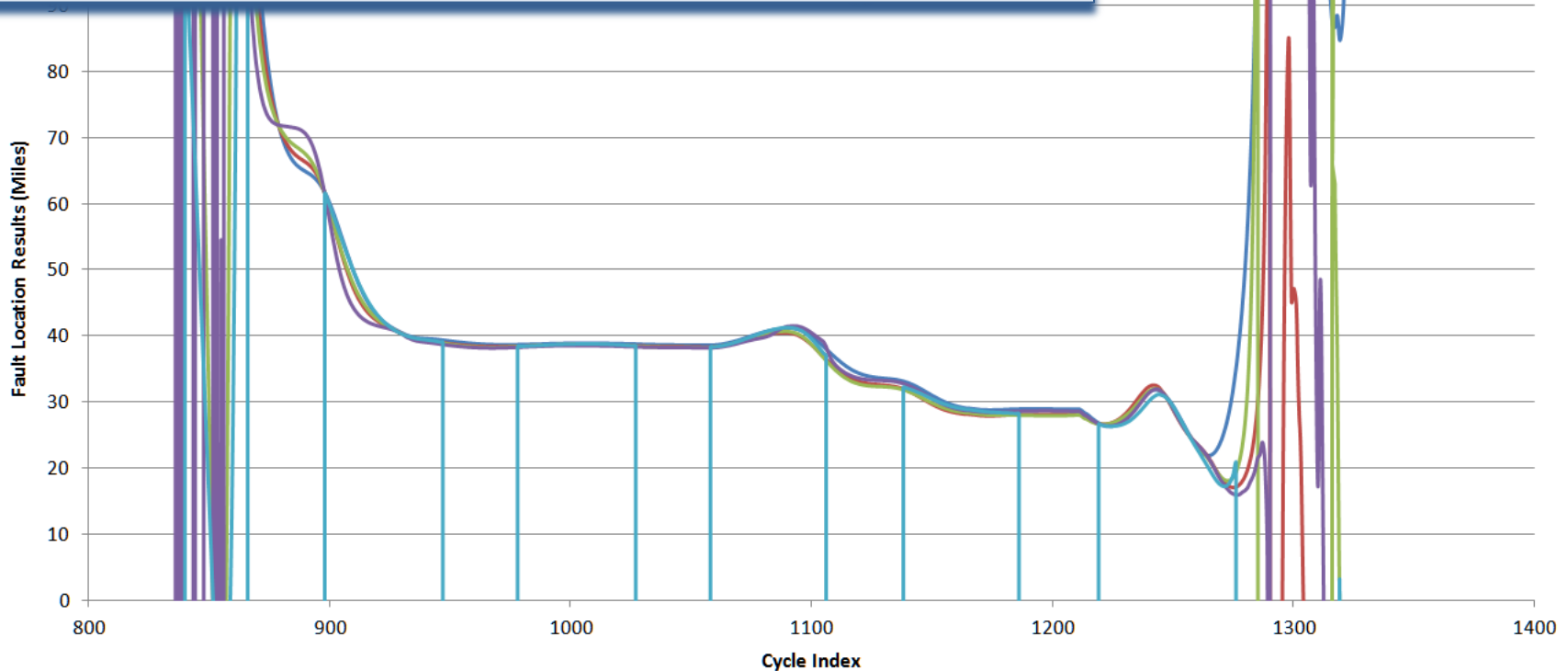


# Getting Started<sub>8</sub>

## Presenting information effectively

openXDA Fault Location Results

Sample Fault Distance Curves from Dominion Virginia Power



# Conclusions

**OSS is available, extensible, well supported**

**Components are available now to build an automated OSS based fault distance system**

**Opportunities exist for improved end-to-end functionality using OSS for new development**

**The OSS approach provides flexibility and scalability to meet each utility's needs**

# Questions?

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