

Modern Mobile Technology in Forestry: Choosing the Right Devices, Applications and Data Management Strategy



MB&G
Kerry Halligan

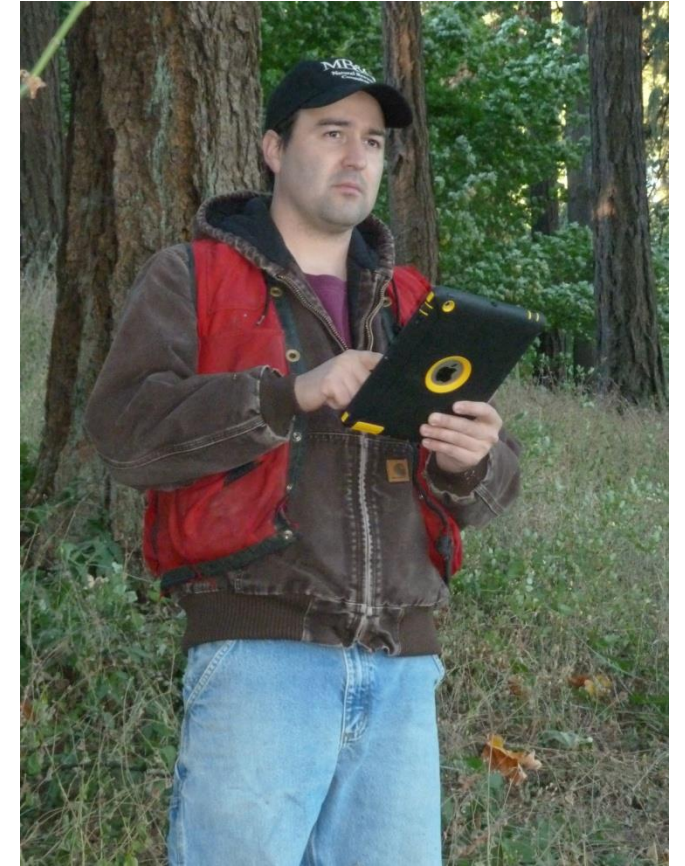
Mason, Bruce & Girard

- Natural Resource Consulting
- Since 1921
- Portland, OR Headquarters
- Three Lines of Business:
 - Forestry
 - Environmental
 - Geospatial



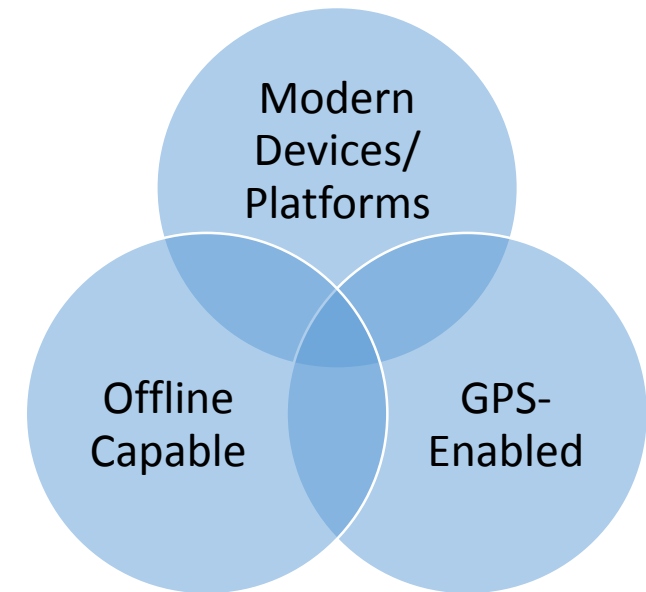
Why We Care about mobile

- We are biologists, foresters, biologists, economists, field technicians
- Wide range of field data needs
 - Wetland delineation
 - Timber cruising
 - Road Inventory
 - GPS data capture (mapping assets, sample locations)
- Purchase mobile devices
- Advise timber owners on field and GIS technologies
- Rely on efficient workflows pre/in/post field to complete projects on schedule & budget



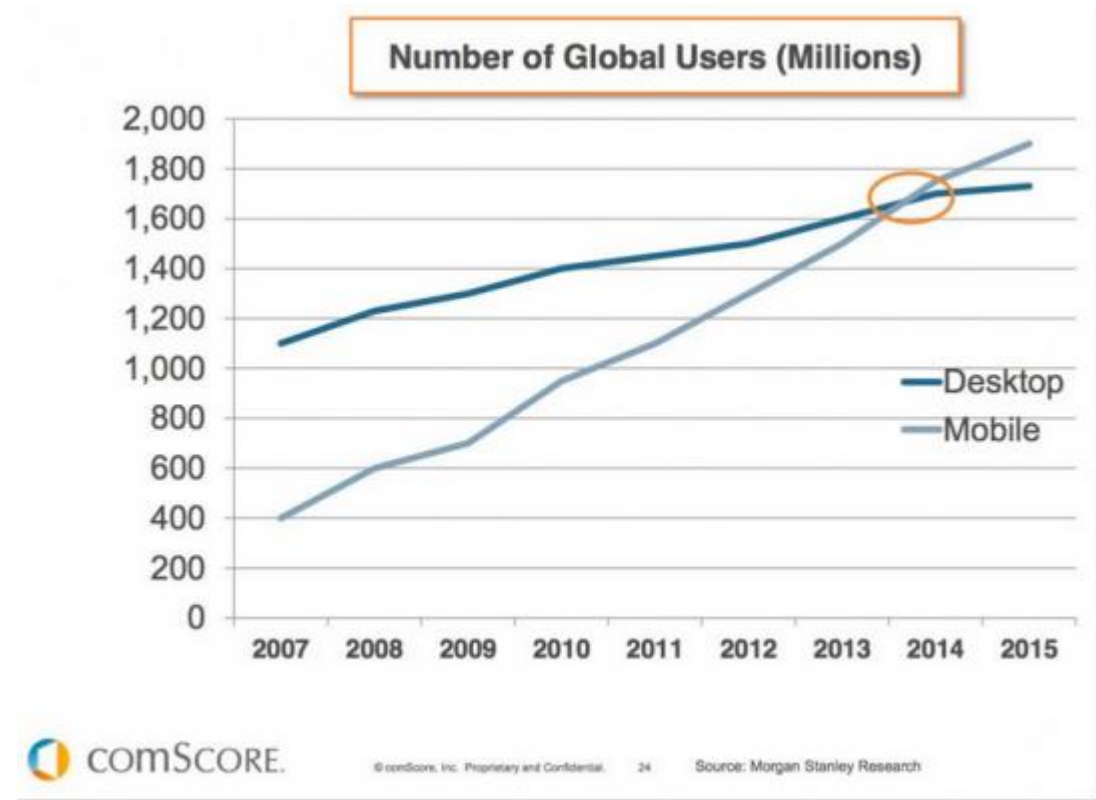
Presentation Goal

- Focus on mobile for natural resources management
 - Modern mobile operating systems and devices (iOS, Android, Windows Phone)
 - Geospatial (GPS/map) integration
 - Remote field applications (no internet access)
- Brief overview of current mobile landscape
- Approach to technology decision making
 - Device Requirements and current devices
 - Application requirements and available apps
 - Data management requirements and solutions



Mobile Landscape: Overview

- Apple
 - Has shipped over 1 billion devices (Apple, Jan. 2015)
 - Sold 10M iPhone 6 on 1st weekend (Apple, Sept. 2014)
- Android
 - Claims 1.4 billion users worldwide (Google, Sept. 2015)
 - Activates 1.5M Android devices every day (Google, July 2013)

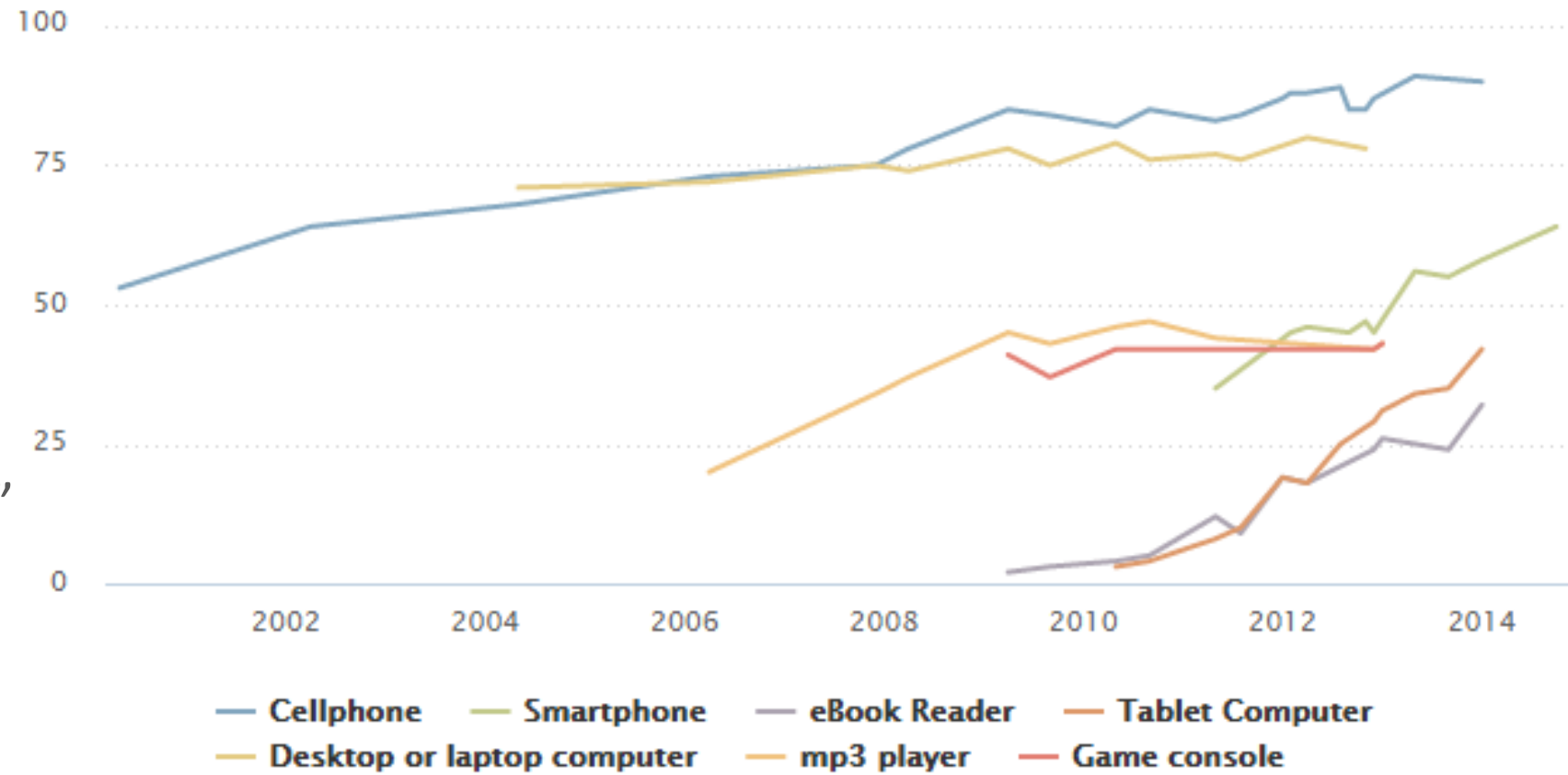


Mobile Devices Everywhere: US Data

American adults:

- 64% own a smartphone
- 42% own a tablet
- 46% describe their smartphone as “Something they couldn’t live Without”

% of American adults who own a ...



Consumer Market US vs. Global

Top Smartphone Platforms
 3 Month Avg. Ending Jul. 2015 vs. 3 Month Avg. Ending Apr. 2015
 Total U.S. Smartphone Subscribers Age 13+
 Source: [comScore MobiLens](#)

	Share (%) of Smartphone Subscribers		
	Apr-15	Jul-15	Point Change
<i>Total Smartphone Subscribers</i>	100.0%	100.0%	N/A
Android	52.2%	51.4%	-0.8
Apple	43.1%	44.2%	1.1
Microsoft	3.0%	2.9%	-0.1
BlackBerry	1.5%	1.3%	-0.2
Symbian	0.1%	0.1%	0.0

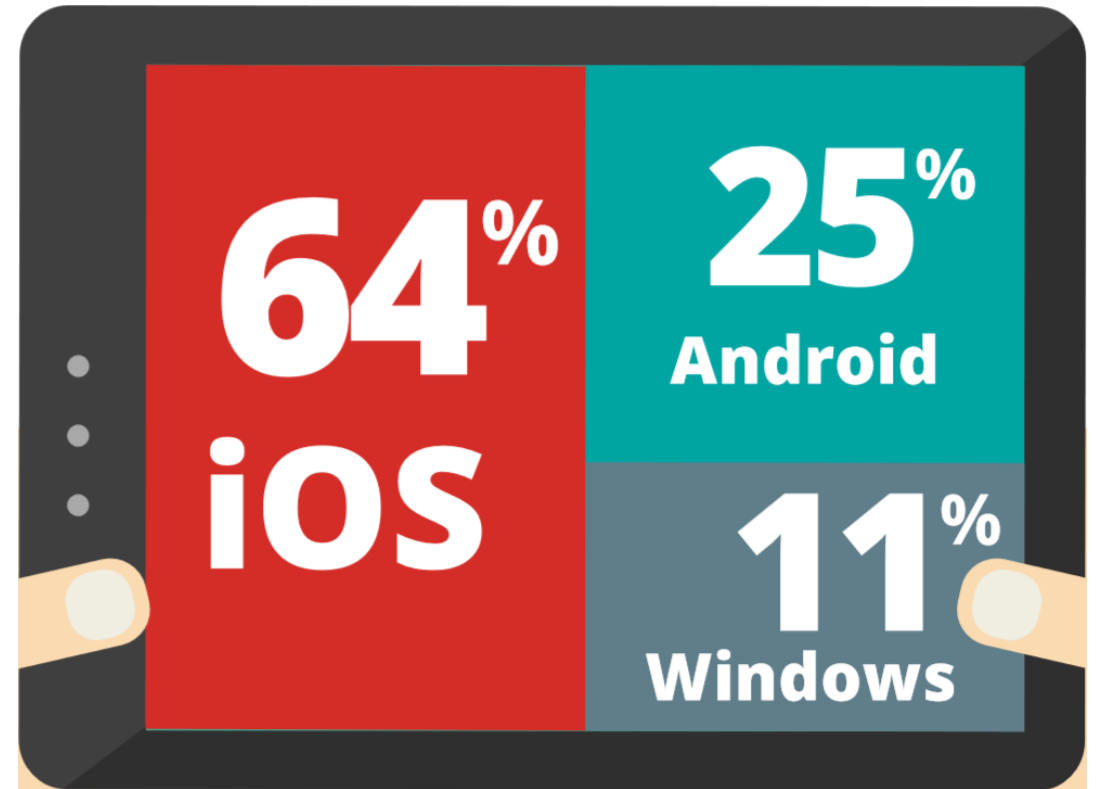
Global Smartphone Market Share
Shipments by Platform

Period	Android	iOS	Windows Phone
2015Q2	82.8%	13.9%	2.6%
2014Q2	84.8%	11.6%	2.5%
2013Q2	79.8%	12.9%	3.4%
2012Q2	69.3%	16.6%	3.1%

Source: IDC, Aug 2015

Enterprise Market

- iOS has much higher market share in enterprise, especially in government & education
- Over the past year:
 - iOS fell from 81 percent to 64 percent
 - Android jumped from 15 percent to 25 percent
 - Windows grew from 4 percent to 11 percent.



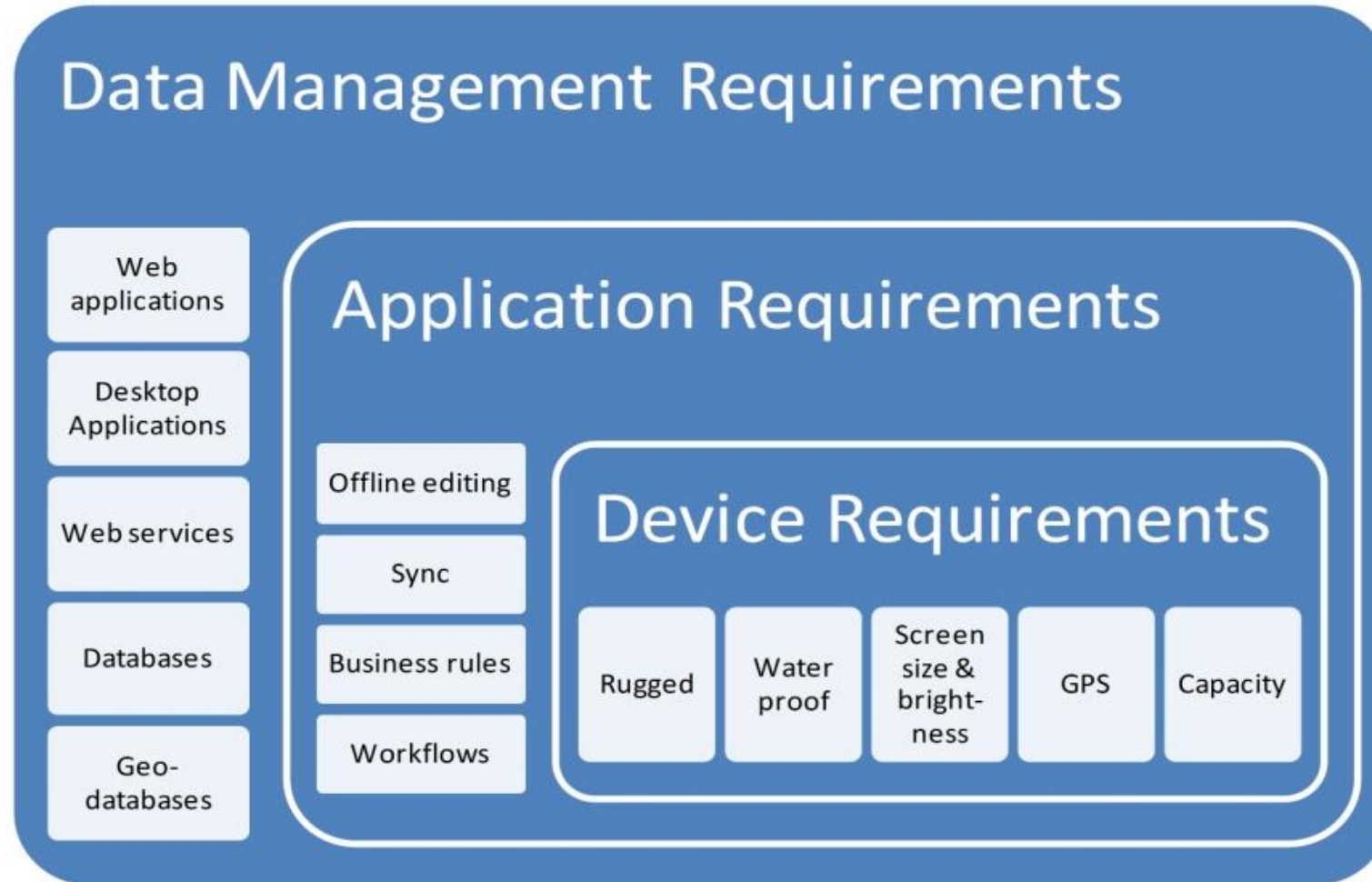
Cheap Powerful Devices



- Huge production volumes and big revenue produces cheap, powerful devices
 - Performance (64 bit, 3GB RAM)
 - Huge storage (up to 128 GB internal)
 - Sensors (GPS with GLONASS, Wi-Fi, Bluetooth, NFC)
 - Waterproof or water resistant
 - Low cost Bluetooth GPS (GPS+GLONASS+WAAS)
 - Phones and tablets often subsidized by vendors (Amazon) or carriers (ATT, Verizon, etc.)



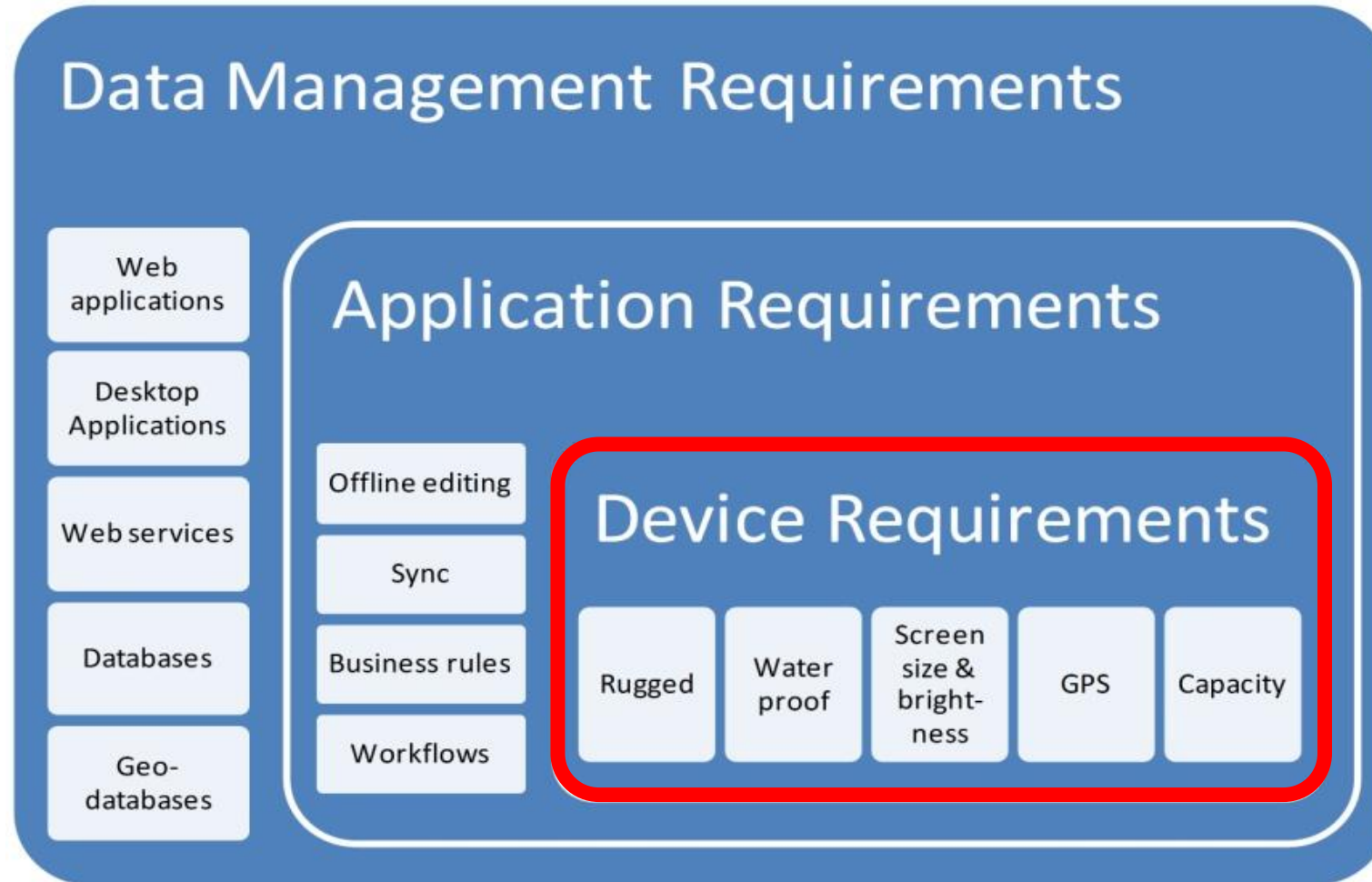
Requirements Driven Approach



Requirements Driven Approach

- Mobile technology decision framework
- Requirements driven - NOT technology driven
- Full lifecycle of application & data
 - Device and application lifecycles: purchase/development, deployment, training, maintenance
 - Data lifecycles: creation, publishing, updating
- Leverage existing investments
 - Skills, software, data, formats, workflows

Device Requirements



Device Requirements





- GPS accuracy
- Ruggedness
- Sunlight readability
- Device cost
- Size, weight, and Battery Life
- Performance and platform version
- Storage/File Transfer (Offline data)



GPS accuracy

- What spatial accuracy do you really need?
 - Locate feature (or yourself) within context of road or stream network, forest stand boundary (<20 m)
 - Record location for integration into GIS, forest inventory system (< 5 m)
 - Relocate small, obscured asset in the future; e.g., permanent plot center point (< 2m)
 - Survey critical asset for engineering work (<1m)

GPS accuracy

Accuracy Category	Typical Accuracy (may be worse dense tree foliage, steep terrain or poor satellite orientation)	Real Time (with WAAS correction)	Post Processing (base station differential corrections)	Example Devices
Survey Grade	<1 m	<1m	<10 cm	
Resource/ Mapping Grade	<15 m	2 - 5 m	.5 - 3 m	
Recreation Grade	< 15 m	3 - 5 m	NA	
Consumer Grade	< 30 m?	Garmin-Glo < 3m	NA	



GPS – Consumer grade

- GPS chips and antennae differences
- High-end phones GPS + GLONASS
- Mid-range phones/tablets GPS
- Low-end tablets may not have hardware GPS
- No WAAS
- A-GPS
 - GPS satellite almanac
 - Time to first fix
 - Pre-cache for offline
- Wi-Fi positioning
- Cell site triangulation
- Easily augment with Bluetooth GPS

Shop » OEM » GPS Sensors



GLO™

Part Number: 010-01055-15

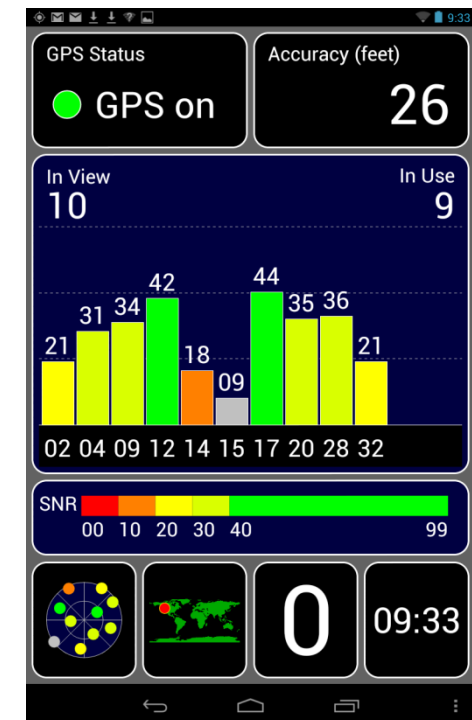
\$99.00 USD

Processing time is 1-3 business days

Add to Cart

Like Share 150 G+

More Images

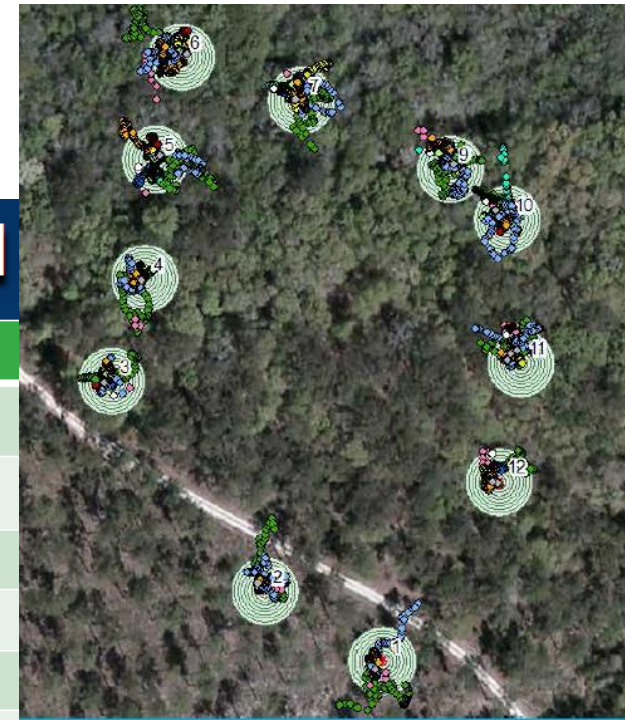


GPS Accuracy Test

- More satellites (GPS + GLONASS) improves accuracy
- WAAS improves accuracy
- Dedicated GPS devices outperform phones and tablets
- Bluetooth GPS units weren't evaluated
- What do you really need to accomplish your work?

Static Test Results - All

GPS	Avg Error (m)	
Post Processed GeoXT 6000 WAAS	1.85	
Post Processed GeoXH 6000 GLONASS	1.92	
Flint_Internal	2.43	
Hemisphere_A100	3.25	
GeoXT 6000 WAAS	3.36	
GeoXH 6000 GLONASS	3.57	6
Garmin_19X	3.67	7
SX_Blue II	3.68	8
Trimble T41	3.96	9
Forge_Internal	4.43	10
Holux_M1000C	4.93	11
iPhone5	7.54	12
GalaxyTab	7.69	13
Nomad_800_Internal	8.42	14



Device Ruggedness

- What level of ruggedness do you really need?
 - Rugged, ruggedish or none?
 - Operate all day in pouring rain with gloves on?
 - Protection from unexpected bumps, dust or occasional rain shower?
 - Do all users need same level of ruggedness?
 - Tradeoff between ruggedness and other features
 - Cost
 - Performance
 - Device size
 - Accessories



Certified Rugged



Trimble Juno T41
Windows/Android
MIL-STD-810G,
IP65/IP68, MIL-
STD-461E



SDG Systems Rampage 6
(Android version of
Juniper Mesa)
MIL-STD-810G, IP67



Panasonic
TOUGHPAD A1
MIL-STD-810G and
IP65



Xplore RangerX
Android Tablet PC MIL-
STD-810G and IP65



Cedar CT7
IP67
Android



Fieldbook E1 Android
10" Tablet
PC MIL-STD-810G and IP65

Ruggedish: Devices and Cases



Otter Box Defender cases



Lifeproof Fre cases



Samsung Galaxy Tab Active with S-Pen Stylus



Sony Xperia Z3



Capacitive stylus



iPad Pro with Pencil



Samsung S6 Active phone
PC MIL-STD-810G and IP65

Sunlight Readability



- NITs - Basic unit of luminance used to measure brightness. The higher the NIT count, the brighter the display (100 NITs often cited)
- Brightness requirements vary with environment (forest vs. desert vs. airplane)
- Brighter screens draw more power and may have poorer thermal management
- Some commercial grade devices as bright as 'sunlight readable' units
- Reduced glare and increased contrast often more important

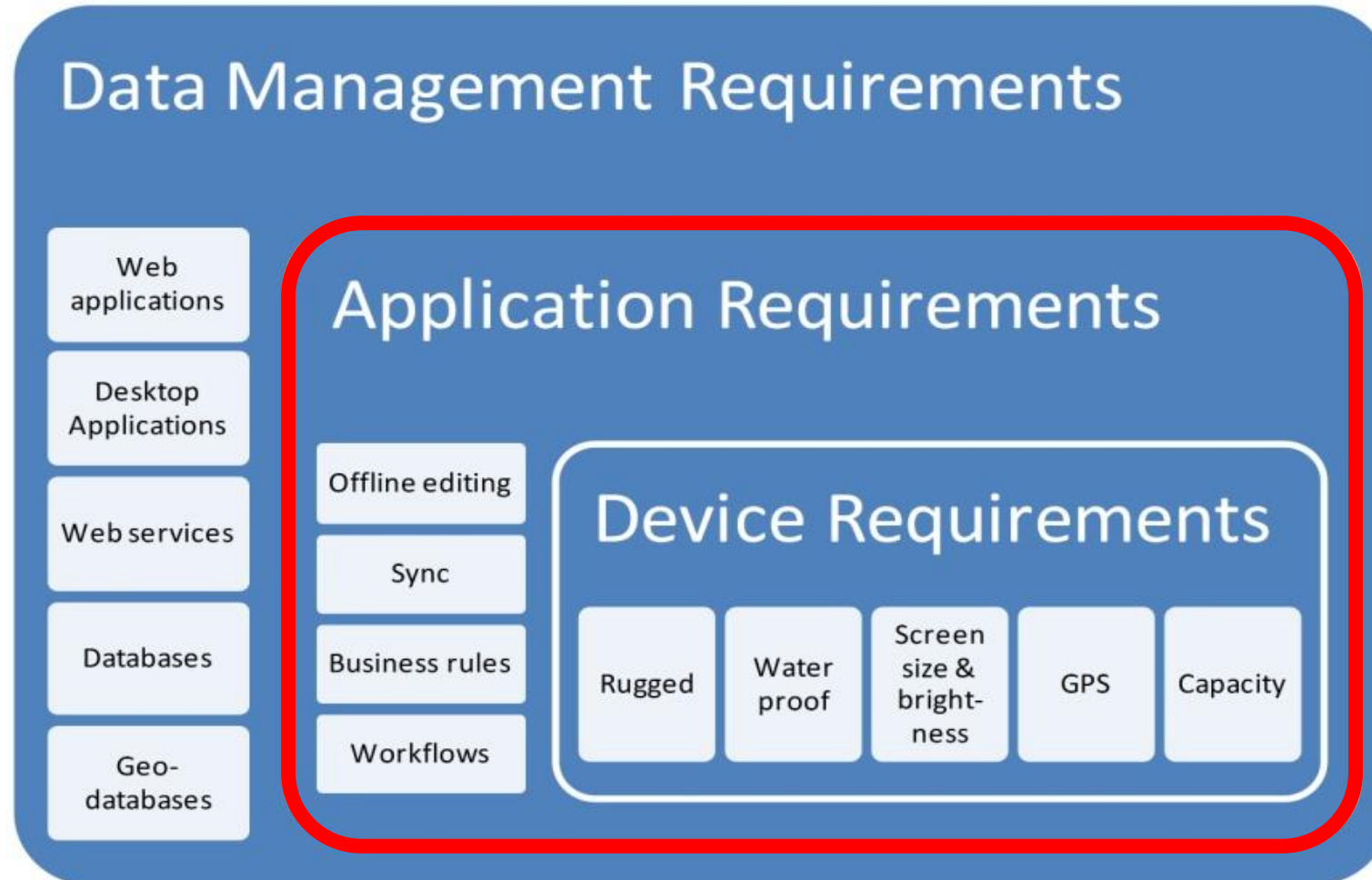
Cost



Other Important Features

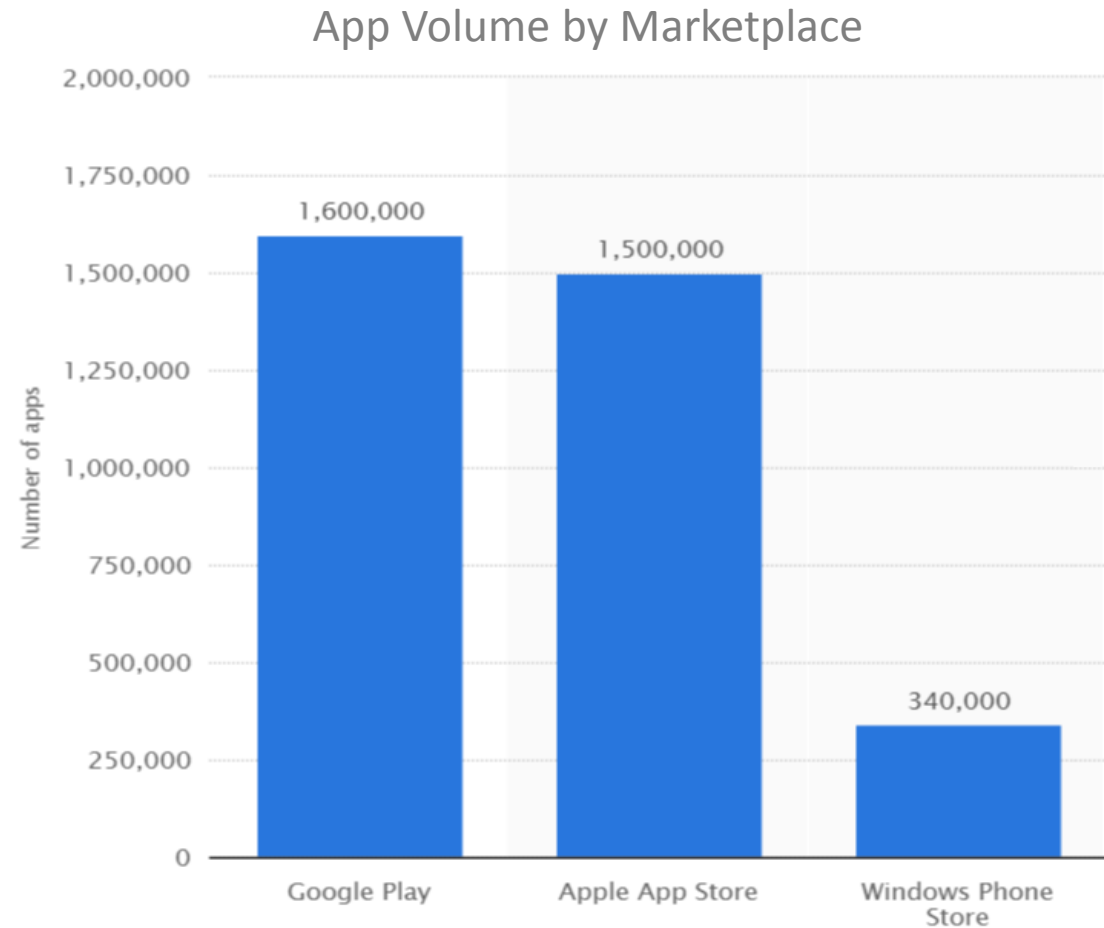
- Device / screen size
 - How will it be used/carried (in vehicles, in vest, in hand)
- Battery life
 - Function of brightness, GPS, cell, Wi-Fi, Bluetooth, temperature
- Performance
 - Most rugged devices ~2 years behind in specs
- Platform currency
 - Most rugged devices several Android versions behind
- Storage Capacity
 - Critical for offline maps, photos, videos
 - For Android devices internal + external (MicroSD)

Application Requirements



Application Requirements & Categories

- App Requirements
 - Map display
 - Navigation & waypoints
 - Data query & search
 - Spatial data collection
 - Attribute data collection
 - Data editing
 - Data transfer(upload/download)



Navigate

- Load, display and select waypoints
- Distance and bearing to selected waypoint
- Collect new waypoints

Display map data

- Display base maps
- Show GPS location

Collect spatial data

- Collect points, lines, polygons
- Add/update attribute data

Forms

Complete Digital Forms

- Custom data model
- Large or complex data entry
- Strong data validation
- Data form lifecycle

Cruise Timber

- Record stand, plot, tree, log data
- Rapid data collection
- Strong data validation

Mapping

Cruise

Navigate

- Load, display and select waypoints
- Distance and bearing to selected waypoint
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Display map data

- Display base maps
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Collect spatial data

- Collect points, lines, polygons
- Add/update attribute data

Mapping

Forms

Two Approaches

- Find 'best' app for each category
 - Cost (multiple apps, multiple devices?)
 - Training
 - Complexity (data management)
- Find best single app based on needs / emphasis
 - No app does everything!

Complete Digital Forms

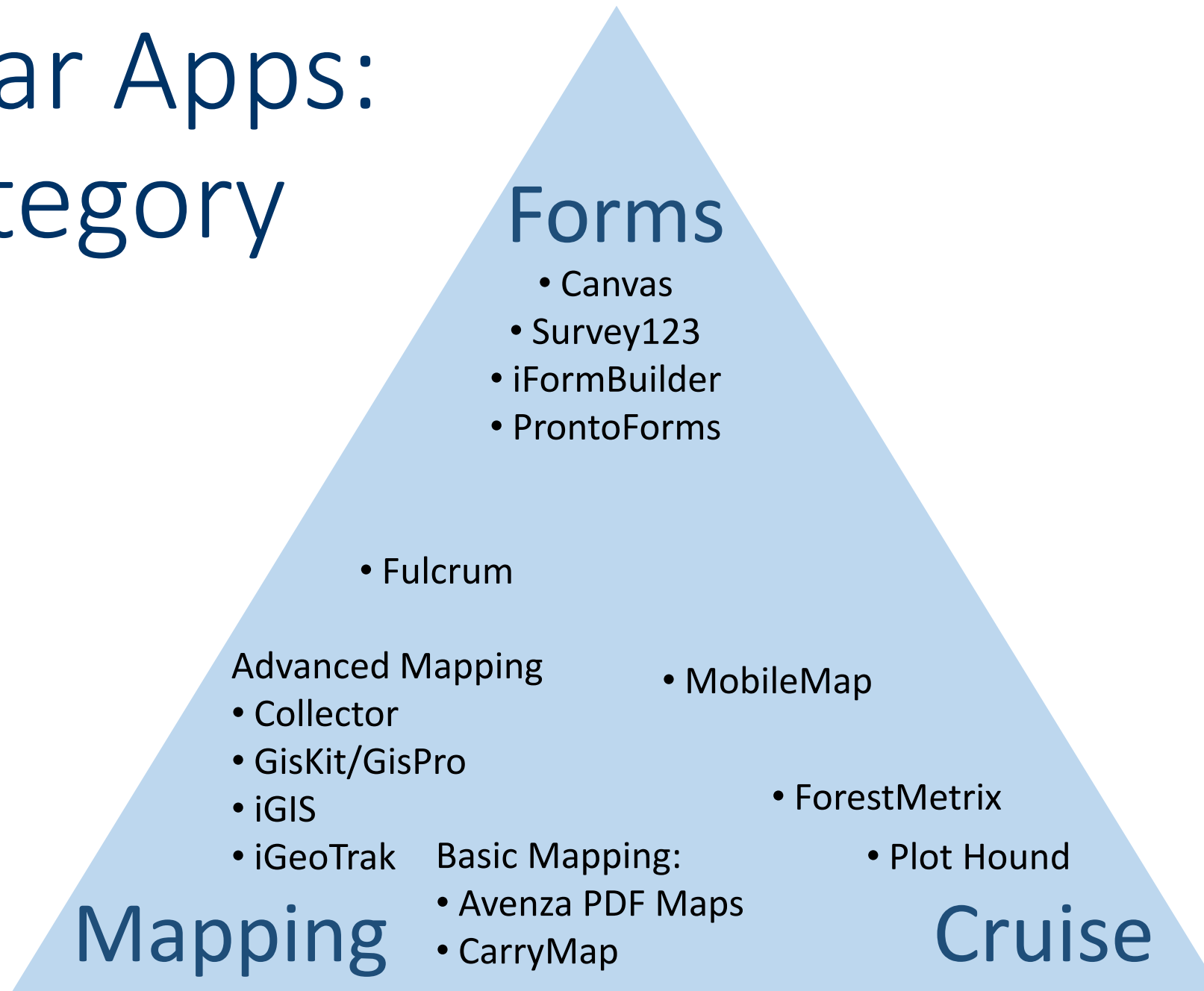
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Cruise Timber

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Cruise

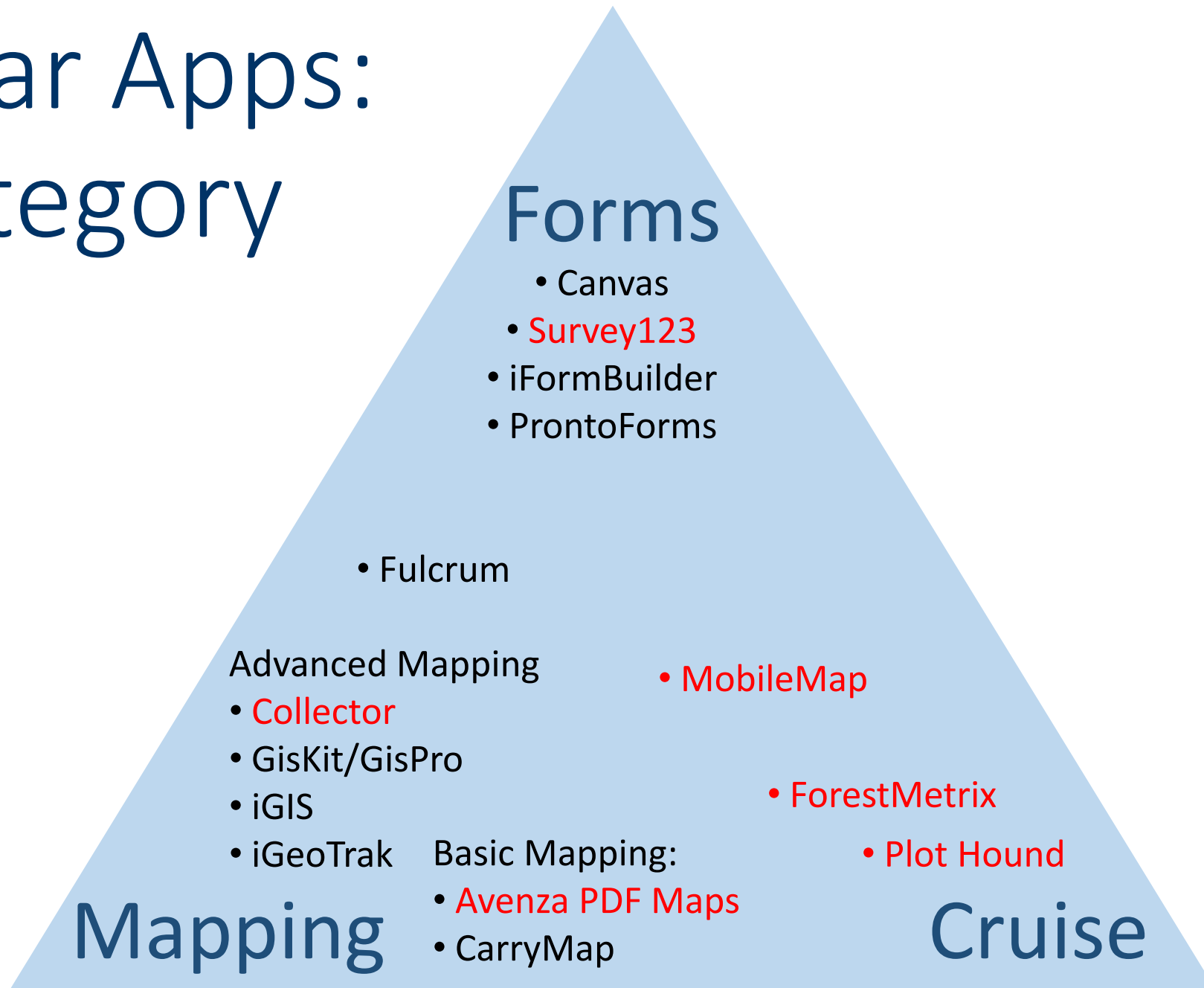
Popular Apps: By Category



Legacy

- T-Cruise
- SilvAssist
- SuperAce
- DataPlus
- RTI
- ArcPad

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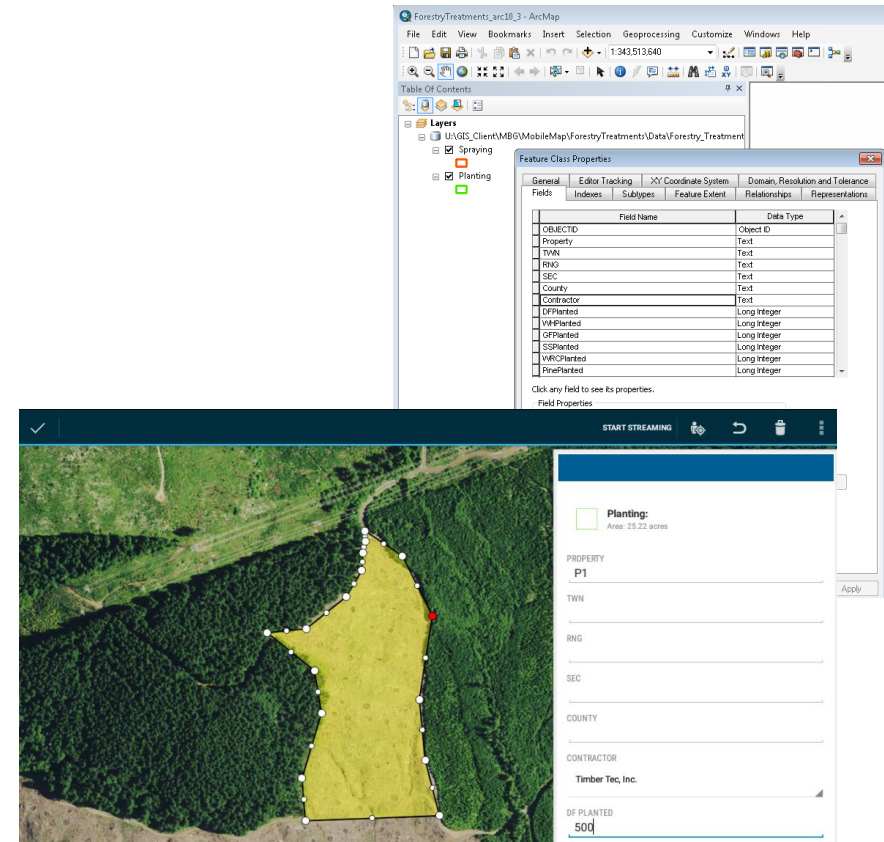
Basic Mapping: Avenza PDF Maps

- Subscription based model (≤ 49 /year)
- Single, offline PDF base map
- GPS location and compass
- Zoom to coordinates
- Measure distance and area
- Colored pushpins for points, create or import
- Colored lines, save from measure line or import
- Record GPS tracks
- Create basic attribute schema on device (string, boolean, real, integer)
- Text/number input or pick lists
- Export as KML, GPX or CSV for email or Dropbox



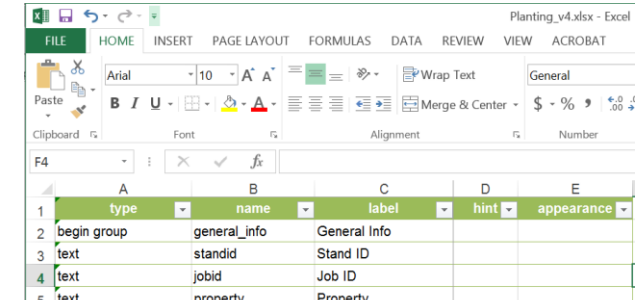
Advanced Mapping: Collector for ArcGIS

- Free app from Esri, requires ArcGIS Online
- Integrates with ArcGIS Desktop and ArcGIS Online
- Single base map downloaded or side loaded in TPK format
- Data model created in ArcMap, published to feature service
- Devices sync to get data model, data (bi-directional)
- Data model enforced on the device, domains, drop downs, etc.
- Strong support for symbology, offline data access and data collection



Forms: Survey123

- Free app from Esri, requires ArcGIS Online
- Schema and form layout created in Excel using XLSXForm specification
- Easy to design and publish new form
- Supports wide range of data types, constraints, styles
- Generates a hosted forms application in ArcGIS Online and a corresponding Feature Service and Web Map
- Location - supports points only (from GPS or dropped)



	A	B	C	D	E
1	type	name	label	hint	appearance
2	begin group	general_info	General Info		
3	text	standid	Stand ID		
4	text	jobid	Job ID		
5	text	priority	Priority		



Cruising: ForestMetrix

- Perpetual license model (\$2,200)
- iPad only
- Built on FileMaker Pro
- Powerful in field analytics
- Compile and merchandize in the field
- Geared toward consultants, procurement foresters, small landowners
- Data transfer via email
- Reporting handled by Excel templates



Cruising: Plot Hound

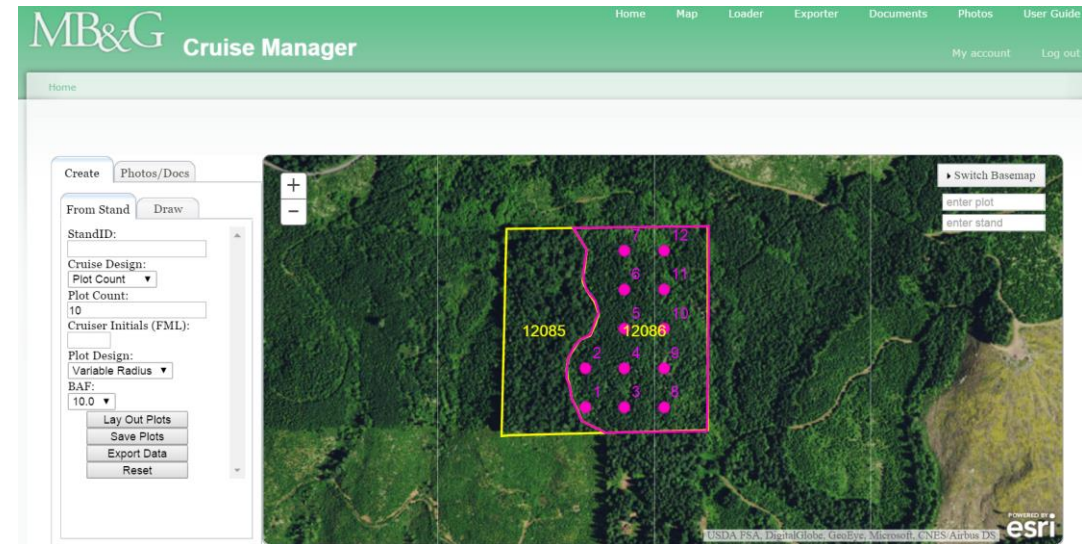
- iPhone, iPad, Android phones
- Free to use mobile and web app
- SilviaTerra business model based on cruising and analysis support, LIDAR services, increased sampling efficiencies
- Enterprise workflow, your data hosted on their servers
- Web application supports
 - Cruise design
 - Monitoring of cruise
 - Download of cruise data
 - Compilation
 - Reports

The screenshot displays the 'Plot #6' interface for 'Duke Forest'. It features a 'Limiting Distance Calculator' dropdown menu. The main data entry form includes fields for Species (loblolly_pine), Diameter (DBH) (22 inches), Total height (108 feet), Merch. height (73 feet), Product (S&W), Flag (checkbox), Age, Crown ratio (25%), Detects (1 defect), and Tree notes. A third tree entry for 'red maple' is partially visible below. A species selection dropdown is open, listing various tree species such as American beech, American holly, American hornbeam, black cherry, blackgum, black oak, Drooping juniper, eastern redcedar, flowering dogwood, loblolly pine, northern red oak, and Other or unknown live tree. At the bottom right, there are 'Drop plot' and 'Complete plot' buttons.

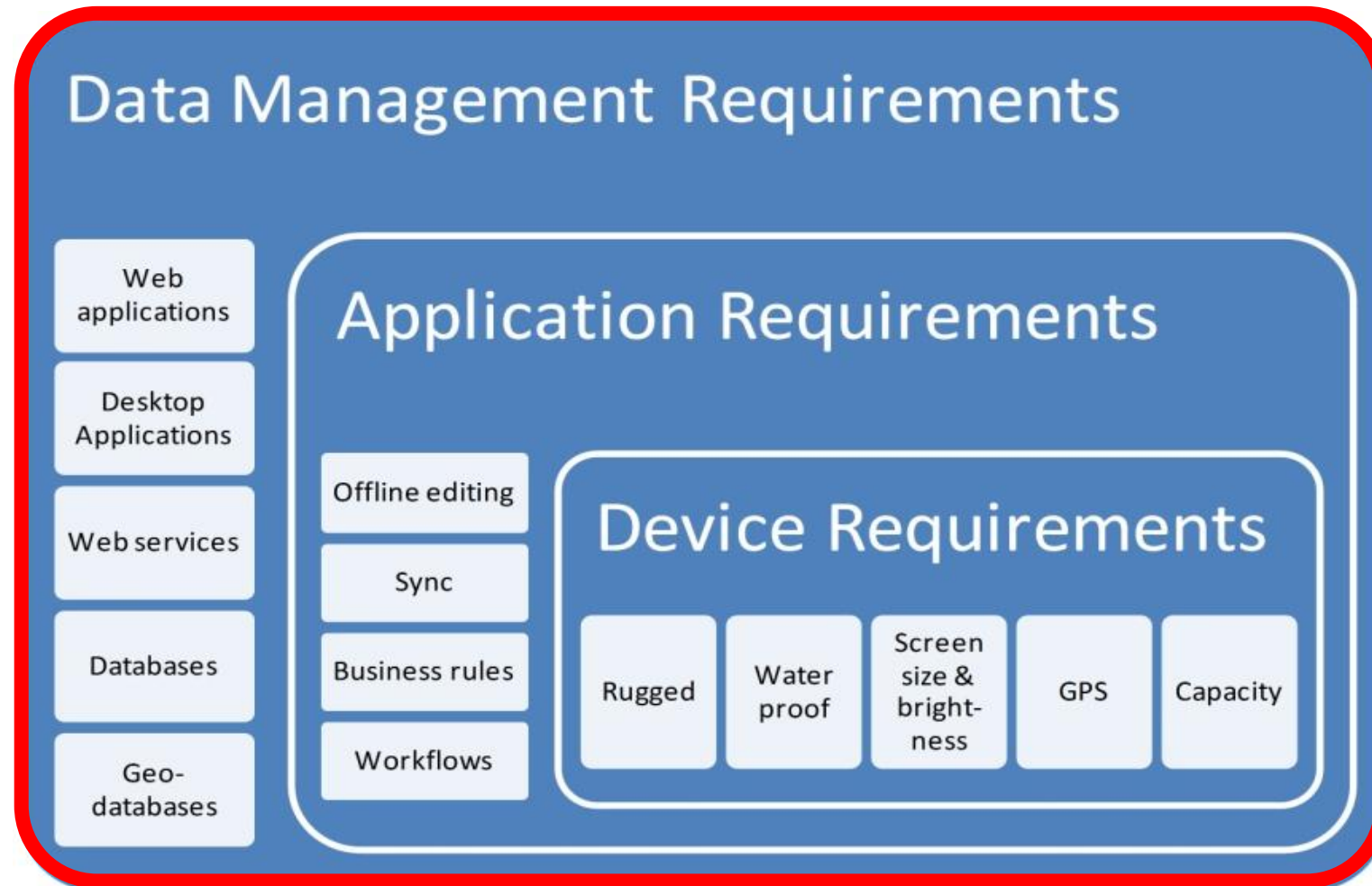


Cruising: MobileMap

- Subscription based model ($\$ \leq 300/\text{year}$)
- Android tablets and phones
- Subscription based pricing model
- GIS-centric application, advanced mapping capabilities (base maps, navigation, symbology)
- Enterprise workflow (ArcGIS Server / ArcGIS Online)
- Data collection only, not compilation (no volume calculations or merchandizing)
- Imports data from other systems (e.g. SuperAce, DataPlus)
- Export data for Forest Inventory and Management Systems (e.g., FPS, MBG Tools)
- Web application supports design, monitoring of cruise, download of cruise data



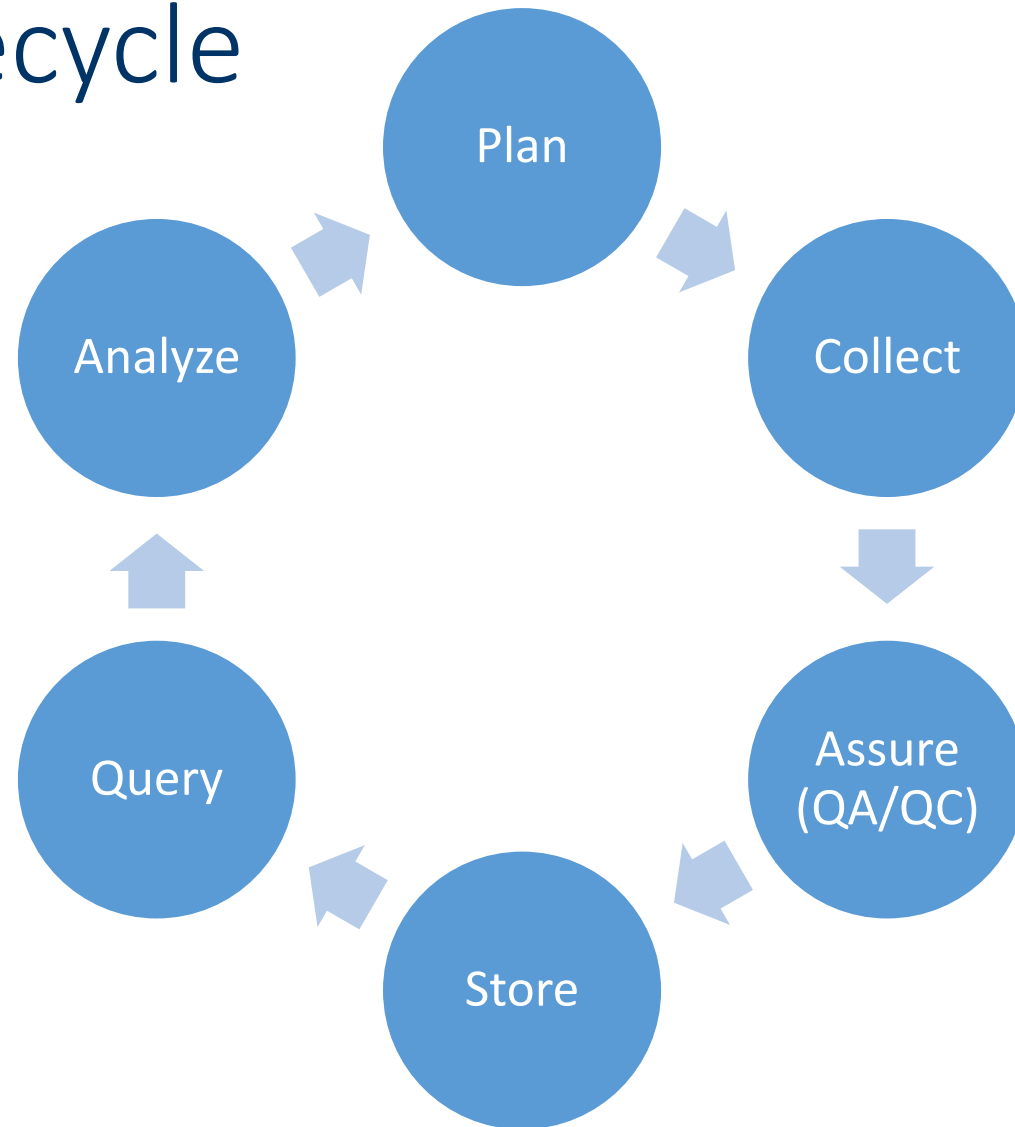
Data Management Requirements



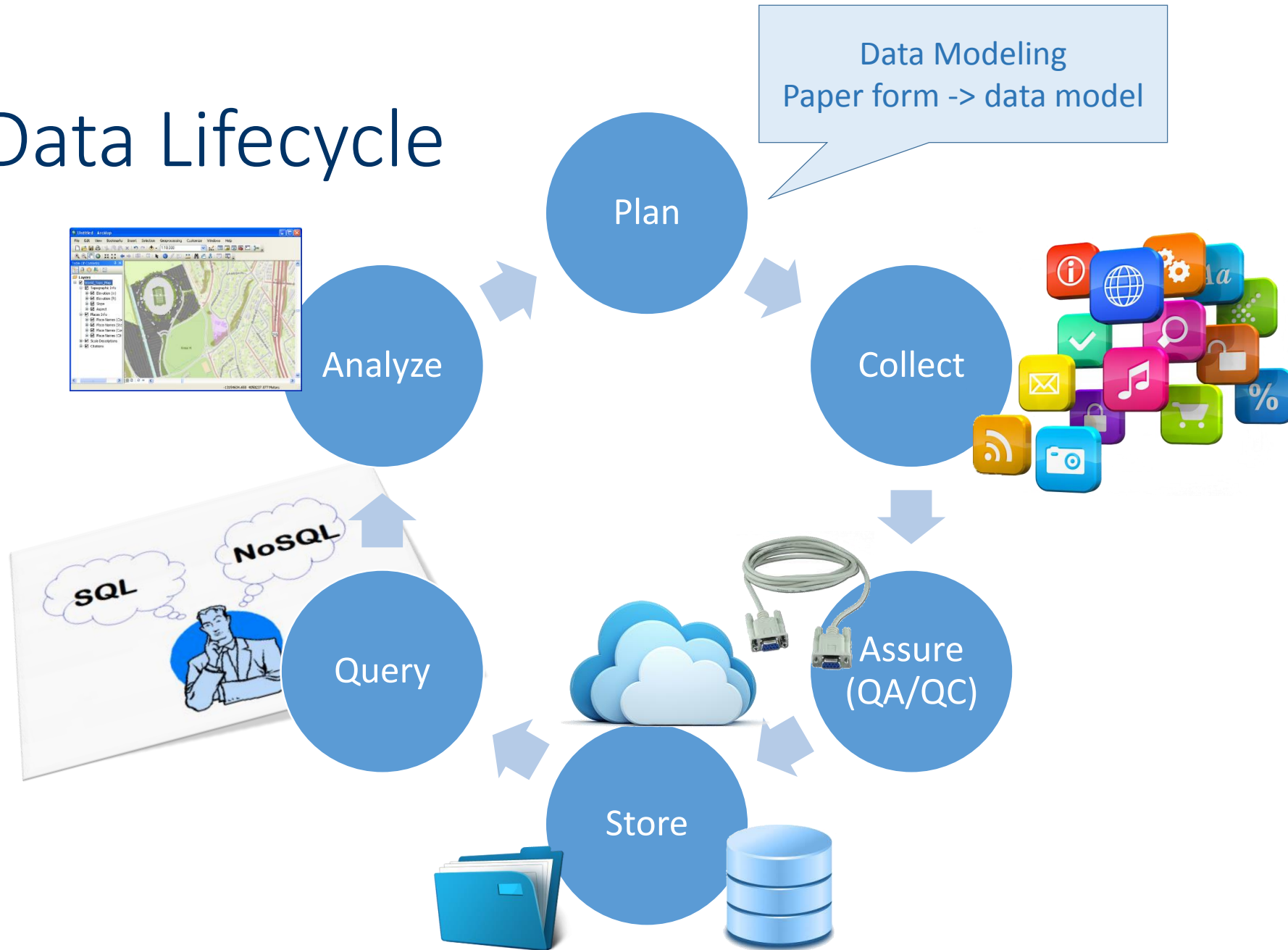
What is Data Management?

- “the architectures, policies, practices and procedures that properly manage the full **data lifecycle** needs of an enterprise”
 - Data Management Association

Data Lifecycle



Data Lifecycle

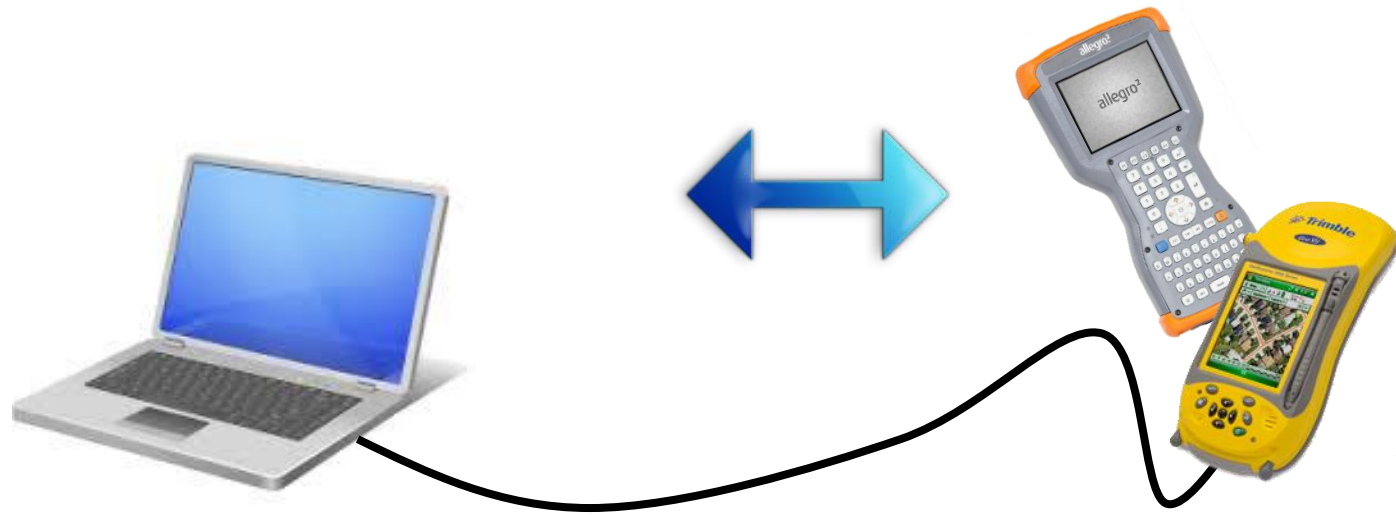


Architectures & Workflows

- Desktop (non-enterprise) - legacy
- Desktop (non-enterprise) - modern
- Enterprise – On-premise
- Enterprise – Cloud hosted
- Hybrids



Desktop - Legacy



- Direct cabling of device
- Transfer of flat files (GPX, Shp, XLS, DBF, etc.)
- Requires import/export (check out/in) processes on desktop system
- Doesn't scale well
- Version control / data merge problems when multiple users or field collection trips
- May require import/export on device

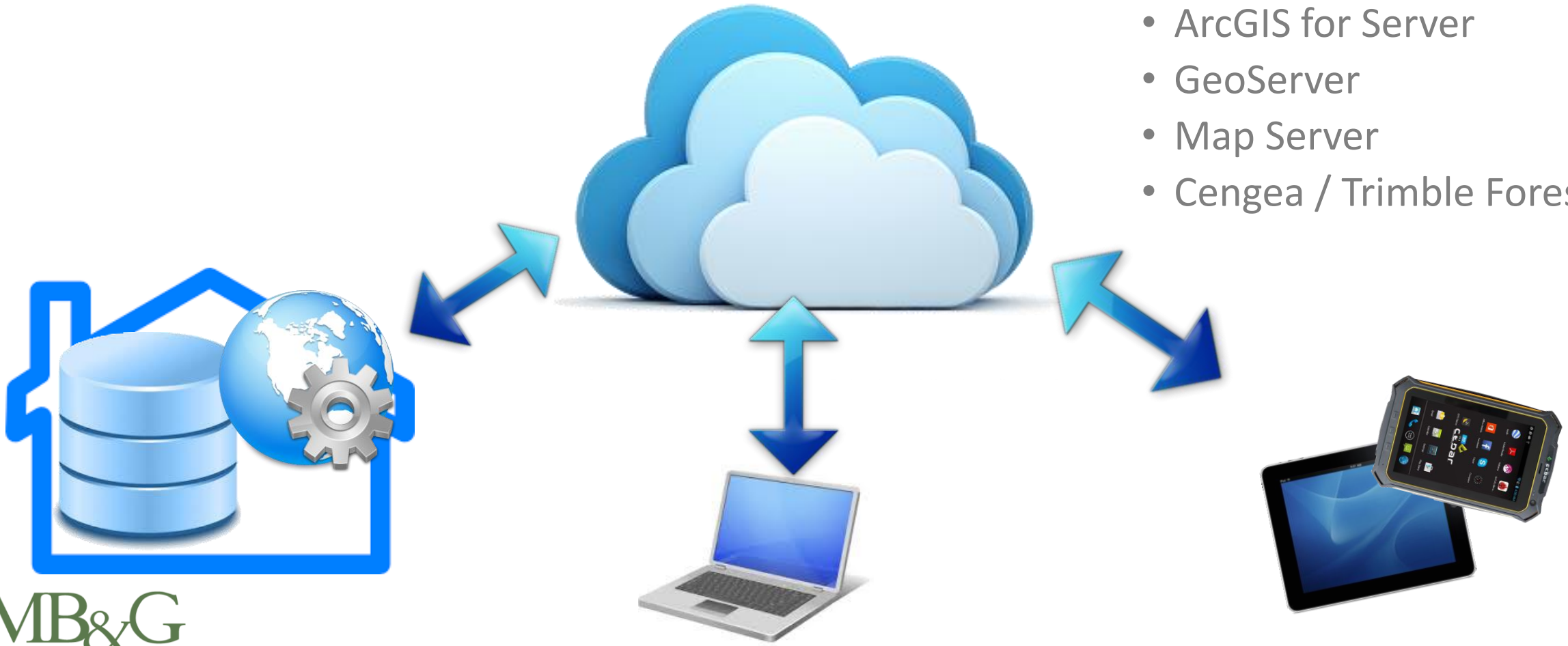
Desktop - Modern



- Transfer of flat files (Transfer of flat files (GPX, Shp, XLS, DBF, KML, PDF))
- File transfer via email or cloud hosted file service (Dropbox, Drive, OneDrive)
- Requires import/export processes on computer
- Version control / data merge problems when multiple users or field collection trips
- May require import/export on device

Enterprise – On Premise

- Data and services hosted in on-premise server(s) using web services
 - ArcGIS for Server
 - GeoServer
 - Map Server
 - Cengage / Trimble Forestry



Enterprise – Cloud Hosted

- Data and services hosted in cloud
 - ArcGIS Online
 - Amazon web services
 - CartoDB



Hybrids



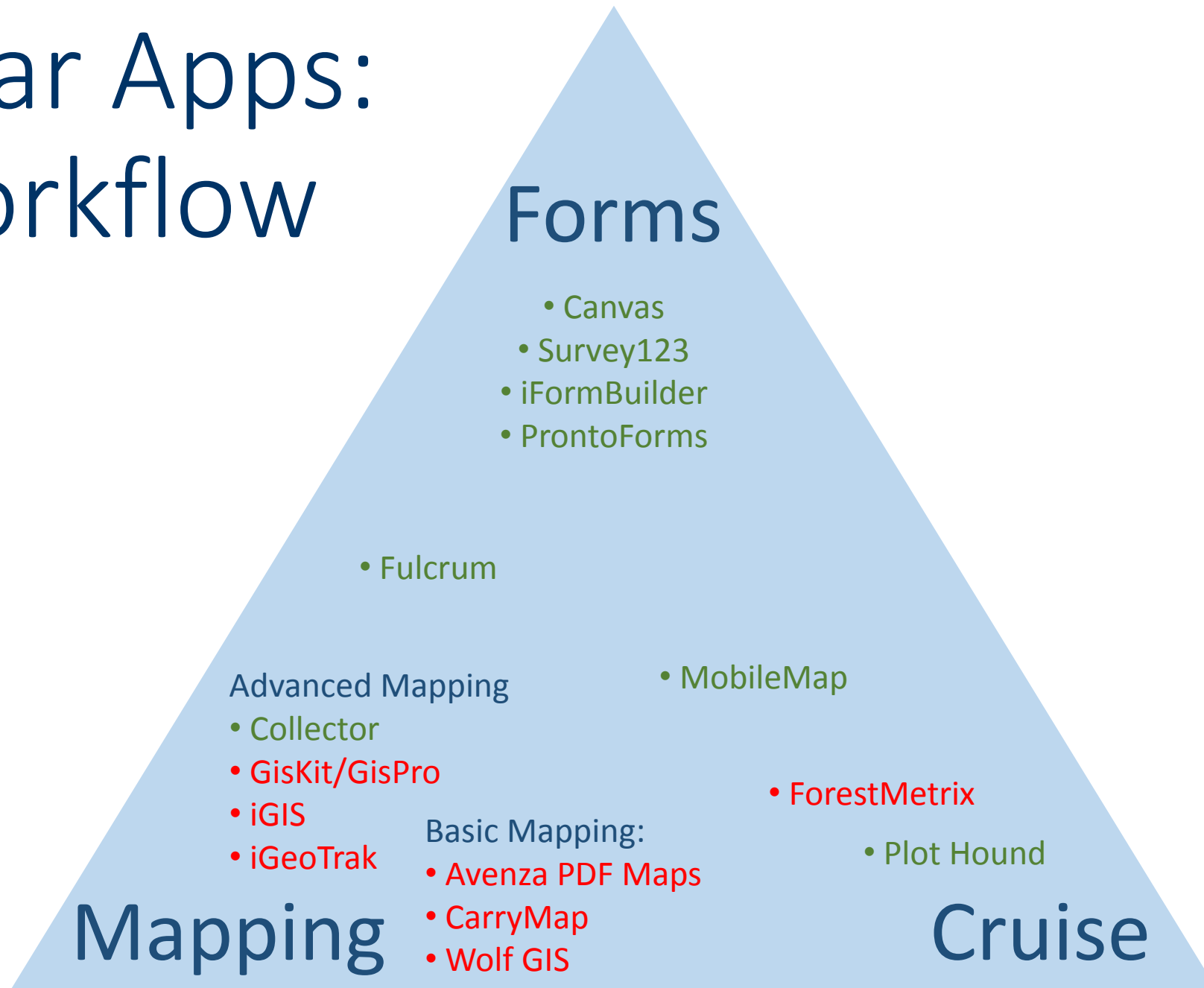
- Streamed base maps + flat files for operational data (GIS Pro)
- Streamed operational data + flat files for base maps (MobileMap)

Benefits of Enterprise Systems

- Efficiency
 - Reduces time importing, exporting, converting data
 - Can access data whenever internet connection available
 - Reduced complexity for users
 - Export/edit/convert/import -> sync
- Collaboration
 - Much easier to share data with coworkers, managers, employees, contractors
- Provides greater security for data
 - Data backed up to database
 - Role-based based security determines access (compare to folders full of Shp files)
 - Versioning workflows (reconcile/post) support edit tracking

Popular Apps: By Workflow

Desktop
Enterprise





What apps, devices and workflows or important considerations did I miss?

