PROGIRA®

Executive Summary

The Posts and Telecommunications Department of The Republic of the Union of Myanmar (PTD) plays a vital role in maximizing the value of the radio frequency spectrum, economically and socially, for the nation. PTD has planned to implement a spectrum management system (SMS) that speeds up the licensing process, as well as provide reliable and precise data on spectrum usage to PTD. Data collected, stored and analysed by the SMS is fundamental to PTD's success; as data output facilitates PTD to make crucial, strategic decisions to capture the value of spectrum.

Every day, spectrum managers and regulators process vast amounts of data, deal with concurrent, parallel-running workflows while having less time simultaneously. PTD's responsibility of managing the spectrum and its data can be complicated, time-consuming and fraught with the dangers of making costly mistakes. In today's world, single data items are just insufficient. However, poor software design can create data silos, which seriously impede an organization's collaboration and productivity. Moreover, unintuitive user-interface can lead to excessive repetitive tasks, time wastage, increase the risk of errors and unnecessary stress among users. Here's an example of poor usability, spectrum regulators may need to open many windows for a search query and going through many windows to look for information. To make things worse, when windows are hard-coded and inflexible to move on the screen. More than often, we have seen systems designed with poor usability which leads to a loss of productivity. It has been reported to cost the US economy 30 billion dollars as a result. On the contrary, intelligent software design and excellent user experience (UX) increase work productivity, reduce training time and protect the data's integrity. Therefore, in the design of an SMS, we were obsessed with providing the best spectrum management experience with optimal UX design principles.

Proposed SMS for PTD - PROGIRA manager

We propose PROGIRA manager to help PTD overcome the challenges of spectrum management. It is an efficient and user-friendly spectrum management system which integrates data management capacities, data analysis, and multiple spectrum management processes as well as functions, on to a secure, stable, and scalable solution.

Customer-centric development of SMS

Because experienced spectrum regulators and their feedback drove the development of PROGIRA manager; the system was built to overcome shortcomings, pitfalls and poor usability of existing, commercialized SMS. Our product developers commit to providing users with an SMS that simplifies complex spectrum management processes yet maintaining security and necessary technical rigour.

Advantages of a Modern Design in an SMS

We offer an SMS fully fulfilling all the requirements as detailed in PTD's document 'Procurement of Spectrum Management System (G 1.3.8)', plus a little more, so that spectrum management is simple and efficient:

- The spectrum database consolidates multiple databases into one, avoiding unnecessary data silos and low productivity

- Utmost flexibility when handling licensing and radio entities' data enabling possibility to group related data records for easy history tracking:
    - All modifications to assignments while performing international coordination are clearly visible
    - Multiple license entries can be associated to a transmitter so all licensing history and changes made are clearly visible
- The powerful search engine allows finding objects easily – search is possible not only by the object itself but also its related items, regardless whether it's a one-to-one or one-to-many relationship between the elements.
- Integrates seamlessly with global leading GIS system – ESRI's ArcGIS and save time as you no longer wait for maps to be drawn. You can view your maps in 2D as well as 3D, online or offline, supporting multiple coordinate systems and asynchronous operation.
- Benefit from a suite of integrated applications, including ArcGIS Pro, ArcGIS Server, ArcMap and others: Display and animation of large numbers of map features are now seamless while maintaining the smooth feel of a native application.
- Spectrum engineering is central to efficient spectrum management, benefit from PROGIRA's state-of-the-art spectrum engineering solutions and services, already embraced by users from over 50 countries around the world
- Implement a comprehensive range of propagation models, including tuneable ones
- Modern and intuitive user-interface that is easy to learn
- Easy to amend, extend existing license types and introduce new ones with templates and customizable fields
- Manage data conveniently with table controls specially designed to sort, filter, and view data easily
- Designed to be easily usable on a single monitor, but fully support two, three or even more monitors at the same time, thus increasing productivity even further
- Uses modeless windows which give you full control and uninterrupted functioning as you edit. Editors are accessible once they are opened, and while it is opened, you have the freedom to do anything you want. Therefore, you can easily switch back and forth to any other windows for reference while editing an item without the need to close the editor, seen in older systems
- Creates interactive, colourful timelines and other views to help visualize your spectrum management processes, data and its interactions

Summary of Functions

PROGIRA® manager consist of multiple interoperable software systems which will be fully functional by the end of Phase 1 implementation according to tender requirements, with the following responsibilities and functions (detailed list would be too long for a summary so only most important functions are listed here):

- Microsoft Windows Server OS
    - Central user account management

- Central user validation and authorization

- Microsoft SQL Server
  - Central secure spectrum management data storage
  - User roles verification
  - Auditing of user actions

- ESRI ArcGIS Server Enterprise
  - Digital elevation data storage and access
  - Digital map data storage and access
  - Digital clutter data storage and access
  - Enterprise edition allows limit access to data to specific users

- PROGIRA® manager
  - Ultimate spectrum overseer software system primarily targeted to automate everyday tasks for communication administrations
  - Robust Client-Server architecture
  - Role based user access
  - Data security and auditing
  - Compliance to ITU-R recommendations SM.1370, SM.1537 and SM.1047
  - Fully integrated with ESRI ArcGIS Runtime
    - Asynchronous map data presentation
    - Map data access for other purposes (effective antenna height calculations, etc)
    - Display of transmitters/allotments on the map
      - Directly selected
      - Related to selected objects (for example single license may cover several transmitters, so all of them will be drawn on a map when license is selected)
    - Hierarchical view as per tender specifications
  - Licensing and related data management for broadcast, point-to-multipoint (fixed and mobile), point-to-point (radio links), radio amateurs, aeronautical, maritime and earth stations
    - Fully user editable license types, templates and processes
    - Preconfigured license types as per tender requirements: Aeronautical Station License, Aircraft Station License, Coast Station License, Port Operations License, Ship Station License, Broadcasting (Terrestrial – sound) License such as AM, FM, DAB, Broadcasting (Terrestrial – television) License such as DVB-T, Broadcasting-satellite License, Community Radio License, Fixed Service License (point-to-point), Fixed Service License (point-to-multipoint), Fixed Service License (point-to-multipoint with band and area defined), Land Mobile Radio – Commercial Cellular Service, Land Mobile Radio - Commercial Radio Trunking, Land Mobile Radio - Private Radio Trunking, Private Mobile Radio (Business Radio) with Band and Area Defined, Private Mobile Radio (Business Radio - point-to-point and point-to-multipoint, mesh), Private Mobile Radio (Business Radio - Single Site, point-to-area), Private Mobile Radio (Business Radio - All Myanmar), VSAT Service Provider License, VSAT Terminal License (in VSAT Service Provider network), Transportable Earth Station License (TES), Permanent Earth Station License (PES), Ship Earth Station License, Aircraft Earth Station License, GSO-non FSS Earth Station License, NGSO-FSS Earth Station License, NGSO-non FSS Earth Station License, Receive-Only Earth Station License (ROES), Amateur Radio License, Experimental/Developmental License, Equipment Demonstration License, Radar (Land-

based and coast-based) License, Short-Range Devices License, Ultra-Wideband (UWB) Devices License
        - Full support for licensing processes as per tender specification:
            - Issuance of new license
            - Renewal, amendment, surrender, and revocation of existing license
    - Automated workflows for licensing processes
        - Fully user editable
        - Preconfigured as will be agreed during design review meeting
        - Ability to call external tools in automated fashion as per tender requirements
    - Financial module
        - Fee table
        - Fee processing for single time and/or monthly/yearly invoice generation
        - Payment tracking
        - Generates monthly summary statement on revenues
    - Site database (vital installations)
    - Coverages calculated using PROGIRA® plan can be
        - Stored within central database
        - Displayed by PROGIRA® manager
        - Imported by PROGIRA® plan into new projects (to avoid recalculation)
    - Frequency allocations/plans
        - Preconfigured data for Radio Regulations plan
        - User editable national and regional plans
    - Open architecture supporting add-ins written in any Microsoft .NET compatible language and data interoperability with external software
    - Powerful search engine allows finding objects easily:
        - By any simple object property
        - By any simple property of related object (regardless whether it's a one-to-one or one-to-many relationship between the elements)
        - By object or related object geography (utilizes geospatial indexing and search functionality of Microsoft SQL Server providing blazingly fast geo-searches)
            - Within (fully contained within)
            - Non-disjoint (fully contained or overlapping)
            - Circular area (centre and radius)
            - Donut area (centre, radius and width)
            - Rectangular area
            - Another geographical object (thus enabling search within certain distance from a country border and other advanced uses)
    - User editable channel database
    - IIS based web site
        - e-Application
        - e-Payment
    - Reports generation
    - Enforcement
    - Equipment database
    - Antenna model database
    - Fully user configurable data validation ranges
    - Fully user configurable user interface
        - Showing/hiding/reordering columns in tables
        - Editable ribbon and quick tools toolbar similar as in Microsoft Office
    - Ability to interface to external systems, if any exists, such as:
        - Employees database
        - Billing/accounting

        - Client (person) database
        - Document register
        - Monitoring system – access monitoring system of PTD

- PROGIRA® plan spectrum engineering tool
    - Seamless integration into PROGIRA® manager
    - Operation on both data from central database as well as in a partly or fully disconnected mode with manual data entry/import.
    - Ability to be installed onto a laptop and be taken into the field if needed (each workstation will be licensed by separate USB key which can be unplugged from workstation and plugged into laptop enabling PROGIRA® plan usage there)
    - Projects support
        - Each project is tied to specific configuration (which in itself describes which terrain, clutter and some other data is used by default)
        - Each project can contain a different subset of data specifically required for specific analysis
            - Imported from central database
            - Imported from ITU notice files
            - Imported from Excel files
            - Imported from other projects
            - Imported from other data sources (orderable by request)
        - Project can be linked to one or more other projects for read-only access to the data contained in them
    - Easily switchable map data (irrespective of its underlying coordinate system – required projections are seamlessly handled by ArcGIS software)
    - Fully integrated geographical information system (ESRI ArcMap or ArcGIS Pro)
        - Operation on central (ArcGIS Server provided) map/terrain/clutter data or fully standalone operation
        - Map/Display – high level to zoom in to details
        - Map view during Quick Calculation, technical analysis
        - Display frequency and coverage of a radio communication system on a map
        - All modules of SMS work with Esri ArcGIS and utilize geographical data (such as DEMs and DSMs)
        - Geographical calculations of:
            - Distance and azimuth between two points on the earth
            - Optical and radio horizon of antenna
            - Line of sight between two antennas
            - Terrain elevation at a specified point
            - Terrain elevation within a specified radius of a point (area)
            - Terrain elevation of points along a path specified by two points
        - Display of:
            - Transmitters within a specified band
            - Receivers within a specified band
            - Field strengths of transmitters in and outside of spectrum database
            - Point-to-point and point-to-multipoint links
    - Fully user configurable user interface (showing/hiding/reordering columns in tables, etc)
    - Specific support for
        - T-DAB (including T-DAB+), DVB-T/T2, AM and FM broadcasting systems
        - Radio links
        - 4G (LTE) and 5G mobile systems

- Propagation modelling according to:
  - As per tender specifications
    - ITU-R Recommendations P.452-16, P.525-3, P.526-14, P.528-3, P.530-17, P.533-13, P.620-7, P.1546-5, P.1812-4
  - Additionally
    - ITU-R Recommendations P.368-9, P.1147-4
    - CRC-Predict – easily tuneable and high accuracy propagation model for point-to-area predictions developed by Canadian Research Centre
  - Propagation model is easily selectable by the user for each specific calculation
- Additional geographical data:
  - Radio refractive index
  - Magnetic inclination (dip) and declination (variation)
  - Blazingly fast, multithreading compatible Progira's own replacement for ITU IDWM (using the same geodata set) for
    - Shorelines
    - Country contours
    - Coastal areas
    - ITU propagation zones
    - Surface conductivities
    - Maritime zones
- Planning criteria according to:
  - ITU-R recommendations BT.2033, BT.655, SM.851, BT.1368, BS.560, BS.1615, BT.417, BS.412, BS.1660
  - GE06 Agreement
  - GE75 Agreement
  - EBU Tech 3348
  - OET Bulletin 69 and related
  - GB 20600-2006
  - 5G-Xcast
  - User definable (to be written in C#)
- Propagation calculations for broadcasting stations, radio links, point to multipoint systems (as applicable):
  - Coverage contours
  - Coverage area
  - Performance
  - Capacity
  - Availability
  - Interference
  - Coordination
- Frequency planning available for all transmitter types
  - Coverage contour
  - Interference
  - Frequency scan (analyses current frequency situation and allows choosing best new frequency)
  - Fading zone (specific for AM)
  - Health-safety distance/zone calculations for any transmitter types (including radars, DVB-T2, FM and DAB transmitters, 2G (GSM/ CDMA), 3G, 4G, 5G (and any other technology) cellular transmitters)
- Specific functionality for point-to-point links

        - Fresnel zone clearance
        - Receiver input signal
        - Minimum antenna height calculation
        - Obstruction calculation in Fresnel zone
        - Reflection point in path profile
        - Meteorological zones input in accordance with ITU-R
        - ITU-R recommendations P.838, P.676, G.821, G.826, G.828, F.634, F.695, F.696, F.697, F.1668, F.1703
    - Automatic SFN timing optimization
    - Reports of calculation results
    - Utilizes full CPU power by fully multithreaded operation

We will also optimize/tune the Recommendation ITU-R P.1546-5 for one city as requested. Due to ITU-R P.1546-5 not being easily tuneable we will also tune CRC-Predict propagation model which considers all the terrain and clutter between transmitter and receiver and so is much more accurate and easily tuneable.

The whole system will be supplied with comprehensive documentation. To assure a smooth, uninterrupted adoption and operation of the system, we will provide PTD in-depth training for the use and maintenance of spectrum management system as a whole, as well as each part separately. We will also offer comprehensive, long-term support and maintenance program for Phase 2.

PROGIRA is the world's leading spectrum planning and management specialists. We have been providing robust spectrum planning and management solutions to users from more than 50 countries all over the world for 17 years. Staffed by professionals who are actively planning and managing spectrum, we are continually innovating to make spectrum planning and management efficient and simple.