BELL LABS EXPERT FORUM ASSESSMENT

INTELLECT TELECOM CAPACITY TRANSFER REPEATER (CTR) INNOVATION

25 JUNE 2014

On 25 June 2014, Bell Labs conducted an Expert Forum to provide Intellect Telecom with an independent assessment of its Capacity Transfer Repeater (CTR) innovation.

As part of this Expert Forum, Bell Labs assembled a team of renowned technology experts and business leaders to provide top-level feedback/opinion on Intellect Telecom's CTR innovation, with a special focus on targeted use cases. In advance, the Expert Team conducted a preliminary review of the CTR Innovation Package provided by Intellect Telecom. At the Expert Forum, Intellect Telecom presented the Repeater Solution to the Expert Team, after which Bell Labs conducted a structured Q&A discussion based on a question set developed and reviewed in advance.

The following document represents the final report of the Expert Forum, which Bell Labs is most pleased to provide Intellect Telecom.

Participants

Intellect Telecom:

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Bell Labs / Alcatel-Lucent:

Mark Bass – Head of Bell Labs Wireless Modeling
Eric Bruth – GSM Business Leader
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Rati Thanawala – Head of Bell Labs Modeling and Customer Advisory
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Understanding of the CTR innovation

- The CTR is a new type of analog wireless repeater solution with a targeted use case for coverage of remote, low-traffic areas.
- By design, the CTR system is designed for up to 3 hops maximum in a row with acceptable performance for GSM in terms of quality (hand off / delay/ phase noise). It has been tested in the field, with performance as expected and even better coverage compared with the classical solution of long feeders connecting the antenna to the BTS at the bottom of the mast.
- The CTR allows an inter-site distance of up to 8 – 10 kilometers, in a flat rural environment, which is considered to be sufficient.

CTR Solution Strengths

- The CTR is an efficient alternative to BTSs in shelters for low traffic environments. Classical BTSs have high energy consumption (3/4 kW each BTS) making them costlier to operate than a CTR solution (260W), which is especially important in areas where the Return on Investment of the network proves challenging.
- There is only a 0.5 dB to 1 dB increase in the NF for the 3 hops, which is a very low loss for such a solution and is not seen as a large constraint impacting performance.
- The CTR being located at the top of the mast, with no feeder loss inserted in the RF chain.
- The CTR comes with an embedded GPS/Glonass based synchronization, and as such has no impairment on clock accuracy for cellular RF.
- The targeted use case is very low traffic areas, and as such traffic would tend to be balanced across TRXs, with little risk of encountering the “parking lot” issue. Furthermore, the solution allocates TRXs on a CTR-by-CTR basis. Each CTR can carry up to 2 carriers at the same time which seems appropriate for a GSM coverage solution.
- A multi-operator shared CTR solution is a strength for additional cost reduction, especially in “white” rural areas, but would require neutral host authorization by the regulator (anti-trust) to be used in a sharing mode.

Recommendations for Deeper Investigation

- The operational conditions for the CTR are - 40/+55 °C temperature (it was noted that -50°C should still be possible) without cooling/heating systems. This range is fine for most places in the world and consistent with state of the art RRHs.

  Recommendation: Start-up conditions need to be confirmed at those extreme temperatures, as system reliability is key because any site visit in remote areas would be very expensive.

- CTR uses a 5.9 GHz band, which is the band used worldwide for fixed services, and in particular microwave.

  Recommendation: Consider introduction of new Transfer bands (e.g., 60 GHz) for deployment flexibility (i.e., avoiding interference in unlicensed band) and larger capacity needs (e.g., for LTE).

- The extension of the CTR solution to other technologies is under study (e.g., UMTS, LTE, eMBMS). This is very important as operators are now considering deploying 3G/4G in their 2G footprint and won't invest as much only for 2G (GSM investment is declining at a steep -30% YoY).
  Recommendation: It is important for such investment to be future proof with new technologies, e.g., when 2G is eventually switched off CTRs already deployed should be reusable for 3G and/or 4G.
- For operation and management, the CTR has its own stand-alone workstation (PC) independent of the RAN OMC (no integration is considered). This can be seen as a strength for multi operator (neutral host) CTRs, but might also be an area of additional cost.
  Recommendation: Investigate how CTR management can be integrated into network OMCs as operators generally prefer to have new management systems integrated /coupled with existing OMCs (e.g., RETA system integrated in OMCs).
- Although the CTR could be used in dense urban areas, it is not seen as a capacity solution; it is mainly a coverage solution. There is no technical limit (design or physical limit); only power consumption limitations restrain this possible usage. However, in the case of remote small villages, the CTR can be deployed as a Hub-and-Spoke solution along the roads to serve those communities.
  Recommendation: It seems more useful to focus CTR development efforts on coverage solutions and on support of new technology (3G/4G) than on urban deployment.
- The CTR is being evaluated as a potential in-building solution. For in building coverage, the repeater might be placed outside of the building and connect to the DAS in-building to extend the reach of a nearby BTS, but this approach seems less practical than current in building solutions.
  Recommendation: This use case doesn't appear to be competitive with typical existing solutions such as DAS and Small Cells. This use case would require more technical description on its feasibility and real cost comparison with existing solutions. Furthermore, indoor coverage is often driven by capacity requirements that the CTR solution does not effectively support.
- CTR benefits have been assessed with respect to traditional BTS solutions. With newer RRH based solutions, power consumption and the need for civil works are less costly. Some vendors may also propose stand alone BTSs with integrated MW backhaul.
  Recommendation: Even if the case might still be favorable to the CTR, the cost-benefits might prove lower compared with new integrated GSM BTSs than with "bulkier" legacy GSM BTSs, and we suggest to also compare the CTR with such newer solutions.

Suggested Use Cases

- The primary identified use cases are:
  - Large countries with environmental conditions and/or sparsely populated areas similar to Russia (e.g., Canada, Australia).
  - Oil and Gas industries.
  - Rural areas in developing countries w/o access to mobile service.

  In addition, we also suggested focusing on the following alternative use cases:
  - **Mining/Forestry industries:** Generally those industries require low capacity coverage of roads and large open areas, for which the CTR solution is well suited.
  - **Coast/Seashore coverage:** To serve nearby islands without requiring cable connections with the continent. Also, to serve marine/fishing/coast guard vessels operating nearby the coast.

- **M2M market**: Beyond serving traditional MNOs, also focus on "M2M only operators", especially those that may evolve to serve the upcoming "Internet of Things" (IoT) revolution that will mainly require very broad coverage at lowest cost.

Innovations (Ideas/Suggestions) for Product Fit/Application in Different Markets

- In addition to working with the ITU-D committee, working directly with national regulators to validate the CTR as the de facto solution for low-cost coverage in rural areas would help in the targeted markets.
- Internet of Things is the next wireless revolution entailing billions of connected devices that will require broad basic coverage with limited data bandwidth, and also present a clear power consumption bill concern. Incumbent operators, and quite possibly new operators with innovative IoT business models, will require very low cost and very low power solutions to cover IoT requirements. This is clearly seen as a potential market for the CTR solution.
- Investigate the introduction of emerging innovative "Analog Signal Processing" techniques into the CTR's design to further reduce the cost and increase the robustness of the solution. (Cf. École Polytechnique de Montreal research work). If of interest we can help making the connection.
- An LTE 1.4 MHz/3 MHz solution might be a good sweet spot of usage for CTRs to provide low-cost data coverage in rural areas of developing countries and accelerate adoption of LTE in those markets.
- By design, the narrow band LTE 3GPP standard settings (1.4 and 3 MHz) has been defined to help reuse legacy infrastructure and spectrum. The limited bandwidth required for the LTE signal in those settings should help with the further use of the CTR, currently designed for GSM, with relatively the same design and cost structure.